U.S. Department of Transportation
Federal Railroad Administration

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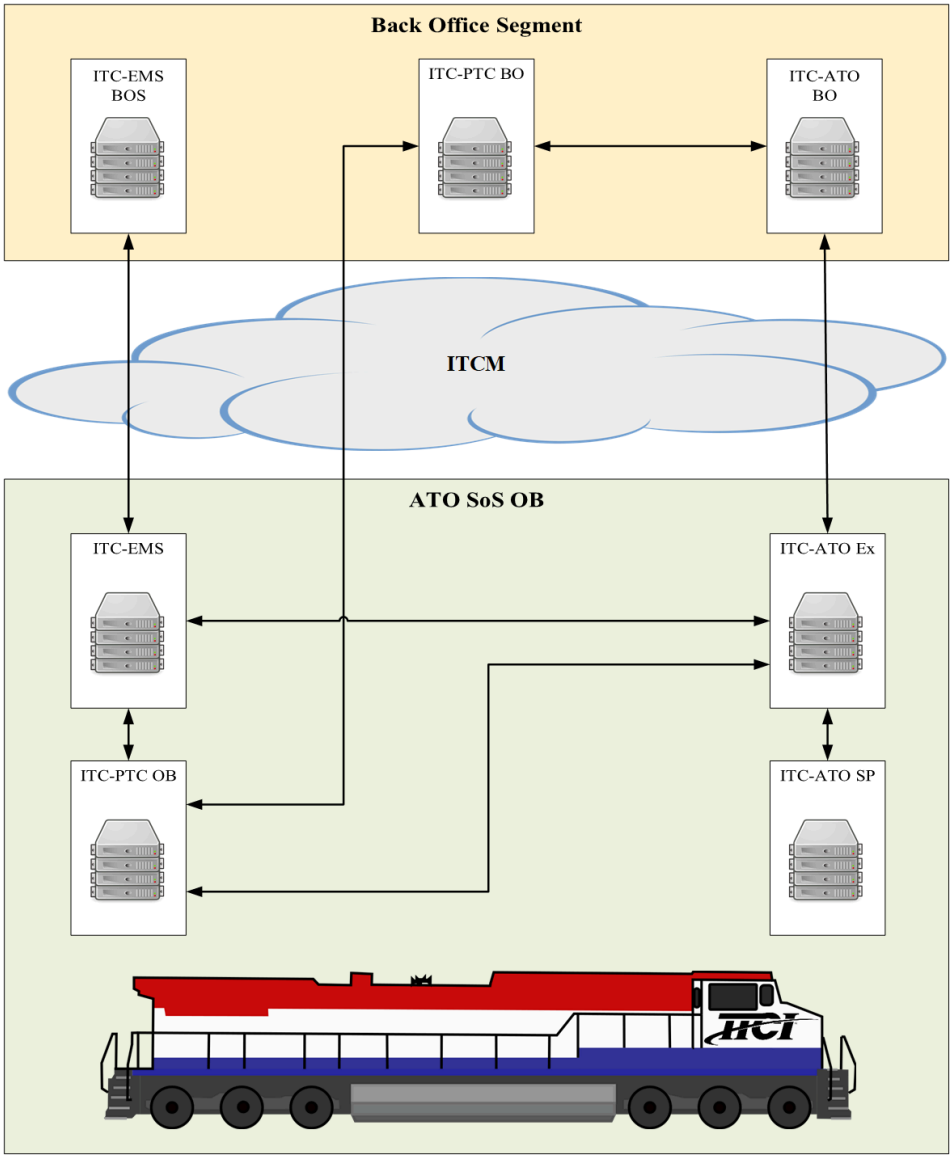
Washington, DC 20590

Automated Train Operation Interface Requirements Specification Development Summary Report



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David C. Hunter - 0000-0002-8139-4544
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14. ABSTRACT

The Federal Railroad Administration contracted Transportation Technology Center, Inc. to define Interface Requirement Specification (IRS) documents for an Interoperable Train Control Automated Train Operation Support System Back Office (ITC-ATOSS BO). This project forms part of a larger Automated Train Operation (ATO) effort in cooperation with the North American railroad industry. The IRS documents define interoperable interfaces between the following:

- Interoperable Train Control Automated Train Operation Executive (ITC-ATO Ex) subsystem and ITC-ATOSS BO
- ITC-ATOSS BO and Interoperable Train Control Positive Train Control Back Office (ITC-PTC BO)

The goal of the ATO effort is to produce interoperable standards which allow an ATO train developed by any railroad to operate on any railroad's territory when equipped with the necessary infrastructure and supported by any railroad's qualified personnel. For an ATO train to be interoperable, it must communicate with each railroad's ITC-ATOSS BO using a standardized interface. The details of this interface are defined by an IRS.

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	1 kilometer (km) = 0.6 mile (mi)
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	= 1.1 short tons
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1 quart (qt) = 0.96 liter (l)	
1 gallon (gal) = 3.8 liters (l)	
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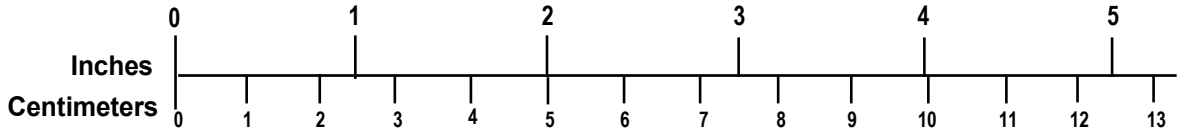

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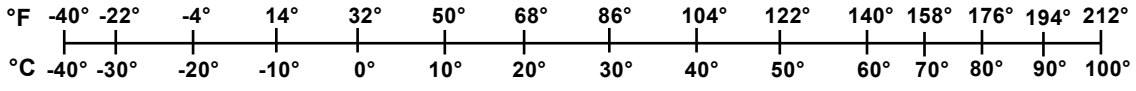

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Executive Summary

From September 3, 2019, through May 19, 2021, the Federal Railroad Administration (FRA) contracted Transportation Technology Center, Inc., in collaboration with the North American railroads, to define Interface Requirement Specification (IRS) documents for an Interoperable Train Control Automated Train Operation Support System Back Office (ITC-ATOSS BO). The ITC-ATOSS BO IRS development project forms part of a larger Automated Train Operation (ATO) effort in cooperation with the North American railroad industry.

The IRS documents define interoperable interfaces between the following:

- Interoperable Train Control Automated Train Operation Executive (ITC-ATO Ex) subsystem and ITC-ATOSS BO
- ITC-ATOSS BO and Interoperable Train Control Positive Train Control Back Office (ITC-PTC BO)

Development of an ITC-ATO BO to ITC-ATO Back Office Decision Support (BODS) IRS was considered but found to be unnecessary for meeting the minimum interoperable requirements, and for being potentially restrictive to railroad ITC-ATOSS BO development options.

The research team worked with the project advisory group (AG) to prepare the defined set of draft ATO IRS documents. Each IRS contains sufficient details required for independent development of subsystem components without unnecessarily inhibiting innovation of product-specific features. The final drafts of the IRS documents may be provided to the Association of American Railroads (AAR) for possible inclusion in the AAR Manual of Standards and Recommended Practices (MSRP).

The goal of the ATO effort is to produce interoperable standards which allow an ATO train developed by any railroad to operate on any railroad's territory when equipped with the necessary infrastructure and supported by any railroad's qualified personnel. For an ATO train to be interoperable, it must communicate with each railroad's ITC-ATOSS BO using a standardized interface. The details of this interface are defined by an IRS.

1. Introduction

The operation of modern trains across the North American railroads requires the onboard computer systems to interoperate with the multiple railroads' back office computer systems. An onboard computer must meet a minimum set of operational and interface requirements to operate across multiple railroads. An Interface Requirement Specification (IRS) documents the requirements necessary for achieving an interoperable interface between two or more computer systems.

The research team created IRS documents to define interoperable interfaces for an Interoperable Train Control Automated Train Operation Support System Back Office (ITC-ATOSS BO) segment. These IRS documents define the interface between the following:

- The Interoperable Train Control Automated Train Operation Executive (ITC-ATO Ex) subsystem and the ITC-ATOSS BO segment
- The ITC-ATOSS BO segment and the Interoperable Train Control Positive Train Control Back Office (ITC-PTC BO) segment

Development of an additional IRS between two subsystems within the ITC-ATOSS BO was also considered, and the reasons for not developing it are discussed.

1.1. Background

Automation is viewed as a means of improving the efficiency of the North American freight rail operations while maintaining safety. To promote the development of interoperable train automation technology, an Association of American Railroads (AAR) Strategic Research Initiative (SRI) to define requirements for ATO began in 2018 with the development of a Concept of Operations for an interoperable ATO System of Systems (ATO SoS). The ATO SoS leverages existing systems, including Interoperable Train Control Positive Train Control (ITC-PTC) and Interoperable Train Control Electronics Management System (ITC-EMS), with new technology to support train automation.

The seamless interchange of automated trains between multiple railroads requires interoperable ATO systems. To be interoperable, an ATO-equipped locomotive must be able to operate on any railroad's territory with the necessary infrastructure and supported by any railroad's qualified personnel, while allowing the flexibility for each railroad to design, procure, implement and package ATO-related capabilities and interfaces according to their own business needs. Central to ATO interoperability is a standardized minimum set of messages and message-related functions that define communication and communication-related behavior between ATO SoS constituent systems and segments.

1.2. Objectives

The objectives of the Automated Train Control Interface Control Documentation project were to define necessary interoperable interfaces for an ITC-ATOSS BO. At the start of the project this was considered to be the development of draft IRS documents defining interoperable messages and interactions between:

- ITC-ATO Ex and ITC-ATOSS BO

- ITC-ATOSS BO and ITC-PTC BO
- ITC-ATO BOS and ITC-ATO BODS

IRS documents were to be developed in cooperation with the AAR SRI ATO development effort to coordinate IRS document development with the communication needs of the ITC-ATO SoS.

1.3. Overall Approach

The research team worked with the ATO technical working group (ATO TWG) that was established as part of the ATO program to provide technical support to the ATO program. The ATO TWG served as this project's AG to prepare the defined set of draft ATO IRS documents. The AG is composed of technical representatives from participating North American Class I railroads and representatives from the FRA office of research and development. The project AG provided technical review, comments, and approval of the draft IRS documents produced as part of this project. The team revised IRS documents using AG feedback so that the IRS documents satisfy the interoperable needs for ATO implementation.

Following the approval by the project AG, final versions of the IRS documents may be provided to the AAR for possible inclusion in the AAR MSRP.

This report provides the FRA with a final summary of the project tasks and activities. Appendix A and Appendix B contain draft IRS documents that were developed as part of the project.

1.4. Scope

In cooperation with the AAR SRI ATO development effort, this project developed draft IRS documents defining the minimum set of interoperable interface requirements, message requirements, and messaging-related functional requirements necessary to support an interoperable ITC-ATOSS BO without unduly restricting the ability of railroads to implement the ATOSS BO according to railroad-specific business needs.

Each IRS includes details required for independent development of subsystem components without unnecessarily inhibiting innovation of product specific features. This project limited the scope to the development of the draft documentation and incorporation of edits and comments from the AG. Further revision of the ATO IRS documents after the initial drafts produced here, as well as adoption of these documents as standards and publication within the AAR MSRP is at the discretion of AAR and its member railroads and is considered outside of the scope of this project.

1.5. Organization of the Report

This summary report highlights the results of the ATO BO IRS project, and is organized as follows:

- Section 1 provides background information on the project to aid in setting the context for the work performed.
- Section 2 provides an overview of the ATO BO IRS project, including:
- Section 3 offers information on the following IRS documents:
    - An overview of the ITC-ATO SoS

    - An overview of the two IRS documents developed
    - An explanation of the decision not to develop an ITC-ATO BO to ITC-ATO BODS IRS
- Section 4 provides project conclusions and recommendations for next steps
- Appendix A contains the ATO Ex to ATOSS BO IRS
- Appendix B contains the ATOSS BO to ITC-PTC BO IRS

2. Development of ATOSS BO Interfaces

The ATOSS BO IRS documents were developed through an ongoing collaboration with the AAR SRI ATO development effort. To help understand the development of the ATOSS BO IRS documents, it is first necessary to understand the various segments and systems within the ATO SoS. Section 3.1 provides an overview.

2.1. ATO SoS Overview

Figure 1 shows the ATO SoS includes three primary constituent systems: ITC-PTC (blue boxes), ITC-EMS (yellow boxes), and ITC-ATOSS (green boxes). No interoperable interfaces involving ITC-EMS or the ITC-PTC wayside were developed as part of this project.

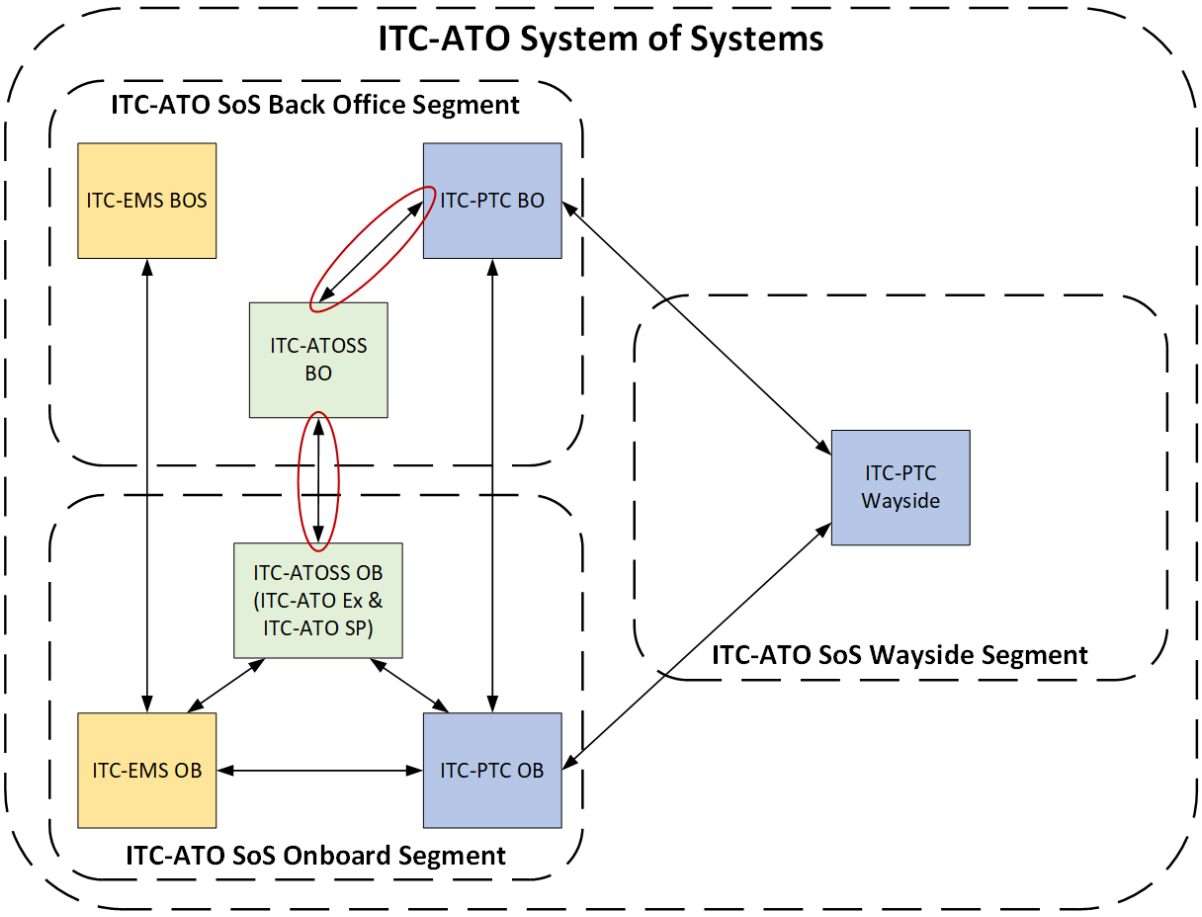

Figure 1. ITC-ATO System Architecture

As Figure 1 shows, the following ATOSS BO interfaces (circled) did not exist and were defined as part of this project:

- ITC-ATOSS onboard (OB) to ITC-ATOSS BO
- ITC-ATOSS BO to ITC-PTC BO

2.1.1. ITC-PTC

ITC-PTC is an interoperable system designed to enhance the safety of railroad operations through enforcement of a train's movement authority and speed limits. The technology is mandated by the Federal government on a large percentage of the nation's rail lines per the Railway Safety Improvement Act of 2008 (RSIA'08).

The RSIA '08 prescribes four hazards the system must mitigate:

1. Train-to-train collisions – achieved by enforcing authority limits above restricted speed operations
2. Over-speed derailments – achieved by enforcing civil and temporary speed limits
3. Incursions into established work zone limits – achieved by enforcing work zone limits
4. Movement of a train through a switch lined in the wrong position – achieved by monitoring switch positions and enforcement

2.1.2. ITC-ATOSS

ITC-ATOSS monitors the internal and external operating environment of the ATO train and initiates appropriate train responses. Upon detection of a hazardous condition, the ITC-ATOSS provides notifications to the affected railroad(s) (i.e., owning, operating, and employing railroads). ITC-ATOSS then provides support for railroad personnel to manage ATO trains. This includes monitoring ATO trains, receiving exception reports, obtaining additional information, and resolving exceptions.

2.1.3. ITC-ATOSS BO

The ITC-ATOSS BO segment provides railroad office personnel and railroad business systems the ability to monitor and support ATO train operations. ITC-ATOSS BO segment data provided to office personnel includes, but not limited to:

- Exception condition data related to onboard detected external conditions
- Exception condition data related to onboard detected intra-train conditions
- Exception condition data related to onboard detected system integrity conditions
- Onboard system health and status data

Additionally, the ITC-ATOSS BO segment provides railroad office personnel the functionality to request and obtain additional sensor specific data (e.g., imagery) as necessary to support ITC-ATOSS OB segment resolution of reported exception conditions (e.g., track obstructions, crossing gate activation failures and/or malfunctions, unknown switch position, etc.).

2.1.4. ITC-ATOSS OB

The ITC-ATOSS OB segment continually processes operational data obtained from peripheral onboard devices, the ITC-PTC OB segment, the ITC-EMS OB segment, and the ITC-ATOSS BO segment to detect and initiate an appropriate train response to hazardous external conditions, intra-train conditions, and system integrity conditions.

The ITC-ATOSS OB segment interfaces with the ITC-ATOSS BO for each operating railroad, the owning railroad, and the employing railroad. ITC-ATOSS OB provides each ITC-ATOSS BO with periodic status updates and report of exception conditions. It also accepts requests from the operating railroad ITC-ATOSS BO for additional sensor specific data (e.g., imagery).

The ITC-ATOSS OB segment is divided into two subsystems, ITC-ATO Ex and ITC-ATO Sensor Platform (ITC-ATO SP). All interoperable communication between ITC-ATOSS OB and each ITC-ATOSS BO are conducted via an ITC-ATO Ex to ITC-ATOSS BO link. The ITC-ATO SP does not have an interoperable interface with the ITC-ATOSS BO.

2.1.5. ITC-EMS

ITC-EMS is an operational efficiency system designed to control train movement by interacting with locomotive control systems (e.g., train's propulsion, train brake systems, etc.). ITC-EMS predictively controls train movement based on the train's current route, mandatory directives (e.g., train control related restrictions: speed restrictions, authority limits, etc.), consist information (e.g., train weight, locomotive status, weight distribution, etc.), track data (e.g., track grade, track curvature, etc.), and pacing information as provided by the operating railroad (i.e., motion control related train movement information). Safety oversight of ITC-EMS is provided by ITC-PTC OB.

No need was found to change the ITC-EMS OB to ITC-EMS BO interface to support ITC-ATO. No interoperable interactions between ITC-ATOSS BO and components of ITC-EMS were identified, so no ITC-EMS-related IRS documents are needed to provide for an interoperable ITC-ATOSS BO.

3. Interface Requirement Specifications

To support the development of an interoperable ATO SoS, IRS documents were created to define the interoperable interfaces identified. This includes the definition of:

- Class D link parameters (Association of American Railroads, 2018)
- Edge Message Protocol (EMP) parameters for each message (Association of American Railroads, 2018)
- The message body
    - All data fields within the message body
    - The order of data within the message body
    - The data type used to encode each data field within the message body
- Message range checking parameters and requirements
- Message field generation requirements
- Message field use requirements
- Message flow diagrams

Specification of this information promotes:

- Use of the Class D link and EMP in a compatible and consistent manner
- Finding and correctly decoding each field within the message body
- Population of each message field with the correct data
- Obtaining data for populating message fields from approved sources
- Correct use of data within message fields for ITC-ATOSS processes

3.1. ITC-ATO Ex to ITC-ATOSS BO Interface

The interoperable ITC-ATO Ex to ITC-ATOSS BO IRS provides for each ATO train to interface with the owning, employing, and each operating railroad's ITC-ATOSS BO. This interface includes messaging and message flow diagrams to support:

- Train initialization – configuration of ATO SoS before operation
- Exception reporting – notifying BO railroad personnel of detected conditions
- Information requests – process for BO railroad personnel to obtain additional OB data such as images and video upon request
- Exception resolution – process for BO railroad personnel to resolve detected conditions to allow for resumption of normal operation

Additional considerations impacting the development of this IRS include the need to minimize the use of 220 MHz radio bandwidth, and the added complexity of routing messages between multiple locomotives and multiple back offices. To reduce 220 MHz radio bandwidth consumption, message sizes were minimized, and options were provided to allow ATO BODS

personnel to request that only the necessary sensory information be sent over the 220 MHz link. The pre-existing interoperable train control messaging (ITCM) system was leveraged to allow for the support of multiple locomotives communicating with multiple back offices. The AAR SRI ATO effort is placing requirements on the ITC-ATOSS BO regarding the management of multiple ATO-enabled trains, and the ITC-ATO Ex to ITC-ATOSS BO supports this management.

Due to the number and complexity of functions requiring ITC-ATO Ex to ITC-ATOSS BO interaction, this interface is the more complex of the two interfaces defined in this project.

3.2. ITC-ATOSS BO to ITC-PTC BO Interface

The interoperable ITC-ATOSS BO to ITC-PTC BO IRS includes messaging and message flow diagrams to support the synchronization of ATO train status information. Train status information includes:

- A list of all active ATO trains
- The current system state of each ATO train
- Reported system faults

This IRS is relatively simple, and primarily provides for ATO BODS personnel to receive locomotive status updates which are already sent to the ITC-PTC BO. It also provides for basic status information to be sent from the ITC-ATOSS BO to the ITC-PTC BO so that the two back offices can detect any discrepancies in train status information. The use of this link to communicate train status information also reduces the information transmitted by ITC-ATO Ex to ITC-ATOSS BO over ITCM.

3.3. ITC-ATO BOS to ITC-ATO BODS Interface

The original ITC-ATOSS architecture divided the ITC-ATOSS BO into two interoperable subsystems, ITC-ATO BOS and ITC-ATO BODS. ITC-ATO BOS was to provide the communication and routing functions necessary to manage multiple ATO trains operating on a railroad's territory, and to maintain persistent ATO-train-related data sets. ITC-ATO BODS was to provide an interface for railroad office personnel to monitor and support ATO trains. An interoperable interface was to be specified between the two. Figure 2(a) shows the resulting interface. Figure 2(b) shows standardized ITC-ATOSS BO to ATO Ex and ITC-ATOSS BO to ITC-PTC BO interfaces.

However, at this time, no processes between ITC-ATO BOS and ITC-ATO BODS that require interfaces spanning boundaries between multiple railroad properties or facilities have been identified. Therefore, an interoperable interface between ITC-ATO BOS and ITC-ATO BODS does not need to be defined. In addition, it was found that defining ITC-ATO BOS and ITC-ATO BODS as separate subsystems would unduly restrict the railroads in designing and deploying their ITC-ATOSS BO. Examples of undue restriction of railroad ITC-ATOSS BO design and deployment include:

- Railroads may have differing approaches to how the railroad personnel interface with ITC-ATOSS BO. For example, one railroad may have a single ITC-ATOSS BO server with a web interface, while another railroad may have separate ITC-ATOSS BODS user terminals which interface to a central ITC-ATOSS server.

- Railroads may have differing approaches to managing ATO-enabled subdivisions. For example, one railroad may want a single railroad-wide ITC-ATO BODS system while another railroad may want an ITC-ATO BODS for each subdivision/district.
- Railroads may have differing approaches to designing the ITC-ATO BOS system. For example, one railroad may want a single railroad-wide ITC-ATO BOS while another railroad may want an ITC-ATO BOS for each subdivision/district.
- Railroads may have differing approaches to interfacing ITC-ATO BODS to ITC-ATO BOS. For example, one railroad may reuse the messages defined as part of this project, while another railroad may develop a series of messages for ITC-ATO BODS to query the status of ATO trains using other parameters (e.g., train operating mode, train location, presence of exception conditions, etc.).

The scope of this project is limited to defining the minimum set of interoperable requirements needed for an ATO train to operate across railroads without unduly restricting the opportunity for railroads to innovate and compete. Since no interoperable requirements were identified to support the separation of ITC-ATOSS BO into two separate subsystems, functional requirements were condensed into a singular ATOSS BO functional requirements document with standardized ITC-ATOSS BO to ATO Ex and ITC-ATOSS BO to ITC-PTC BO interfaces (Figure 2(b)).

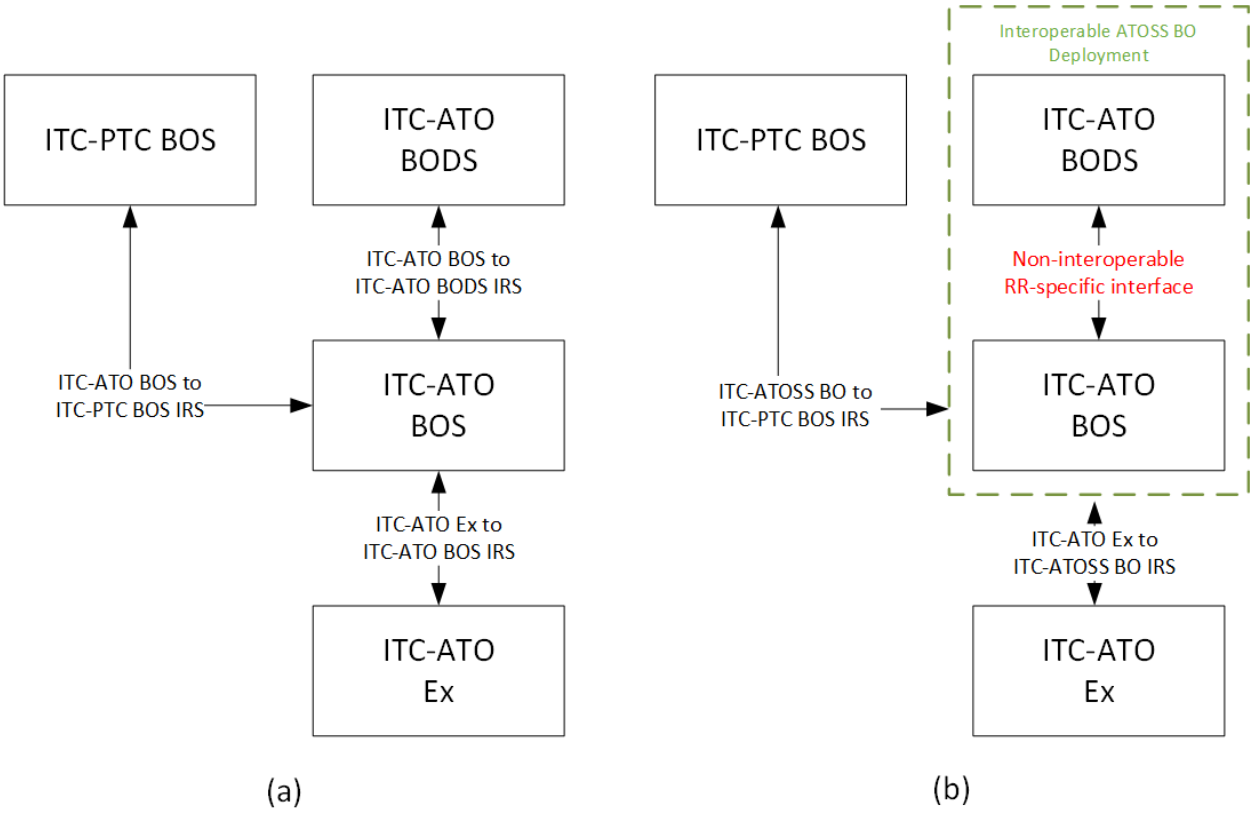

Figure 2. Changes in Approach to Defining ATOSS BO

4. Conclusion

The research team worked with the industry ATO TAG, and AAR's SRI ATO development effort, to define the interfaces for an interoperable ITC-ATOSS BO segment, thereby providing support for interoperable ATO.

The interoperable ITC-ATO Ex to ITC-ATOSS BO IRS includes messaging and message flow diagrams to support:

- Train initialization
- Train condition monitoring
- Exception reporting
- Information requests
- Exception resolution

The interoperable ITC-ATOSS BO to ITC-PTC BO IRS includes messaging and message flow diagrams to support:

- Synchronizing train state information
- Reporting train status changes
- Reporting train condition information

An additional interface between proposed ITC-ATO BOS and ITC-ATO BODS subsystems was considered. It was rejected as unnecessary for interoperability and because it unduly restricted railroad ATOSS BO development.

Researchers recommend that the ITC-ATO Ex to ITC-ATOSS BO IRS and ITC-ATOSS BO to ITC-PTC BO IRS be reviewed as ATO development progresses and updated as needed. Once the ATO system definition development is completed, the revised ITC-ATO Ex to ITC-ATOSS BO and ITC-ATOSS BO to ITC-PTC BO IRS documents will be provided to the AAR for possible inclusion in the AAR MSRP.

5. References

Association of American Railroads (2018). Class D Messaging. *AAR Manual of Standards and Recommend Practices, S-9356, K4*. Association of American Railroads.

Association of American Railroads (2018). Edge Message Protocol. *AAR Manual of Standards and Recommended Practices, S-9354, K4*. Association of American Railroads.

U.S. Government Publishing Office (2008, October 16). Rail Safety Improvement Act of 2008. *Federal Rail Safety Improvements, Public Law 110-432(122 STAT. 4848)*.

Abbreviations and Acronyms

ACRONYM	DEFINITION
AG	Advisory Group
AAR	Association of American Railroads
ATO	Automated Train Operation
ATO Ex	ATO Executive Subsystem
ATO SoS	ATO System of Systems
ATOSS	ATO Support System
BO	Back Office
BODS	Back Office Decision Support
BOS	Back Office Server
EMP	Edge Message Protocol
EMS	Electronics Management System
FRA	Federal Railroad Administration
IRS	Interface Requirements Specification
ITC	Interoperable Train Control
ITCM	Interoperable Train Control Messaging
MSRP	Manual of Standards and Recommended Practices
PTC	Positive Train Control
SP	Sensor Platform
SRI	Strategic Research Initiatives
TWG	Technical Working Group

Appendix A.
ITC-ATO Ex to ITC-ATOSS BO IRS

Automated Train Operation Interface Requirements Specification Development Summary Report: Appendix A. ITC-ATO Ex to ITC-ATOSS BO IRS Interface Requirements Specification

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Prepared by Transportation Technology Center, Inc.

May 2021

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1.0 Scope

This document defines interoperable communication requirements to establish a bidirectional interface between the paired subsystems. This includes specifying the protocols used, message format, message contents, data types, messaging parameters, message generation requirements, message verification requirements, and message use requirements. It does not include specification of the physical communication link between the paired subsystems.

1.1 Document Identification

This document defines the interoperable message interface requirements for communication between the Interoperable Train Control Automated Train Operation Executive (ITC-ATO Ex) Subsystem and Interoperable Train Control Automated Train Operation Support System Back Office (ITC-ATOSS BO).

1.1.1 IRS Version Number

An interface version number is used by ATO subsystems to automatically distinguish between the interfaces implemented using this IRS revision and interfaces implemented using future IRS revisions. Any new revision of this IRS of which changes the interface will increment the interface version number by 1. Valid versions range from 1 to 255. Version 0 is reserved. The interface version number is a digital interface identification and is not the same thing as the IRS document revision number. An IRS revision of which does not change the interface, such as revisions to improve clarity, will not increment the interface version number.

The interface version number for this IRS is 1.

1.2 System Overview

The ATO system consists of four segments:

- ITC-ATOSS Back Office Segment
- ITC-ATO Onboard Segment
- ITC-ATO Field Segment
- Communication Segment (ITCM)

Each ITC-ATO system segment is composed of one or more subsystems. Figure 1 depicts the relationship of each ITC-ATO segment and subsystem. Only ATO SoS components (e.g., ITC-PTC OB, ITC-ATO Ex, ITC-EMS) and components that interact directly with ITC-ATO SoS (e.g., LIG, LCCM) are shown. This IRS documents the interface between ITC-ATO Ex and ITC-ATOSS BO as shown in Figure 1.

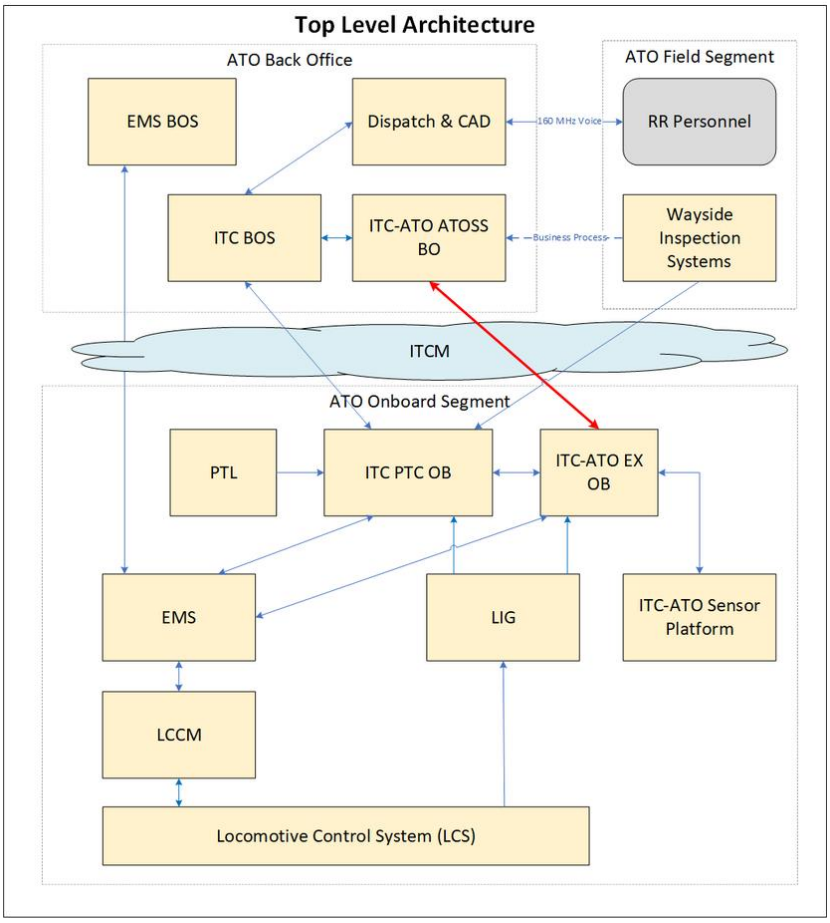

Figure 1: ATO Top Level Architecture

Each locomotive may simultaneously communicate with several ITC-ATOSS BOs, and each ITC-ATOSS BO may communication with multiple locomotives. Each individual ITC-ATO Ex to ITC-ATOSS BO link is governed by this IRS.

1.3 Document Overview

Interoperable protocol requirements, message definitions, message use, and messaging functions for the interface between ITC-ATO Ex and ITC-ATOSS BO are defined within this document. This document is organized into four sections:

- Section 1 identifies the interfaced subsystems to which this IRS applies, provides an overview of the document, and an acronym list.
- Section 2 lists applicable standards and reference documents.
- Section 3 provides message definitions and messaging requirements.
- Section 4 provides message process narratives to place some messaging requirements in context.

Subsections of Section 3 generally contain two parts: narrative text and explicit requirements. The narrative text includes background information, goals and other supplemental information provided to

clarify the requirements. In accordance with RFC 2119, the following terms are used to identify requirements, preferences or recommendations, and options:

- Absolute requirements contain the word “shall” and follow in a lettered list beneath the narrative text.
- Absolute prohibitions contain the term “shall not” and follow in a lettered list beneath the narrative text along with absolute requirements.
- Recommendations are identified as such and use the word “should” or “recommended” instead of “shall.” The use of "should" means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- Recommendations against an undesirable system feature or behavior are identified with the terms “should not” or "not recommended." The use of these terms mean that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood, and the case carefully weighed before implementing any behavior described with this label.
- The terms “may” or “optional” indicate system features or behaviors that are truly optional.

1.4 Acronyms and Abbreviations

Table 1: Acronyms and Abbreviations

Abbreviation	Meaning
ASCII	American Standard Code for Information Interchange
AG	Application Gateway
AAR	Association of American Railroads
ATO	Automated Train Operation
ATO Ex	ATO Executive Subsystem
ATO SP	ATO Sensor Platform
BODS	Back Office Decision Support
BOS	Back Office System
CRL	Certificate Revocation List
CRC	Cyclic Redundancy Check
EMP	Edge Message Protocol
EOT	End of Train
EMS	Energy Management System
HMAC	Hashed Message Authentication Code
HOT	Head of Train
ID	Identification
IP	Internet Protocol
I-ETMS®	Interoperable Electronic Train Management System®
IRS	Interface Requirements Specification
ITC-PTC	Interoperable Train Control Positive Train Control
ITCM	Interoperable Train Control Messaging
LCCM	Locomotive Command and Control Module
LIG	Locomotive Interface Gateway
MCD	Master Condition Dataset
min	Milliseconds
ms	Minutes

Abbreviation	Meaning
N/A	Not Applicable
OOI	Object of Interest (Defined in Section 1.5)
OB	Onboard
OPK	Operational Private Key
PTC	Positive Train Control
QoS	Quality of Service
RR	Railroad
ROW	Right of Way
s	Seconds
SCAC	Standard Carrier Alpha Code
TTL	Time To Live
TCD	Train and Crew Dataset
TCP	Transport Control Protocol
TLS	Transport Layer Security
µs	Microsecond
UTC	Universal Time Coordinated

1.5 Terminology

The following definitions apply within all ATO IRSes.

Table 2: Terminology

Term	Definition
0x	A prefix used to denote a base-16 (hexadecimal) number
ACK	An acknowledge message indicating successful reception of a message.
Application	In this IRS, application refers to ITC-ATO Ex and ITC-ATOSS BO. When a requirement refers to an application, the requirement applies to both ITC-ATO Ex and ITC-ATOSS BO.
ATO-modified message	A message which is defined for non-ATO systems, such as ITC-PTC, and is modified for ATO use. Modifications may include additional enumeration values and/or additional message fields.
ATO SoS	The term ATO System of Systems (SoS) is used to define the collection of systems (i.e., ITC-PTC, ITC-EMS, and ITC-ATOSS) that interact and perform the functions necessary to support interoperable ATO train operations.
Clear distance	The distance along the track centerline of the train's route for which the foul volume has been verified to be clear of obstructions.
Discard	Discard is used in reference to a received message failing verification. When a requirement mandates that a system discards a message, it means that: • The receiving subsystem must not use the message for any purpose other than generating a NACK. • Other than generating a NACK, the receiving application behaves as though no message was received. For example, if a status message fails verification, it does not reset the polling process watchdog timer. • If a reason is found to discard a message, the receiver ceases message verification. Discarding a message does not prohibit logging of the message or use of the message for debugging purposes.
Dynamic field	A dynamic field is a data element within a record.

Term	Definition
Field	A field is one distinct data element within a message. Each field is individually defined within a message. Fields within the message body are given a numerical identifier called the field ID.
Inoperative state	A state not supporting ATO operation. See Appendix A-2.
Intercept distance	The closest distance along the train route at which an OOI's trajectory prediction interval intersects the foul volume at the predicted location of the train.
NACK	A negative acknowledge message indicating an error in receipt of a message, or receipt of an invalid message.
Object of interest (OOI)	1. An object in the foul volume ahead of a train that presents a collision hazard to a train. 2. An object in the ROW that may move into the foul volume and present a collision hazard to a train. 3. A person or vehicle in the ROW. 4. An object in the foul volume of an adjacent track that presents a collision hazard to a train operating on the adjacent track.
Obstruction	An OOI within the foul volume.
Prediction interval	A standard statistical term used to refer to an interval in which a future observation is, to a given degree of certainty, predicted to fall. When referring to an OOI, the prediction interval is the volume in which a specific OOI is predicted to lie at a given time and with a given certainty. For example, a prediction might be made that: • An OOI will, in exactly 1 min 23.01 s, reside within a given spherical region. • The radius of this region is 7.13 ft. • The center of this region is 203 ft in front of the HOT and along the train route with a +8.3ft horizontal offset and +3.7 ft vertical offset from the track centerline. • The probability of the OOI actually residing in this region at the given time is p=0.9999 This region is then used by ATO SP to calculate intercept probabilities. If any part of an OOI's prediction interval intersects the foul volume an intercept may occur, depending on the train's speed and acceleration. Note: The use of p=0.9999 is an example. Refer to the ATO SP Subsystem Requirements for information regarding required probabilities.
Receiving application	The application (either ITC-ATO Ex or ITC-ATOSS BO) which is receiving a message
Record	A record is an atomic group of one or more dynamic data fields in which the group, as a whole, is repeated zero, one, or several times within one message.
Record loop	A contiguous set of 0, 1, or more records of the same type. A record loop is proceeded by a static field containing the number of records within the record loop.
Requesting message	A message to which a reply is expected
Reply	A message sent in response to another message; includes ACKs and NACKs.
Sending application	The application (either ITC-ATO Ex or ITC-ATOSS BO) which is sending a message.
Sense distance	The maximum distance along the track centerline of the train's route in which the sensor platform is capable of detecting all obstructions within the foul volume. Detection of an object within the sense distance does not necessarily include

Term	Definition
	classification. The sense distance depends on environmental conditions, sensor platform capabilities, and sensor platform health.
Static field	A static field is a field which occurs once per message, is required in every message, and is located outside of record loops.
Umler®	An electronic resource maintained by Railinc which stores and provides critical data for North American transportation equipment, including characteristic information about train cars and locomotives.
Unsolicited message	An unsolicited message is a message sent without having been requested.

1.6 Data Types

Data type abbreviations used throughout this document are defined in the following two subsections.

1.6.1 Common Data Types

The common data types used in this document match data types frequently used in computer programming and electrical engineering.

Table 3: Common Data Types

Type	Description
binary	Raw binary data file of type specified in message
double	Double precision (8 byte) floating point number, IEEE 754 compatible
enum	Enumeration. The transmitted value will be an unsigned integer of the specified size. A mapping of value to meaning will be provided. Any values not specified are unused.
float	Single precision (4 byte) floating point number, IEEE 754 compatible
int	Signed (2's complement) integer of the specified size
string	ASCII coded text string. Null terminated unless otherwise specified.
uint	Unsigned integer of the specified size

1.6.2 Railroad-Specific Data Types

The following data types are specific to the railroad industry.

Table 4: Railroad-Specific Data Types

Type	Description
MP	Milepost. Stored as a 4-byte unsigned integer. Multiply by 0.0001 to convert from stored value to milepost number.
SCAC	Railroad standard carrier alpha code (SCAC). Encoded as a four-character ASCII string, left justified, space filled, no null termination.
U	Locomotive unit data field. 10 bytes ASCII encoded in form of "SCAC 12345" The SCAC may be two to four characters long and is left-justified, space filled. The locomotive number may be one to six numbers long and is right-justified, space filled.
ECEF	Earth-centered, earth-fixed Position (LSB = 1 centimeter) Byte 0-3 X Coordinate ± 0-900,000,000 cm Byte 4-7 Y Coordinate ± 0-900,000,000 cm Byte 8-11 Z Coordinate ± 0-900,000,000 cm

2.0 References

2.1 Applicable Documents

The following normative documents of the exact revision and date, form a part of this specification to the extent specified herein:

Table 5: Applicable Documents

Document	Section
AAR Standard	S-9101.V1.2 (Revised 2019): Locomotive Electronics and Train Consist System Architecture
AAR Manual of Standards and Recommend Practices Section K4	S-9354.V2.0 (Revised 2018): Edge Message Protocol
AAR Manual of Standards and Recommend Practices Section K4	S-9356.V2.0 (Revised 2018): Class D Messaging
AAR Standard	S-9379: Requirements for Using an ITC EMP Application Gateway

2.2 Reference Documents

The following documents provide information which may be useful in implementing this interface, but do not contain interface requirements.

Table 6: Reference Documents

Document	Section
Automated Train Operation (ATO) System Requirements	Rev 1.0, April 22, 2019
AAR Manual of Standards and Recommend Practices Section K4	S-9501: Positive Train Control Data Model Definition
AAR Manual of Standards and Recommend Practices Section K4	S-9503: Interoperable Electronic Train Management System® (I-ETMS) Subdivision File
AAR Manual of Standards and Recommend Practices Section K4	S-9357: Mutually Authenticated Key Exchange
AAR Manual of Standards and Recommend Practices Section K4	S-9360: Data Protection
Automated Train Operation System Requirements (forthcoming)	N/A
Automated Train Operation Subsystem Requirements (forthcoming)	ATO Executive
Automated Train Operation Subsystem Requirements (forthcoming)	ITC-EMS Requirements for ATO
Automated Train Operation Subsystem Requirements (forthcoming)	ITC-PTC Onboard Requirements for ATO

3.0 Interoperable ITC-ATO EX – ITC-ATOSS BO Interface Requirements

Messaging requirements and descriptions in this section define an interoperable interface between ITC-ATO Ex and ITC-ATOSS BO. The messaging requirements and descriptions include protocol requirements, descriptions of the message structure, message definitions, message creation requirements, and message verification requirements.

To achieve an interoperable interface, all communication between ITC-ATO Ex and ITC-ATOSS BO must comply with the AAR standards S-9354 (Edge Message Protocol) and S-9356 (Class D Messaging). AAR standard S-9355 (Class C Messaging) is not used in this interface.

3.1 Class D Interface Requirements

It is assumed that a direct Class D link between ITC-ATO Ex and each ITC-ATOSS BO will not be possible. Instead, messaging between ITC-ATO Ex and ITC-ATOSS BO will be conducted through ITCM. ITC-ATO Ex connects to the ITCM Application Gateway using a Class D link as defined in AAR Standard S-9356, Class D Messaging. The ITCM Application Gateway then provides for message transport to and from ITC-ATOSS BO using the various onboard communication options (Wi-Fi, cellular link, or 220-MHz radio)

The interface of ITC-ATOSS BO with each railroad's ITCM network is beyond the scope of this document. Only the connection between The Class D configurable parameters necessary for ITC-ATO Ex to connect to the ITCM Application Gateway are defined Table 7.

a) *ITC-ATO Ex shall send messages to ITC-ATOSS BO via the onboard ITCM Application Gateway.*

b) *ITC-ATO Ex shall communicate with the ITCM Application Gateway using the Class D messaging service defined in AAR MSRP Section K4, S-9356.*

c) *ITC-ATO Ex shall accept messages sent by ITC-ATOSS BO via the ITCM Application Gateway.*

3.1.1 Class D Link Attributes

The following link attributes will be used for the Class D connection between ITC-ATO Ex and the ITCM application gateway. Refer to S-9356 Section 3 for more information on the definition and use of Class D parameters. The IP addresses for each subsystem are defined in AAR standard S-9101 Appendix F. All other configurable Class D parameters are defined here.

Table 7: ITC-ATO Ex to ITCM Application Gateway Link Attributes

Attribute	ITC-ATO Ex	ITCM Application Gateway
TCP Role	Client	Server
Mode	Bidirectional	Bidirectional
Local Address	The IP address for ITC-ATO Ex is defined in S-9101 Appendix F.	The IP address for the ITCM Application Gateway shall be as defined in S-9101 Appendix F.
Remote Address	The IP address for ITC-ATO Ex is defined in S-9101 Appendix F.	The IP address for the ITCM Application Gateway be as defined in S-9101 Appendix F.
Local Port	N/A	TBC-IRS-Q0-Q1-CD-1
Remote Port	TBC-IRS-Q0-Q1-CD-1	N/A

Attribute	ITC-ATO Ex	ITCM Application Gateway
Log Traffic	TBC-IRS-Q0-Q1-CD-2	TBC-IRS-Q0-Q1-CD-3
Keep-Alive Interval	TBC-IRS-Q0-Q1-CD-4	TBC-IRS-Q0-Q1-CD-4
Keep-Alive ACK Timeout	TBC-IRS-Q0-Q1-CD-5	N/A
Data ACK Enabled	TBC-IRS-Q0-Q1-CD-6	TBC-IRS-Q0-Q1-CD-6
Data ACK Timeout	TBC-IRS-Q0-Q1-CD-7	TBC-IRS-Q0-Q1-CD-7
Data NACK Retry Limit	TBC-IRS-Q0-Q1-CD-8	TBC-IRS-Q0-Q1-CD-8
ACK Timer Delay	TBC-IRS-Q0-Q1-CD-9	TBC-IRS-Q0-Q1-CD-9
Retransmit Delay	TBC-IRS-Q0-Q1-CD-10	TBC-IRS-Q0-Q1-CD-10
Connection Attempt Timeout	TBC-IRS-Q0-Q1-CD-11	N/A
Connection Delay	TBC-IRS-Q0-Q1-CD-12	N/A
Connection Retry Limit	TBC-IRS-Q0-Q1-CD-13	N/A
Reconnection Limit	TBC-IRS-Q0-Q1-CD-14	N/A
Shared Port	N/A	No
TLS Enabled	No	No
TLS Private Key	N/A	N/A
TLS Public Certificate	N/A	N/A
TLS Encryption Method	N/A	N/A
TLS Trusted Root Store	N/A	N/A
TLS CRL Source	N/A	N/A
TLS Local CRL	N/A	N/A

3.2 EMP Requirements

The ITCM communication infrastructure supports messaging between ITC-ATO Ex to ITC-ATOSS BO. To support ITCM-based delivery, messages sent between ITC-ATO Ex and ITC-ATOSS BO comply with the EMP message format defined in AAR MSRP Section K4, S-9354.

The EMP message wrapper is used by both applications to facilitate message transmission, reception, decoding, and routing within the ITCM infrastructure. The EMP message format is provided in Table 8.

Table 8: EMP Message Structure

Field	Size	Description
EMP Header	Variable	The EMP header contains protocol information which is included with every message.
Message Body	Variable	The contents of the message.
Data Integrity Value (EMP Footer)	4 bytes	A data integrity check value computed around the EMP header and message data. May be a CRC, HMAC, or set to indicate no data integrity value.

a) *Interoperable messages between ITC-ATO Ex and ITC-ATOSS BO shall comply with the EMP message structure defined in AAR MSRP Section K4, S-9354.*

3.2.1 EMP Header

The EMP header supports application interpretation of messages exchanged between applications. Table 9 shows the EMP header structure, including field size and order.

Table 9: EMP Header Fields

Field		Size (Bytes)	Data Type	Description
Protocol Version		1	uint	EMP header version
Message Type (ID)		2	uint	Message type (ID) identification number of the message contained in the EMP message body.
Message Version		1	uint	Message version of the message contained in the EMP message body.
Flags (1 byte)	Bit 0: Time Stamp Format	1 bit	enum	EMP time stamp format bit. 0) Relative time 1) Absolute time
	Bit 1: Encryption	1 bit	enum	0) EMP message body is not encrypted 1) EMP message body is encrypted
	Bit 2: Compression	1 bit	enum	0) EMP message body is not compressed 1) EMP message body is compressed
	Bits 3-4: Data integrity	2 bits	enum	0) No data integrity supported 1) CRC calculated and stored in the EMP footer 2) HMAC calculated and stored in the EMP footer 3) Reserved
Data Length		3	uint	Size of EMP message body (excludes EMP header and EMP footer)
Message Number		4	uint	Application message sequence number
Message Time		4	uint	Time of message creation
Variable Header Size		1	uint	Total size of all message header fields following this field. Excludes the message body and footer.
Time To Live		2	uint	Message time to live; used in routing.
Quality of Service (2 bytes)	Class	3 bits	uint	EMP message class
	Priority	3 bits	uint	EMP message priority
	Network Preference	3 bits	uint	EMP network preference
	Special Handling	4 bits	uint	EMP special handling parameter
	Service Request	3 bits	uint	EMP service request
Source		Up to 64	string	Message source address
Destination		Up to 64	string	Message destination address

3.2.1.1 EMP Header Protocol Version Field

The receiving application uses the EMP header Protocol Version field to interpret the EMP header and footer according to the correct version of the EMP and S-9354.

a) *When an application generates a message, the application shall set the EMP header Protocol Version field to the EMP header version implemented by the application.*

3.2.1.2 EMP Header Message Type (ID) Field

The EMP header Message Type (ID) field provides the message type (ID) value associated with the specific message contained within the EMP message body. The receiving application uses the EMP header Message Type (ID) field to correctly identify each message received. The sending application sets the value of the EMP header Message Type (ID) field to the message type (ID) value provided in the description of the message being generated.

a) *When an application generates a message, the application shall set the EMP message Type (ID) field to the message type (ID) number defined for the specific message being generated.*

3.2.1.3 EMP Header Message Version Field

The receiving application uses the EMP message version, in conjunction with the EMP message type (ID), to identify the format and contents of the EMP message body. The sending application sets the value of the EMP header message version field to the message version defined in the IRS.

When an application generates a message, the application shall set the EMP header Message Version Field to the message version number defined for the specific message being generated.

3.2.1.4 EMP Header Flags Field

The EMP message header Flags field contains flags specifying the time stamp format, if encryption is used, if compression is used, and the data integrity settings. The remaining bits are reserved for future use. The use of the EMP message header flags is defined within the requirements for each message type (ID)

3.2.1.4.1. EMP Header Flags Field Bit 0: Time Stamp Format

The EMP header Flag field bit 0: Time Stamp Format provides the time of message generation. The EMP header Flag field bit 0: Time Stamp Format is set to 0 if the EMP header Message Time field contains the time since the last message of the same type was created by the sending application. The EMP header Flag bit 0: Time Stamp Format is set to 1 if the EMP header Message Time field contains the absolute time of message creation as specified in Section 3.2.1.7. The time stamp format is specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP Header Flag field bit 0: Time Stamp Format to the value defined for the specific message type (ID).*

3.2.1.4.2. EMP Header Flags Field Bit 1: Encryption

The EMP header flag bit 1: Encryption is set to 0 if the EMP message body is not encrypted and 1 if the EMP message body is encrypted.

a) *When an application generates a message, the application shall set the EMP header Flag bit 1: Encryption to the value defined for the specific message type (ID).*

3.2.1.4.3. EMP Header Flags Field Bit 2: Compression

The EMP header Flag bit 2: Compression is set to 0 if the body of the message is not compressed and 1 if the body of the message is compressed. The use of compression is specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP header Flag bit 2: Compression to the value defined by the specific message type (ID).*

3.2.1.4.4. EMP Header Flags Field Bits 3 and 4: Data Integrity

The EMP header Flag bits 3 and 4: Data Integrity are treated as a single two-bit enumeration which use the enumeration values given in Table 10. The use of data integrity and the data integrity value is specified in the description of each message.

Table 10: EMP Header Flags Field Bits 3 and 4 Enumeration Values

Value	Description
1	No data integrity supported
2	CRC calculated and stored in the EMP footer
3	HMAC calculated and stored in the EMP footer
4	Reserved

a) *When an application generates a message, the application shall set the EMP header Flag bits 3 and 4: Data Integrity to the value defined for the specific message type (ID).*

3.2.1.5 EMP Header Data Length Field

The EMP header Data Length field provides the length of the EMP message body. The length of the EMP header and EMP footer are not included in this value. Instructions for calculating the length of the EMP message body are provided in the description of each message.

a) *When an application generates a message, the application shall set the EMP header Data Length field to the length, in bytes, of the EMP message body.*

3.2.1.6 EMP Header Message Number Field

The EMP header message number is used to place messages within a sequence and to identify repeated messages. Generation and use of this field is described in Section 3.4.2.

3.2.1.7 EMP Header Message Time Field

The EMP header Message Time field contains the time the message was generated which allows the receiving application to identify and discard stale messages. If the time required to generate a message is greater than one second, the time of generation is considered to be the time at which generation of the message was completed. Relative time stamps and absolute time stamps are supported. A relative time stamp gives the time elapsed since the last message of the same type was generated. An absolute time stamp gives the absolute time of message generation, measured as seconds since midnight, January 1, 1970. An EMP header Message Time field value of 0 indicates a relative time and a 1 indicates absolute time.

Note: S-9354 does not clearly indicate the management of leap seconds by EMP. Unix/POSIX time, of which the EMP absolute time resembles (but does not duplicate), assumes an ideal day length of 86,400 seconds and ignores leap seconds. Other time standards, such as UTC, account for leap

seconds. Improperly handling leap seconds could (currently) result in an error of about 30s, and this error would increase with time. Assuming this section remains in the ATO IRSes, this issue will be resolved later in the ATO development process.

3.2.1.7.1. EMP Header Message Time Field: Absolute Time

a) *When an application generates a message and the message description specifies the use of an absolute time stamp, the application shall set the EMP header Message Time field to the UTC time of message creation as measured by the sending application's clock.*

b) *When an application generates a message and the message description specifies the use of an absolute time stamp, the application shall set the EMP header Message Time field to the number of seconds elapsed since midnight, January 1st, 1970.*

3.2.1.7.2. EMP Header Message Time Field: Relative Time

a) *When an application generates a message and the message description specifies the use of a relative time stamp, the sending application shall set the EMP header message time field to the number of seconds since the last message of the same message type (ID) was generated by the sending application.*

3.2.1.8 EMP Header Variable Header Size Field

The EMP header Variable Header Size field provides the total size, in bytes, of the variable-size portion of the EMP message header which supports correct interpretation of the message by the receiving application. The variable-size portion of the EMP message header includes the EMP header fields Time to Live, Routing QoS, Source Address, and Destination Address. This includes the bytes used for the null termination of the address strings.

a) *When an application generates a message, the application shall set the EMP header Variable Header Size field to the sum of the sizes, in bytes, of the EMP header TTL field, Routing QoS field, Source Address field, and the Destination Address field.*

3.2.1.9 EMP Header Time to Live Field

The EMP header Time to Live field provides the maximum time in which a message may reside in the message delivery infrastructure. If a message is not delivered by the end of the time period specified in the EMP header Time to Live field, the message is discarded by the message delivery infrastructure and will not be delivered. The EMP header Time to Live field is distinct from the class D time to live and persists through non-class D delivery methods. The EMP header Time to Live is specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP Header Time to Live field to the value defined by the requirements for the specific message type (ID).*

3.2.1.10 EMP Header QoS Field

The EMP header QoS field defines a message priority for use by network routing and queuing services. The EMP QoS field consists of several sub fields all of which are specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP Header message QoS field value to the QoS value defined by the requirements for the specific message type (ID).*

3.2.1.11 EMP Header Source Address Field

The EMP header Source Address field contains the EMP address for the application from which the message originated. For the purposes of ATO, this is also the address to which a reply should be sent.

a) When an application generates a message, the application shall set the EMP header Source Address field to the EMP address of the application generating the message.

b) *When an application generates a message, the application shall format the EMP header Source Address field in compliance with S-9379.*

c) *When an application generates a message, the application shall encode the EMP source address as a null-terminated ASCII string.*

3.2.1.12 EMP Header Destination Address Field

The EMP header Destination Address field contains the EMP address of the receiving application.

a) *When an application generates a message, the application shall set the EMP header Destination Address field to the EMP address of the application to which the message is being sent.*

b) *When an application generates a message, the application shall format the EMP header Destination Address Field in compliance with S-9379.*

c) *When an application generates a message, the application shall encode the EMP destination address as a null-terminated ASCII string.*

The message body starts in the byte immediately following the EMP header. Message body content for each message type (ID) is defined in Section 3.3.1.1.2. Messages consist of static fields and records, as defined in Section 1.5. Records are repeated in a loop of 0, 1, or many instances. A message containing records has an associated record counter indicating the number of times each record is repeated. Fields may be of fixed or variable size, as specified in the message description. A field with a variable size is preceded by a fixed-size field specifying the size of the variable-size field. Requirements related to the management of records and variable-size fields are given on a message-by-message basis.

a) *When an application generates a message, the application shall start the message body in the byte immediately following the end of the EMP header.*

b) *When an application generates a message, the application shall include in the message body all static data fields specified in the message description for the specific message type (ID) being generated.*

c) *When an application generates a message, the application shall order the message fields in the order given in the message description for the specific message type (ID) being generated.*

d) *When an application generates a message, the application shall generate each fixed size field to be the size specified in the message description for the specific message type (ID) being generated.*

e) When an application generates a message, the application shall encode each message field using the data type specified in the message description for the specific field being encoded.

3.2.2 EMP Footer

The EMP footer contains a data 32-bit integrity field covering the entire EMP header and message body. This field may contain a CRC, an HMAC, or the value 0. The EMP footer is set to 0 if the message does not include a data integrity check. The use of CRC, HMAC, or no data integrity value, is specified on a message-by-message basis in the message definition.

a) When an application generates a message, and the message description requires neither a CRC nor an HMAC, the sending application shall set the EMP footer to 0x00000000.

b) When an application generates a message, and the message description requires a CRC, the sending application shall set the EMP footer data integrity field to the value calculated per the CRC calculation procedure given in S-9354.

c) When an application generates a message, and the message description requires an HMAC value, the sending application shall set the EMP footer data integrity field to the calculated HMAC value.

3.3 Message Definitions

All messages sent between ITC-ATO Ex and ITC-ATOSS BO are defined in this section.

3.3.1 ITC-ATO Ex to ITC-ATOSS BO Messages

This section documents all messages sent by ITC-ATO Ex to ITC-ATOSS BO. The following message type (ID) assignments are currently made and shown in Table 11:

Table 11: ITC-ATO Ex to ITC-ATOSS BO Messages

Message Type (ID)	Version	Description
Q100	1	ITC-ATO Ex to ITC-ATOSS BO Poll
Q101	1	ITC-ATOSS BO to ITC-ATO Ex Poll ACK
Q102	1	ITC-ATOSS BO Poll Registration
Q103	1	ITC-ATO Ex/ITC-ATO SP Configuration Version List Request
Q110	1	ITC-ATO Ex System State Report
Q111	1	Exception Report
Q114	1	Information Request ACK
Q115	1	Information Retrieval
Q116	1	Condition Resolution ACK

3.3.1.1 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message, Version 1

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message is used as part of the polling process described in the ATO Subsystem Requirements document. The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message is sent to each ITC-ATOSS BO with which ITC-ATO Ex is registered; once the polling process has started ITC-ATO Ex will constantly be sending ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) messages to one or several ITC-ATOSS BOs. An overview of this process is given in

Section 4.3 Detailed requirements for achieving the polling process, including the poll rate, are given in the ATO Subsystem Requirements document.

3.3.1.1.1. ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message EMP Header Parameters

Message-specific EMP header values for the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message are specified in Table 12.

Table 12: ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type (ID)		2	uint	Q100
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q100-1
QoS	Class	3 bits	uint	TBC-IRS-Q100-2
	Priority	3 bits	uint	TBC-IRS-Q100-3
	Network Preference	3 bits	uint	TBC-IRS-Q100-4
	Special Handling	4 bits	uint	TBC-IRS-Q100-5
	Service Request	3 bits	uint	TBC-IRS-Q100-6

3.3.1.1.1.1 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message EMP Header Data Length Field

The EMP header Data Length field for an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message contains the length, in bytes, of the message body. The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message contains a record loop which is repeated a variable number of times. The loop is preceded by a counter indicating the number of times the record is repeated.

In order to calculate the value stored in the EMP data length field, the size of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message body must be calculated at run time for each ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message generated. The size of an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message is the sum of:

- 7 bytes for field IDs 1-4.
- 6 bytes multiplied by the value of field ID 4 for field IDs 4.1 and 4.2.
- 13 bytes for field IDs 5-8.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.1.1.2 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message EMP Header Number Field

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message EMP header message number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.1.2. ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Body

A summary of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message body is given in Table 13. Detailed descriptions and requirements follow.

Table 13: ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Body

ID	Field	Size, bytes	Data Type	Description
1	Railroad SCAC	4	SCAC	Railroad SCAC of the operating railroad
2	ATO Mode	1	enum	Current operating mode of the ATO system. See Table 16.
3	ITC-ATO Ex State	1	enum	Current state of ITC-ATO Ex. See Table 17
4	Subdivision/District Record Counter	1	uint	Number of subdivisions/districts
<Start subdivision/district record loop>				Repeat once for each subdivision/district
4.1	Subdivision/District ID	2	uint	PTC subdivision/district identification number
4.2	Track Data Version	4	uint	Version of associated track data subdivision/district file
<End subdivision/district record loop>				
5	ITC-ATO Ex Configuration Data Integrity Code	4	enum	Data Integrity Code of ITC-ATO Ex configuration dataset
6	ITC-ATO SP Configuration Data Integrity Code	4	enum	Data Integrity Code of ITC-ATO SP configuration dataset
7	Poll Rate	1	uint	Poll rate in minutes
8	Coordination Number	4	uint	Unique ITC-ATO Ex-assigned message coordination number for use in the resulting ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 14. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.1.2.

Table 14: ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left-justified, space filled Must contain at least two letters
2	ATO Mode	0 to 3 (Valid enumeration values)
3	ITC-ATO Ex State	0 to 17 (Valid enumeration values)

3.3.1.1.3. ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Reliable Messaging Properties

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 15.

Table 15: ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q001)
Number of Retries	TBC-IRS-Q100-7
Retry Interval	TBC-IRS-Q100-8

3.3.1.1.4. ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Field Generation Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message body are given in this section.

3.3.1.1.4.1 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Railroad SCAC Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Railroad SCAC field contains the SCAC of the ITC-ATOSS BO to which the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message is being sent.

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall set the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Railroad SCAC field to the SCAC of the ITC-ATOSS BO to which the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message is being sent.*

3.3.1.1.4.2 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ATO Mode Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ATO Mode field contains the current operating mode of ITC-ATO Ex as set by the ATO mode switch. If the mode switch is between positions or if there is an error reading the position of the mode switch the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ATO Mode field will be set to "Unknown/error." The valid values of this enumeration are listed in Table 16. All other values are unused.

Table 16: ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ATO Mode Field Enumeration Values

Value	ATO Mode
0	Unknown
1	Attended
2	Unattended
3	Passive

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall set the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ATO Mode field to the current ITC-ATO Ex mode switch position using the enumeration values given in Table 16.*

3.3.1.1.4.3 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ITC-ATO Ex State Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex State field reports the current operating state of the ITC-ATO Ex subsystem. The valid values of this enumeration are listed in Table 17. All other values are unused.

Table 17: ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ITC-ATO Ex State Field Enumeration Values

Value	ITC-ATO Ex State
0	Power up
1	Failed
2	ITC-ATO Ex Non-Init
3	Initialization
4	Pre-Arm Setup
5	Unarmed Configured
6	Armed Automated Standby
7	Automated Active
8	Automated Exception
9	Attended Active
10	Attended Exception
11	Manual Control
12	Manual Setup
13	Attended Setup
14	Attended Ready
15	ITM
16	Shadow
17	ATO Suspended

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall set the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex State field to the current ITC-ATO Ex state using the enumeration values given in Table 17.*

3.3.1.1.4.4 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Subdivision/District Record Counter, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District Record Counter field contains the number of subdivisions/districts that ITC-ATO Ex has registered with the receiving ITC-ATOSS BO. Each ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District record consists of only the Subdivision/District ID dynamic field. The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District record is repeated once for each subdivision/district that ITC-ATO Ex has registered with the receiving ITC-ATOSS BO. If there are no registered subdivisions/districts (e.g., during initialization), the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District Record Counter will be 0 and there will be no ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District ID records present.

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall set the Subdivision/District Record Counter field to the number of subdivisions/districts ITC-ATO Ex has registered with the receiving ITC-ATOSS BO.*

b) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall repeat the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District record once for each subdivision/district ITC-ATO Ex has registered with the receiving ITC-ATOSS BO.*

3.3.1.1.4.5 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Subdivision/District ID Dynamic Field, Generation Requirements

Each instance of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District ID dynamic field provides one PTC subdivision/district ID that ITC-ATO Ex has registered with the receiving ITC-ATOSS BO, and PTC Subdivision/District IDs are not repeated. The full set of ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/district ID dynamic fields provide a complete list of subdivisions/districts registered with the receiving ITC-ATOSS BO.

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall set each instance of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District ID dynamic field to the PTC subdivision/district ID of the corresponding subdivision/district.*

3.3.1.1.4.6 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Track Data Version Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Track Data Version field provides ITC-ATOSS BO with the version of the track data file currently in use for the associated subdivision/district. This allows ITC-ATOSS BO to use the correct track data file when creating Information Request (Q014) messages.

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex shall set each instance of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Track Data Version field to the version of the track data file for the corresponding subdivision/district.*

3.3.1.1.4.7 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ITC-ATO Ex Configuration Data Integrity Code Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex Configuration Data Integrity Code field provides the data integrity code calculated for the ITC-ATO Ex configuration dataset. The CRC is used to confirm the dataset validity and detect file corruption. Calculation of the ITC-ATO Ex configuration dataset data integrity code by ITC-ATO Ex is described in the ITC-ATO Ex Subsystem Requirements.

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall set the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex Configuration Data Integrity Code field to the most recently calculated data integrity code of the ITC-ATO Ex configuration dataset.*

3.3.1.1.4.8 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ITC-ATO SP Configuration Data Integrity Code Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO SP Configuration Data Integrity Code field provides the CRC calculated for the ITC-ATO SP configuration dataset. This data integrity

code is received from ITC-ATO SP during train initialization and stored by ITC-ATO Ex. The data integrity code is used to continually confirm dataset validity during automated operations.

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall set the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO SP Configuration Data Integrity Code field to the most recently received data integrity code of the ITC-ATO SP configuration dataset.*

3.3.1.1.4.9 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Poll Rate Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Poll Rate field reports the minimum rate, in minutes, that the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message will be sent to the receiving ITC-ATOSS BO. An ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message may be sent more frequently, such as upon ITC-ATO Ex state change. A poll rate of 0 indicates that ITC-ATO Ex will be deregistration polling with the receiving ITC-ATOSS BO; this process is completed using the ITC-ATOSS BO Poll Registration (Q100) message.

a) *When ITC-ATO Ex generates an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATO Ex shall populate the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Poll Rate field with the rate, in minutes, at which the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message will be sent to the ITC-ATOSS BO.*

3.3.1.1.4.10 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Coordination Number Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message coordination number is generated according to the numbering process described in Section 3.4.3.

3.3.1.1.5. ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Field Use Requirements

Requirements placed on ITC-ATO Ex regarding the verification and use of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message are given in this section.

3.3.1.1.5.1 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Railroad SCAC Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Railroad SCAC field contains the SCAC of the ITC-ATOSS BO to which ITC-ATO Ex is sending the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message.

a) *If ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message in which the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Railroad SCAC does not match ITC-ATOSS BO's SCAC, ITC-ATOSS BO shall discard the message.*

3.3.1.1.5.2 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ATO Mode Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ATO Mode field provides ITC-ATOSS BO with the ITC-ATO Ex's current ATO Mode.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATOSS BO shall use the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ATO Mode field*

as the current ATO Mode of the specific ITC-ATO Ex of which sent the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message.

3.3.1.1.5.3 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ITC-ATO Ex State Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex State field provides ITC-ATOSS BO with the current ITC-ATO Ex State.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATOSS BO shall use the ITC-ATO Ex to ITCX-ATOSS BO Poll (Q100) message ATO Mode field as the current state of the specific ITC-ATO Ex of which sent the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message.*

3.3.1.1.5.4 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Subdivision/District Record Counter Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District Counter field provides ATOSS BO with the number of subdivisions/districts ITC-ATO Ex has registered with the receiving ITC-ATOSS BO. The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District Record Counter field also assists ITC-ATOSS BO in correctly unpacking the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message by providing the receiving ITC-ATOSS BO with the number of times the Subdivision/District ID Record Loop is repeated.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATOSS BO shall use the value contained in the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District Counter field as the number of subdivisions/districts the sending ITC-ATO Ex currently has registered with the receiving ITC-ATOSS BO.*

b) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC ATOSS BO shall extract the number of ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivisions/District ID records indicated by the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District ID Record Counter field.*

3.3.1.1.5.5 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Subdivision/District ID Dynamic Field, Use Requirements

Each instance of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District ID dynamic field identifies one subdivisions/district of which the sending ITC-ATO Ex has registered with the receiving ITC-ATOSS BO.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATOSS BO shall use each instance of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Subdivision/District dynamic field to identify a subdivision/district that the sending ITC-ATO Ex has registered with the receiving ITC-ATOSS BO.*

3.3.1.1.5.6 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Track Data Version Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Track Data Version field provides ITC-ATOSS BO with the version of the track data file currently in use for the associated subdivision/district. ITC-ATOSS BO must use this track data file when creating Information Request (Q014) messages.

a) *When ITC-ATOSS receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex shall use each instance of the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Track Data Version field as the version of the track data file for the corresponding subdivision/district in use by the ITC-ATO Ex that generated the message.*

3.3.1.1.5.7 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ITC-ATO Ex Configuration Data Integrity Code Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex Configuration Data Integrity Code field is used by the ITC-ATOSS BO to confirm dataset validity and detect file corruption.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATOSS BO shall use the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO Ex Configuration CRC field as the data integrity code calculated across the ITC-ATO Ex configuration currently in use by the sending ATO Ex.*

3.3.1.1.5.8 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message ITC-ATO SP Configuration Data Integrity Code Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO SP Configuration Data Integrity Code field is used by the receiving ITC-ATOSS BO to confirm the dataset validity and detect file corruption.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATOSS BO shall use the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message ITC-ATO SP Configuration Data Integrity Code field as the data integrity code calculated across the ITC-ATO SP configuration currently in use by the ITC-ATO SP connected to the sending ITC-ATO Ex.*

3.3.1.1.5.9 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Poll Rate Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Poll Rate field provides ITC-ATOSS BO with the poll rate currently in use by the sending ITC-ATO Ex.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message, ITC-ATOSS BO shall use the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Poll Rate field at the current poll rate for the sending ITC-ATO Ex.*

3.3.1.1.5.10 ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) Message Coordination Number Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.1.2 ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message, Version 1

The ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message is part of the reliable message process described in Section 3.4.4 and is used as the acknowledge for the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message.

3.3.1.2.1. ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) EMP Header Parameters

Message-specific EMP header values for the ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message are specified in Table 18.

Table 18: ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type		2	uint	Q101
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q101-1
QoS	Class	3 bits	uint	TBC-IRS-Q101-2
	Priority	3 bits	uint	TBC-IRS-Q101-3
	Network Preference	3 bits	uint	TBC-IRS-Q101-4
	Special Handling	4 bits	uint	TBC-IRS-Q101-5
	Service Request	3 bits	uint	TBC-IRS-Q101-6

3.3.1.2.1.1 ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) EMP Header Data Length Field

The ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message only contains static fields, so the message is always the same size of 5 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.2.1.2 ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) EMP Header Number Field

The ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.2.2. ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message Body

A summary of the ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message body is given in Table 19. Detailed descriptions and requirements follow.

Table 19: ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message Body

ID	Field	Size, bytes	Data Type	Description
1	ACK Status	1	enum	ACK Status. See Table 20.
2	Coordination Number	4	uint	Coordination number from ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message to which this message is a reply.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 20. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 20: ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.2.3. ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message Field Generation, Requirements

Requirements placed on ITC-ATO Ex regarding populating the fields in an ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message body are given in this section,

3.3.1.2.3.1 ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message ACK Status Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message ACK Status field indicates if the ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 21: ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message successfully received
1	NACK – message discarded

3.3.1.2.3.2 ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message Coordination Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.2.4. ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message fields are given in this section.

3.3.1.2.4.1 ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message ACK Status Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.2.4.2 ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) Message Coordination Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.3 ITC-ATOSS BO Poll Registration (Q102) Message, Version 1

During train initialization, ITC-ATO Ex sends the ITC-ATOSS BO Poll Registration (Q102) message to the ITC-ATOSS BO of each operating railroad to start the polling process. ITC-ATO Ex also sends an ITC-ATOSS BO Poll Registration (Q102) message to end the polling process when the train has completed its drive through the territories associated with a given BO. See the ITC-ATO Ex subsystem requirements for more details.

3.3.1.3.1. ITC-ATOSS BO Poll Registration (Q102) EMP Header Parameters

Message-specific EMP header values for the ITC-ATOSS BO Poll Registration (Q102) message are specified in Table 22.

Table 22: ITC-ATOSS BO Poll Registration (Q102) EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type		2	uint	Q102
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q102-1
QoS	Class	3 bits	uint	TBC-IRS-Q102-2
	Priority	3 bits	uint	TBC-IRS-Q102-3
	Network Preference	3 bits	uint	TBC-IRS-Q102-4
	Special Handling	4 bits	uint	TBC-IRS-Q102-5
	Service Request	3 bits	uint	TBC-IRS-Q102-6

3.3.1.3.1.1 ITC-ATOSS BO Poll Registration (Q102) EMP Header Data Length Field

The EMP header data length field for an ITC-ATOSS BO Poll Registration (Q102) message contains the length, in bytes, of the message body. As shown in Section 3.3.1.3.2, the ITC-ATOSS BO Poll Registration (Q102) message contains one record loop and three variable length fields. The record loop is preceded by a counter indicating the number of times the record is repeated.

In order to calculate the value stored in the EMP data length field, the size of the ITC-ATOSS BO Poll Registration (Q102) message body must be calculated dynamically at run time. This size is the sum of:

- 7 bytes for field IDs 1-4.
- The value of field ID 4 multiplied by 2 bytes for field ID 4.1.
- 5 bytes for field ID 5-6
- The value of field ID 6 for the variable-length field 7.
- 1 byte for field ID 8.
- The value of field ID 8 for the variable-length field 9.
- 1 byte for field ID 10.
- The value of field ID 10 for the variable-length field ID 11.
- 4 bytes for field ID 12.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.3.1.2 ITC-ATOSS BO Poll Registration (Q102) EMP Header Number Field

The ITC-ATOSS BO Poll Registration (Q102) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.3.2. ITC-ATOSS BO Poll Registration (Q102) Message Body

A summary of the ITC-ATOSS BO Poll Registration (Q102) message body is given in Table 23. Detailed descriptions and requirements follow.

Table 23: ITC-ATOSS BO Poll Registration (Q102) Message Body

ID	Field	Size, bytes	Data Type	Description
1	IRS Version Number	1	uint	Interface version number given in Section 1.1.1 of this IRS.
2	Railroad SCAC	4	SCAC	SCAC of the ITC-ATOSS BO to which message is sent
3	Reason for Sending	1	enum	Reason this message was sent. See Table 26
4	Subdivision/District Record Counter	1	uint	Number of subdivisions/districts associated with this ITC-ATOSS BO
<Start subdivision/district record loop>				Repeat once for each subdivision/district
4.1	Subdivision/District ID	2	uint	PTC subdivision/district identification
<End subdivision/district record loop>				
5	Train ID SCAC	4	SCAC	SCAC of the railroad of which assigned the Train ID
6	Train ID Length	1	uint	Length of Train ID field
7	Train ID	varies	string	Train identification number
8	Current ITC-ATO Ex Configuration Version Length	1	uint	Length of the Current ITC-ATO Ex Configuration Version field
9	Current ITC-ATO Ex Configuration Version	varies	string	Version of the ITC-ATO Ex Configuration which is currently in use
10	Current ITC-ATO SP Configuration Version Length	1	uint	Length of Current ITC-ATO SP Configuration Version field
11	Current ITC-ATO SP Configuration Version	varies	string	Version of the ITC-ATO SP Configuration which is currently in use
12	Coordination Number	4	uint	Unique ITC-ATO Ex-assigned message coordination number for use in the resulting ITC-ATOSS BO Poll Registration Confirmation message.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 24. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 24: ITC-ATOSS BO Poll Registration (Q102) Message Field Ranges

ID	Field	Range
2	Railroad SCAC	Capital letters, left-justified, space filled Must contain at least two letters
3	Reason for sending	0 to 1 (Valid enumeration values)
4.1	Subdivision/District ID	0 to 9999
5	Train ID SCAC	Capital letters, left-justified, space filled Must contain at least two letters
6	Train ID Length	0 to 30

3.3.1.3.3. ITC-ATOSS BO Poll Registration (Q102) Message Reliable Messaging Properties

The ITC-ATOSS BO Poll Registration (Q102) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 25.

Table 25: ITC-ATOSS BO Poll Registration (Q102) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	ITC-ATOSS BO Poll Registration Confirmation (Q002) message
Number of Retries	TBC-IRS-Q102-7
Retry Interval	TBC-IRS-Q102-8

3.3.1.3.4. ITC-ATOSS BO Poll Registration (Q102) Message Field Generation Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in an ITC-ATOSS BO Poll Registration (Q102) message body are given in this section.

3.3.1.3.4.1 ITC-ATOSS BO Poll Registration (Q102) Message IRS Version Number Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message IRS Version Number field contains the interface version number of the IRS currently in use by ITC-ATO Ex. The ITC-ATOSS BO will then use that IRS version for all communication with ITC-ATO Ex for the remainder of the session. The IRS version number is not the same as the IRS document revision; it is a digital identification number and is assigned in Section 1.1.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall populate the ITC-ATOSS BO Poll Registration (Q102) message IRS Version Number field with the interface version number of the ITC-ATO Ex-to-ITC-ATOSS BO IRS currently in use by ITC-ATO Ex.*

3.3.1.3.4.2 ITC-ATOSS BO Poll Registration (Q102) Message Railroad SCAC Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Railroad SCAC field provides the SCAC of the railroad with which ITC-ATO Ex is registering to start the polling process. This is the ITC-ATOSS BO to which the ITC-ATOSS BO Poll Registration (Q102) message is being sent.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall populate the ITC-ATOSS BO Poll Registration (Q102) message Railroad SCAC field with the SCAC of the railroad with which ITC-ATO Ex is initiating the polling process.*

3.3.1.3.4.3 ITC-ATOSS BO Poll Registration (Q102) Message Reason for Sending Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Reason for Sending field indicates why the ITC-ATOSS BO Poll Registration (Q102) message was sent. Possible values are given in Table 26.

Table 26: ITC-ATOSS BO Poll Registration (Q102) Message Reason for Sending Field Enumeration Values

Value	Description
0	Registering with receiving ITC-ATOSS BO
1	Deregistering with receiving ITC-ATOSS BO

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall populate the ITC-ATOSS BO Poll Registration (Q102) message Reason for Sending field with the reason the message was sent using the enumeration values given in Table 26.*

3.3.1.3.4.4 ITC-ATOSS BO Poll Registration (Q102) Message Subdivision/District ID Record Counter Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID Record Counter field contains the number of subdivisions/districts ITC-ATO Ex has registered with the receiving ITC-ATOSS BO. This is the number of subdivisions/districts to be traversed by the ATO train that are associated with the ITC-ATOSS BO receiving the ITC-ATOSS BO Poll Registration (Q102) message. The ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID record consists of only the ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID dynamic field. The ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District record is repeated once for each subdivision/district ITC-ATO Ex has registered or is registering with the receiving BOS.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message to register with an ITC-ATOSS BO, ITC-ATO Ex shall set the Subdivision/District ID Record Counter field to the number of subdivisions/districts ITC-ATO Ex is registering with the receiving ITC-ATOSS BO.*

b) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message to deregister with an ITC-ATOSS BO, ITC-ATO Ex shall set the Subdivision/District ID Record Counter field to the number of subdivisions/districts ITC-ATO Ex has registered with the receiving ITC-ATOSS BO.*

c) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall repeat the ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID record once for each subdivision/district.*

3.3.1.3.4.5 ITC-ATOSS BO Poll Registration (Q102) Message Subdivision/District ID Dynamic Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID dynamic field is repeated once for each subdivision/district registered with the receiving ITC-ATOSS BO. This provides the receiving ITC-ATOSS BO with a complete list of subdivision/districts managed by that ITC-ATOSS BO and of which the train is or will be traversing.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall set each instance of the ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID dynamic field to a PTC subdivision/district ID of a subdivision/district associated with the receiving ITC-ATOSS BO and of which the train is or will be traversing.*

b) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall not repeat the same PTC subdivision/district ID in two different instances of the ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID dynamic field.*

3.3.1.3.4.6 ITC-ATOSS BO Poll Registration (Q102) Message Train ID SCAC Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Train ID SCAC field contains the SCAC of the railroad that assigned the train ID given in the ITC-ATOSS BO Poll Registration (Q102) message Train ID field.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall populate the ITC-ATOSS BO Poll Registration (Q102) message Train ID SCAC field with the SCAC of the railroad that assigned the train ID.*

3.3.1.3.4.7 ITC-ATOSS BO Poll Registration (Q102) Message Train ID Length Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Train ID Length field contains the length, in bytes, of the train's identification number, which is stored in the following ITC-ATOSS BO Poll Registration (Q102) message Train ID field.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall set the ITC-ATOSS BO Poll Registration (Q102) Train ID Length field to the length of the train's ID.*

3.3.1.3.4.8 ITC-ATOSS BO Poll Registration (Q102) Message Train ID Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Train ID field provides the train identification number assigned to this train by the railroad receiving the message. The train ID is a variable-length alpha-numeric string, and each railroad assigns their own train ID to each train according to their business practices. This string does not include a null termination.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall set the ITC-ATOSS BO Poll Registration (Q102) message Train ID field to the train ID assigned by the railroad to which the message is being sent.*

3.3.1.3.4.9 ITC-ATOSS BO Poll Registration (Q102) Message Current ITC-ATO Ex Configuration Version Length Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version Length field contains the length of the configuration version number, which is stored in the following ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field. This is also the length of the following ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall set the ITC-ATOSS BO Poll Registration (Q102) Current ITC-ATO Ex Configuration Version Length field to the length of the following ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field.*

3.3.1.3.4.10 ITC-ATOSS BO Poll Registration (Q102) Message Current ITC-ATO Ex Configuration Version Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field provides the version of the ITC-ATO Ex configuration currently in use. See the ITC-ATO Ex Subsystem Requirements for details.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall set the ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field to the version of the ITC-ATO Ex configuration currently in use.*

3.3.1.3.4.11 ITC-ATOSS BO Poll Registration (Q102) Message Current ITC-ATO SP Configuration Version Length Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version Length field contains the length of the configuration version number, which is stored in the ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version field. This is also the length of the following ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version field.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall set the ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version Length field to the length of the following ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version field.*

3.3.1.3.4.12 ITC-ATOSS BO Poll Registration (Q102) Message ITC-ATO SP Configuration Version Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version field provides the version of the ITC-ATO SP configuration currently in use. ITC-ATO Ex receives this value from ITC-ATO SP during system initialization.

a) *When ITC-ATO Ex generates an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATO Ex shall set the ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version field to the version of the ITC-ATO SP configuration currently in use as provided by ITC-ATO SP.*

3.3.1.3.4.13 ITC-ATOSS BO Poll Registration (Q102) Message Coordination Number Field, Generation Requirements

The ITC-ATOSS BO Poll Registration (Q102) message coordination number is generated according to the numbering process described in Section 3.4.3.

3.3.1.3.5. ITC-ATOSS BO Poll Registration (Q102) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the ITC-ATOSS BO Poll Registration (Q102) message are given in this section.

3.3.1.3.5.1 ITC-ATOSS BO Poll Registration (Q102) Message IRS Version Number Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message IRS Version Number field provides the IRS Version currently implemented by ITC-ATO Ex.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the ITC-ATOSS BO Poll Registration (Q102) message IRS Version Number field as the interface version currently implemented by ITC-ATO Ex.*

3.3.1.3.5.2 ITC-ATOSS BO Poll Registration (Q102) Message Railroad SCAC Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Railroad SCAC field provides the SCAC of the railroad with which ITC-ATO Ex is registering the polling process. If ITC-ATOSS BO receives a poll message for some other RR it is discarded.

a) *If ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message in which the ITC-ATOSS BO Poll Registration (Q102) message SCAC field does not match the SCAC of the receiving ITC-ATOSS BO, ITC-ATOSS BO shall discard the message.*

3.3.1.3.5.3 ITC-ATOSS BO Poll Registration (Q102) Message Reason for Sending Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Reason for Sending field provides ITC-ATOSS BO with the reason the ITC-ATOSS BO Poll Registration (Q102) message was sent. See Table 26.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the ITC-ATOSS BO Poll Registration (Q102) message Reason for Sending field to identify the reason why the ITC-ATOSS BO Poll Registration (Q102) message was sent using the enumerating values given in Table 26.*

3.3.1.3.5.4 ITC-ATOSS BO Poll Registration (Q102) Message Subdivision/District ID Record Counter, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID Record Counter field provides the number of subdivision/districts being registered and is used by ITC-ATOSS BO to correctly unpack the ITC-ATOSS BO Poll Registration (Q102) message.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the value contained in the ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID Record Counter field as the number of subdivision/districts being registered by the sending ITC-ATO Ex.*

b) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ASTOSS BO shall extract the number of subdivision/district ID records indicated by the ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID Record Counter field.*

3.3.1.3.5.5 ITC-ATOSS BO Poll Registration (Q102) Message Subdivision/District ID Dynamic Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID dynamic field provides the subdivision/district ID for a specific subdivision/district being registered with the receiving ITC-ATOSS BO by the ATO train.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the subdivision/district ID contained in each instance of the ITC-ATOSS BO Poll Registration (Q102) message Subdivision/District ID Dynamic field to identify a specific subdivision/district being registered by the sending ITC-ATO Ex.*

3.3.1.3.5.6 ITC-ATOSS BO Poll Registration (Q102) Message Train ID SCAC Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Train ID SCAC field provides the SCAC of the railroad that assigned the associated train ID and is used as the SCAC portion of the train ID.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the SCAC contained in the ITC-ATOSS BO Poll Registration (Q102) message Train ID SCAC field as the SCAC of the associated train ID.*

3.3.1.3.5.7 ITC-ATOSS BO Poll Registration (Q102) Message Train ID Length Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Train ID Length field helps ITC-ATOSS BO interpret the ITC-ATOSS BO Poll Registration (Q102) message by providing ITC-ATOSS BO with the length of the following ITC-ATOSS BO Poll Registration (Q102) message Train ID field.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the value contained in the ITC-ATOSS BO Poll Registration (Q102) message Train ID Length field as the length, in bytes, of the following the ITC-ATOSS BO Poll Registration (Q102) message Train ID field.*

3.3.1.3.5.8 ITC-ATOSS BO Poll Registration (Q102) Message Train ID Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Train ID field provides the train ID of the ATO train that is attempting to register with the ITC-ATOSS BO.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the ITC-ATOSS BO Poll Registration (Q102) message Train ID field as the train ID of the ATO train attempting to register with the ITC-ATOSS BO.*

3.3.1.3.5.9 ITC-ATOSS BO Poll Registration (Q102) Message Current ITC-ATO Ex Configuration Version Length Field, Use Requirements

The ITC-ATOSS Poll Registration (Q102) Message Current ITC-ATO Ex Configuration Version Length field helps ITC-ATOSS BO interpret the ITC-ATOSS BO Poll Registration (Q102) message by

providing the ITC-ATOPSS BO with the length of the following ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the value contained in the ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version Length field as the length, in bytes, of the following ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field.*

3.3.1.3.5.10 ITC-ATOSS BO Poll Registration (Q102) Message Current ITC-ATO Ex Configuration Version Field, Use Requirements

The ITC ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field provides the version of the ITC-ATO Ex configuration currently in use by ITC-ATO Ex.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field as the ITC-ATO Ex configuration version currently in use by the sending ITC-ATO Ex.*

3.3.1.3.5.11 ITC-ATOSS BO Poll Registration (Q102) Message Current ITC-ATO SP Configuration Version Length Field, Use Requirements

The ITC ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version field provides the length of the following ITC-ATOSS BO Poll Registration (Q102) message ITC-ATO SP Configuration Version field.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the ITC-ATOSS BO Poll Registration (Q102) message Current ITC-ATO Ex Configuration Version Length field as the length, in bytes, of the following ITC-ATOSS BO Poll Registration (Q102) message ITC-ATO SP Configuration Version field.*

3.3.1.3.5.12 ITC-ATOSS BO Poll Registration (Q102) Message ITC-ATO SP Configuration Version Field, Use Requirements

The ITC ATOSS BO Poll Registration (Q102) message Current ITC-ATO SP Configuration Version field provides the version of the ITC-ATO SP configuration currently in use by the ITC-ATO SP connected to the sending ITC-ATO Ex.

a) *When ITC-ATOSS BO receives an ITC-ATOSS BO Poll Registration (Q102) message, ITC-ATOSS BO shall use the ITC-ATOSS BO Poll Registration (Q102) message ITC-ATO SP Configuration Version field as the ITC-ATO SP configuration version currently in use by the ITC-ATO SP connected to the sending ITC-ATO Ex.*

3.3.1.3.5.13 ITC-ATOSS BO Poll Registration (Q102) Message Coordination Number Field, Use Requirements

The ITC-ATOSS BO Poll Registration (Q102) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.1.4 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message, Version 1

ITC-ATO Ex sends the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message to the ITC-ATOSS BO of each operating railroad to request summary information to validate the ITC-ATO Ex and ITC-ATO SP configuration file versions. The back office responds with the ITC-ATO Ex Configuration Version List (Q003) message.

3.3.1.4.1. ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message EMP Header Parameters

Message-specific EMP header values for the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message are specified in Table 27.

Table 27: ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q103
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q103-1
QoS	Class	3 bits	uint	TBC-IRS-Q103-2
	Priority	3 bits	uint	TBC-IRS-Q103-3
	Network Preference	3 bits	uint	TBC-IRS-Q103-4
	Special Handling	4 bits	uint	TBC-IRS-Q103-5
	Service Request	3 bits	uint	TBC-IRS-Q103-6

3.3.1.4.1.1 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) EMP Header Data Length Field

The EMP header data length field for an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message contains the length, in bytes, of the message body. The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message contains a repository record loop which is repeated between 0 and 4 times. The record loop is preceded by a counter stating how many times the loop is repeated.

In order to calculate the value stored in the EMP header data length field, the size of the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message body must be calculated at run time for each ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message generated. This size is the sum of:

- 16 bytes for field IDs 1-4.
- The value of field ID 4 for field ID 5.
- 1 byte for field ID 6.
- The value of field ID 6 for field ID 7.
- 1 byte for field ID 8.

- 1 byte multiplied by the value of field ID 8 for field ID 8.1.
- The sum of the values of each instance of field ID 8.1 for each instance of field 8.2.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.4.1.2 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) EMP Header Number Field

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) EMP Header Number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.4.2. ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Body

A summary of the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message body is given in Table 28. Detailed descriptions and requirements follow.

Table 28:ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Body

ID	Field	Size, bytes	Data Type	Description
1	IRS Version Number	1	uint	Interface version number given in Section 1.1.1 of this IRS
2	Railroad SCAC	4	SCAC	Railroad SCAC of the ITC-ATOSS BO this message is sent to
3	Lead Locomotive ID	10	U	ID of the locomotive on which ITC-ATO Ex is installed
4	ITC-ATO Ex Vendor Name Length	1	uint	Length of ITC-ATO Ex vendor name
5	ITC-ATO Ex Vendor Name	varies	uint	Name of ITC-ATO Ex vendor
6	ITC-ATO SP Vendor Name Length	1	uint	Length of ITC-ATO SP vendor name
7	ITC-ATO SP Vendor Name	varies	uint	Name of ITC-ATO SP vendor
8	Repository Record Counter	1	uint	Number of repositories
<Start Repository record loop>				Repeat once for each repository
8.1	Repository Name Length	1	uint	Number of characters in the repository name
8.2	Repository Name	varies	string	Repository name
<End Repository record loop>				

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 29. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 29: ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Field Ranges

ID	Field	Range
2	Railroad SCAC	Capital letters, left-justified, space filled Must contain at least 2 letters
7	Repository Record Counter	6
8.1	Repository Name Length	14, 16
8.2	Repository Name	The only valid values are: • ITC-ATO Ex Common • ITC-ATO Ex Config • ITC-ATO Ex Software • ITC-ATO SP Common • ITC-ATO SP Config • ITC-ATO SP Software

3.3.1.4.3. ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Reliable Messaging Properties

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 30.

Table 30: ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message
Number of Retries	TBC-IRS-Q103-7
Retry Interval	TBC-IRS-Q103-8

3.3.1.4.4. ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Field Generation Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message body are given in this section.

3.3.1.4.4.1 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message IRS Version Number Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message IRS Version Number field contains the interface version number of the IRS currently implemented by ITC-ATO Ex. The interface version number for this IRS is defined in Section 1.1. The interface version implemented is defined in the ITC-ATO Ex IRS versions configuration file as described in the ITC-ATO Ex Subsystem requirement document.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex shall populate the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message IRS Version field with the interface version number of the ITC-ATO Ex-to-ITC-ATOSS BO IRS defined in the ITC-ATO EX IRS versions configuration file.*

3.3.1.4.4.2 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Railroad SCAC Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Railroad SCAC field provides the SCAC of the ITC-ATOSS BO from which the configuration version list is being requested. This is also the ITC-ATOSS BO to which the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message is sent.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall populate the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Railroad SCAC field with the SCAC of the railroad BOS from which a configuration version list is requested.*

3.3.1.4.4.3 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Lead Locomotive ID Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version Request (Q103) message Lead Locomotive ID field is populated with the ID of the locomotive on which ATO Ex in installed, and also must be the lead locomotive of the train. This is a string containing locomotive unit data as described in Section 1.6.2. The ID of the lead locomotive is provided by ITC-ATO Ex's internal configuration dataset.

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report message, ITC-ATO Ex shall populate the ITC-ATO Ex/ITC-ATO SP message Lead Locomotive ID field with the ID of the locomotive on which ITC-ATO Ex is installed.*

3.3.1.4.4.4 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO Ex Vendor Name Length Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name Length field provides the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name Length field to the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field.*

3.3.1.4.4.5 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO Ex Vendor Name Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field contains the name of the ITC-ATO Ex vendor. The ITC-ATO Ex vendor name:

- Must be unique to the vendor; two separate vendors must not use the same name.
- Is encoded as an ASCII string
- Has a null termination
- Is limited to 255 characters.
- Is contained in the ITC-ATO Ex configuration files as defined in the ITC-ATO Ex subsystem requirements.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field to the name of the ITC-ATO Ex vendor.*

3.3.1.4.4.6 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO SP Vendor Name Length Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name Length field provides the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name field.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name Length field to the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name field.*

3.3.1.4.4.7 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO SP Vendor Name Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name field contains the name of the ITC-ATO SP vendor. The ITC-ATO SP vendor name:

- Must be unique to the vendor; two separate vendors must not use the same name.
- Is encoded as an ASCII string
- Has a null termination
- Is limited to 255 characters.

ITC-ATO Ex must acquire a copy of the ITC-ATO SP vendor name from ITC-ATO SP prior to generating an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name to the name of the ITC-ATO SP vendor.*

3.3.1.4.4.8 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Repository Record Counter Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Record Counter field contains the number of repositories from which ITC-ATO Ex is requesting a configuration file version. The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Record consists of the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name Length and Repository Name dynamic fields. The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Record is repeated once for each repository from which files are being requested.

Note: The current design concept requires exactly three repositories to be sent for ITC-ATO Ex and exactly three to be sent for ITC-ATO SP. As a result, this field always has a value of 6.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Record Counter field to the number of repositories from which ITC-ATO Ex is requesting a configuration file version.*

b) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall repeat the Repository Record once for each repository.*

3.3.1.4.4.9 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Repository Name Length Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name Length dynamic field contains the length of the name being transmitted in the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name dynamic field.

Note: The current design concept only allows the repository names listed in Table 29 to be used. As a result, the only valid values of this field are the lengths of those names, including the null termination.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Repository Name Length field to the length of the repository name in the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name field.*

3.3.1.4.4.10 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Repository Name Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name dynamic field provides the name of the repository from which ITC-ATO Ex is requesting a set of valid ITC-ATO Ex/ITC-ATO SP configuration fileset versions.

Note: The current design concept only allows the repository names listed in Table 29 to be used.

a) *When ITC-ATO Ex generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATO Ex shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Repository Name dynamic field to the repository name from which ITC-ATO Ex/ITC-ATO SP configuration fileset versions are being requested.*

3.3.1.4.5. ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Field Use Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message body are given in this section.

3.3.1.4.5.1 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message IRS Version Number Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message IRS Version Number Field provides ITC-ATOSS BO with the IRS version currently implemented by ITC-ATO Ex. This information is not sent in every message; ITC-ATOSS BO must retain the IRS version number for the duration of the session.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATOSS BO shall use the IRS version given by the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message IRS Version Number Field for communication with the specific ITC-ATO Ex sending the message until that specific ITC-ATO provides a different IRS version number.*

3.3.1.4.5.2 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Railroad SCAC Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Railroad SCAC field contains the SCAC of the ITC-ATOSS BO from which the configuration version list is being requested. If it does not match the SCAC of the receiving ITC-ATOSS BO, the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message should be discarded.

a) *If ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message in which the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Railroad SCAC field does not match the SCAC of the receiving ITC-ATOSS BO, ITC-ATOSS BO shall discard the message.*

3.3.1.4.5.3 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Lead Locomotive ID Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Lead Locomotive ID field provides ITC-ATOSS BO with the ID of the lead locomotive of the train where the ITC-ATO Ex is installed.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Lead Locomotive ID field to identify the lead locomotive of the train where the sending ITC-ATO Ex is installed.*

3.3.1.4.5.4 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO Ex Vendor Name Length Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name Length field is provided to assist ITC-ATOSS BO in correctly interpreting the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message by providing the length of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name Length field at the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field.*

3.3.1.4.5.5 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO Ex Vendor Name Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field provides the ITC-ATO Ex vendor name. It is used by ITC-ATOSS BO to help

provide the correct information in the resulting ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO Ex Vendor Name field to identify the vendor of the sending ITC-ATO Ex.*

3.3.1.4.5.6 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO SP Vendor Name Length, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name Length field assists ITC-ATOSS BO in correctly interpreting the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message by providing the length of the following ITC-ATO Ex / ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name field.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name Length field as the length of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ATO SP Vendor Name field.*

3.3.1.4.5.7 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message ITC-ATO SP Vendor Name, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name field provides the ITC-ATO SP vendor name so that ITC-ATOSS BO can send the correct information in the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message ITC-ATO SP Vendor Name field to identify the vendor of the ITC-ATO SP connected to the sending ITC-ATO Ex.*

3.3.1.4.5.8 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Repository Record Counter Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Record Counter field is used by ITC-ATOSS BO to correctly unpack the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message by providing the number of number of times the ITC-ATO Ex/ITC-ATO SP Repository record loop is repeated.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Requests (Q103) message, ITC-ATOSS BO shall use the value contained in the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Record Counter field as the number of repositories included in the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message.*

b) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall extract the number of ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository records indicated by the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Record Counter field.*

3.3.1.4.5.9 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Repository Name Length Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name Length dynamic field helps ITC-ATOSS BO interpret the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message by providing ITC-ATOSS BO with the length of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name Dynamic field.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall use the value contained in each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name Length dynamic field as the length, in bytes, of the following instance of the ITC-ATO Ex/ITC-ATOP SP Configuration Version List Request (Q103) message Repository Name dynamic field.*

3.3.1.4.5.10 ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) Message Repository Name Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name Dynamic field provides the repository name of the corresponding repository.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message, ITC-ATOSS BO shall use each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message Repository Name dynamic field as the name of the corresponding repository.*

3.3.1.5 ITC-ATO Ex System State Report (Q110) Message, Version 1

ITC-ATO Ex sends the ITC-ATO Ex System State Report (Q110) message to the ITC-ATOSS BO of each operating railroad to report changes in ITC-ATO Ex state and errors related to state transitions.

3.3.1.5.1. ITC-ATO Ex System State Report (Q110) EMP Header Parameters

Message-specific EMP header values for the ITC-ATO Ex System State Report (Q110) message are specified in Table 31.

Table 31: ITC-ATO Ex System State Report (Q110) EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type		2	uint	Q110
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q110-1
QoS	Class	3 bits	uint	TBC-IRS-Q110-2
	Priority	3 bits	uint	TBC-IRS-Q110-3
	Network Preference	3 bits	uint	TBC-IRS-Q110-4
	Special Handling	4 bits	uint	TBC-IRS-Q110-5
	Service Request	3 bits	uint	TBC-IRS-Q110-6

3.3.1.5.1.1 ITC-ATO Ex System State Report (Q110) EMP Header Data Length Field

The EMP header data length field for an ITC-ATO Ex System State Report (Q110) message contains the length, in bytes of the message body.

In order to calculate the value stored in the EMP data length field, the size of the ITC-ATO Ex System State Report (Q110) message body must be calculated dynamically at run time. This size is the sum of:

- 23 bytes for field IDs 1-8.
- The value of field 8 for the variable-length field 9.
- 4 bytes for field ID 10.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.5.1.2 ITC-ATO Ex System State Report (Q110) EMP Header Number Field

The ITC-ATO Ex System State Report (Q110) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.5.2. ITC-ATO Ex System State Report (Q110) Message Body

A summary of the ITC-ATO Ex System State Report (Q110) message body is given in Table 32. Detailed descriptions and requirements follow.

Table 32: ITC-ATO Ex System State Report (Q110) Message Body

ID	Field	Size, bytes	Data Type	Description
1	IRS Version	1	uint	Interface version number given in Section 1.1.1 of this IRS
2	Railroad SCAC	4	SCAC	SCAC of the BOS to which this message is sent
3	Reason for Sending	1	enum	Event that triggered this message. See Table 34.
4	Previous ITC-ATO Ex State	1	uint	ITC-ATO Ex state prior to sending this message. See Table 35.
5	Current ITC-ATO Ex State	1	uint	ITC-ATO Ex state when message was generated. See Table 36.
6	Lead Locomotive ID	10	U	Locomotive ID of the lead locomotive.
7	Train ID SCAC	4	SCAC	SCAC of the railroad of which assigned the Train ID
8	Train ID Length	1	uint	Train ID length
9	Train ID	varies	string	Train identification number
10	Coordination Number	4	uint	ATO Ex-assigned coordination number for use in the resulting ITC-ATO Ex System State Report ACK (Q010) message

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 33. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 33: ITC-ATO Ex System State Report (Q110) Message Field Ranges

ID	Field	Range
2	Railroad SCAC	Capital letters, left-justified, space filled Must contain at least two letters
3	Reason for sending	1 to 12 (Valid enumeration values)
4	Previous ITC-ATO Ex State	0 to 17 (Valid enumeration values)
5	Current ITC-ATO Ex State	0 to 17 (Valid enumeration values)
7	Train ID SCAC	Capital letters, left-justified, space filled Must contain at least two letters
8	Train ID Length	0 to 30
9	Train ID	May only contain letters, numbers, spaces, and the null termination.

3.3.1.5.3. ITC-ATO Ex System State Report (Q110) Message Field Generation, Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in an ITC-ATO Ex System State Report (Q110) message body are given in this section.

3.3.1.5.3.1 ITC-ATO Ex System State Report (Q110) Message IRS Version Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message IRS Version Number field contains the interface version number of the IRS currently implemented by ITC-ATO Ex. The interface version number for this IRS is defined in Section 1.1.

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message ITC-ATO Ex shall populate the ITC-ATO Ex System State Report (Q110) message IRS Version field with the interface version number of the ITC-ATO Ex-to-ITC-ATOSS BO IRS currently implemented by ITC-ATO Ex.*

3.3.1.5.3.2 ITC-ATO Ex System State Report (Q110) Message Railroad SCAC Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Railroad SCAC field provides the railroad SCAC of the ITC-ATOSS BO to which this message is sent.

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message, ITC-ATO Ex shall set the ITC-ATO Ex System State Report (Q110) message Railroad SCAC field to the SCAC of the ITC-ATOSS BO to which ITC-ATO Ex is sending the ITC-ATO Ex System State Report (Q110) message.*

3.3.1.5.3.3 ITC-ATO Ex System State Report (Q110) Reason for Sending Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Reason for Sending field indicates what event caused the ITC-ATO Ex System State Report (Q110) message to be sent to the back office. Enumeration values are given in Table 34.

Table 34: ITC-ATO Ex System State Report (Q110) Message Reason for Sending Field Enumeration Values

Value	Reason for Sending
0	Reserved
1	Cab switch unarmed while train is moving
2	Step switch provided an unarmed indication while train is moving
3	Change to selected mode switch position
4	Tran movement detected in a non-permissive state
5	Condition requiring train stop has been resolved
6	Onboard integrity verification failure
7	Exception condition exists requiring train to stop or remain stopped
8	ITC-EMS transition to Attended Engaging
9	ITC-PTC OB disengage soft-key selection
10	Current operating railroad ITC-ATOSS BO reporting “shadow” indication
11	Current operating railroad ITC-ATOSS BO not reporting “shadow” indication

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message, ITC-ATO Ex shall populate the ITC-ATO Ex System State Report (Q110) message Reason for Sending field with the reason the message was sent using the enumeration values given in Table 34.*

3.3.1.5.3.4 ITC-ATO Ex System State Report (Q110) Message Previous ITC-ATO Ex State Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Previous ITC-ATO Ex State field contains the previous operating state of ITC-ATO Ex. If the ITC-ATO Ex System State Report (Q110) message was triggered by an event that caused a change in ITC-ATO Ex state, or by an ITC-ATO Ex state change, this is the state of ITC-ATO Ex immediately prior to the ITC-ATO Ex state change. If the ITC-ATO Ex System State Report (Q110) message was not triggered by an event that caused a change in ITC-ATO Ex state, or by an ITC-ATO Ex state change, this state is the state of ITC-ATO Ex at the time the message was triggered and will be the same as the ITC-ATO Ex System State Report (Q110) message Current ITC-ATO Ex State field. Enumeration values for populating the Previous ITC-ATO Ex State field are given in Table 35.

Table 35: ITC-ATO Ex System State Report (Q110) Message Previous ITC-ATO Ex State Field Enumeration Values

Value	Previous ITC-ATO Ex State
0	Power Up
1	Failed
2	ITC-ATO Ex Non-Init
3	ITC-ATO Ex Initialization
4	Pre-Arm Setup
5	Unarmed Configured
6	Armed Automated Standby
7	Automated Active
8	Automated Exception
9	Attended Active
10	Attended Exception
11	Manual Control
12	Manual Setup
13	Attended Setup
14	Attended Ready
15	ITM
16	Shadow
17	ATO Suspend

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message, ITC-ATO Ex shall set the ITC-ATO Ex System State Report (Q110) message Previous ITC-ATO Ex State field to the previous ITC-ATO Ex state use the enumeration values given in Table 35.*

3.3.1.5.3.5 ITC-ATO Ex System State Report (Q110) Message Current ITC-ATO Ex State Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Current ITC-ATO Ex State field contains the current operating state of ITC-ATO Ex. If the ITC-ATO Ex System State Report (Q110) message was triggered by an event that caused a change in ITC-ATO Ex state, or by an ITC-ATO Ex state change,

this is the state of ITC-ATO Ex immediately after the ITC-ATO Ex state change. If the ITC-ATO Ex System State Report (Q110) message was not triggered by an event that caused a change in ITC-ATO Ex state, or by an ITC-ATO Ex state change, this state is the state of ITC-ATO Ex at the time the message was triggered and will be the same as the ITC-ATO Ex System State Report (Q110) message Previous ITC-ATO Ex State field. Enumeration values for populating the Current ITC-ATO Ex State field are given in Table 36.

Table 36: ITC-ATO Ex System State Report (Q110) Message Current ITC-ATO Ex State Field Enumeration Values

Value	Current ITC-ATO Ex State
0	Power Up
1	Failed
2	ITC-ATO Ex Non-Init
3	ITC-ATO Ex Initialization
4	Pre-Arm Setup
5	Unarmed Configured
6	Armed Automated Standby
7	Automated Active
8	Automated Exception
9	Attended Active
10	Attended Exception
11	Manual Control
12	Manual Setup
13	Attended Setup
14	Attended Ready
15	ITM
16	Shadow
17	ATO Suspend

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message, ITC-ATO Ex shall set the ITC-ATO Ex System State Report (Q110) message Current ITC-ATO Ex State field to the current operating state of ITC-ATO Ex use the enumeration values given in Table 36.*

3.3.1.5.3.6 ITC-ATO Ex System State Report (Q110) Message Lead Locomotive ID Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Lead Locomotive ID field is populated with the ID of the lead locomotive of the train reporting the exception. This is a string containing locomotive unit data as described in Section 1.6.2. The ID of the lead locomotive is provided by ITC-ATO Ex's internal configuration dataset.

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report message, ITC-ATO Ex shall populate the ITC-ATO Ex System State Report (Q110) message Lead Locomotive ID field with the ID of the lead locomotive of the train reporting the exception.*

3.3.1.5.3.7 ITC-ATO Ex System State Report (Q110) Message Train ID SCAC Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Train ID SCAC field contains the SCAC of the railroad that assigned the train ID given in the ITC-ATO Ex System State Report (Q110) message Train ID field. If the train ID is not available this is the SCAC of the ITC-ATOSS BO to which the ITC-ATO Ex System State Report (Q110) message is being sent.

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message, ITC-ATO Ex shall populate the ITC-ATO Ex System State Report (Q110) message Train ID SCAC field with the SCAC of the railroad that assigned the train ID.*

3.3.1.5.3.8 ITC-ATO Ex System State Report (Q110) Message Train ID Length Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Train ID Length field contains the length, in bytes, of the train's identification number, which is stored in the ITC-ATO Ex System State Report (Q110) message Train ID field. If the ITC-ATO Ex System State Report (Q110) message is sent before a train ID has been assigned the ITC-ATO Ex System State Report (Q110) message Train ID Length field will be set to 0 and the ITC-ATO Ex System State Report (Q110) message Train ID field will not be present.

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message, ITC-ATO Ex shall set the ITC-ATO Ex System State Report (Q110) Train ID Length field to the length of the train's ID.*

3.3.1.5.3.9 ITC-ATO Ex System State Report (Q110) Message Train ID Field, Generation Requirements

The ITC-ATO Ex System State Report (Q110) message Train ID field provides the train's identification number as assigned by the railroad to which the ITC-ATO Ex System State Report (Q110) message is sent. The train's identification number is a variable number of alpha-numeric characters containing a railroad-assigned identifier. This string does not include a null termination.

a) *When ITC-ATO Ex generates an ITC-ATO Ex System State Report (Q110) message, ITC-ATO Ex shall set the ITC-ATO Ex System State Report (Q110) message Train ID field to the train identification number assigned by to the train by the railroad to which the message is being sent.*

3.3.1.5.4. ITC-ATO Ex System State Report (Q110) Message Field Use Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in an ITC-ATO Ex System State Report (Q110) message body are given in this section.

3.3.1.5.4.1 ITC-ATO Ex System State Report (Q110) Message IRS Version Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message IRS Version field provides ITC-ATOSS BO with the IRS version currently implemented by ITC-ATO Ex.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall use the IRS version given by the ITC-ATO Ex System State Report (Q110)*

message IRS Version field as the interface version implemented by the specific ITC-ATO Ex sending the message.

3.3.1.5.4.2 ITC-ATO Ex System State Report (Q110) Message Railroad SCAC Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Railroad SCAC field contains the SCAC of the ITC-ATOSS BO to which ITC-ATO Ex is sending the ITC-ATO Ex System State Report (Q110) message.

a) *If ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message in which the ITC-ATO Ex System State Report (Q110) message Railroad SCAC field does not match ITC-ATOSS BO's SCAC, ITC-ATOSS BO shall discard the message.*

3.3.1.5.4.3 ITC-ATO Ex System State Report (Q110) Reason for Sending Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Reason for Sending field is used to provide ITC-ATOSS BO with the reason the ITC-ATO Ex System State Report (Q110) message was sent.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall, using the enumeration values in Table 34, use the ITC-ATO Ex System State Report (Q110) message Reason for Sending field to identify the reason that the ITC-ATO Ex System State Report (Q110) message was sent.*

3.3.1.5.4.4 ITC-ATO Ex System State Report (Q110) Message Previous ITC-ATO Ex State Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Previous ITC-ATO Ex State field is used to provide ITC-ATOSS BO with the ITC-ATO Ex operating state that prior to the event that triggered the ITC-ATO Ex System State Report (Q110) message.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall use the ITC-ATO Ex System State Report (Q110) message Previous ITC-ATO Ex State field as the operating state of the sending ITC-ATO Ex immediately prior to the generation of the ITC-ATO Ex System State Report (Q110) message.*

3.3.1.5.4.5 ITC-ATO Ex System State Report (Q110) Message Current ITC-ATO Ex State Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Current ITC-ATO Ex State is used to provide ITC-ATOSS BO with the current ITC-ATO Ex operating state.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall use the ITC-ATO Ex System State Report (Q110) message Current ITC-ATO Ex State as the operating state of the sending ITC-ATO Ex as of the time the ITC-ATO Ex System State Report (Q110) message was generated.*

3.3.1.5.4.6 ITC-ATO Ex System State Report (Q110) Message Lead Locomotive ID Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Lead Locomotive ID field provides the locomotive ID of the lead locomotive.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall use the ITC-ATO Ex System State Report (Q110) message Lead Locomotive ID field as the ID of the lead locomotive on the train on which the sending ITC-ATO Ex is installed.*

3.3.1.5.4.7 ITC-ATO Ex System State Report (Q110) Message Train ID SCAC Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Train ID SCAC field provides the SCAC of the RR that issued the train ID. If the train ID is not available this is the SCAC of the ITC-ATOSS BO to which the Exception Report (Q111) message was sent.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall use the ITC-ATO Ex System State Report (Q110) message Train ID SCAC field as the SCAC of the associated train ID.*

3.3.1.5.4.8 ITC-ATO Ex System State Report (Q110) Message Train ID Length Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Train ID Length field helps ITC-ATOSS BO interpret the ITC-ATO Ex System State Report (Q110) message by providing ITC-ATOSS BO with the length of the following ITC-ATO Ex System State Report (Q110) message Train ID field.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall use the value contained in the ITC-ATO Ex System State Report (Q110) message Train ID Length field as the length, in bytes, of the following ITC-ATO Ex System State Report (Q110) message Train ID field.*

3.3.1.5.4.9 ITC-ATO Ex System State Report (Q110) Message Train ID Field, Use Requirements

The ITC-ATO Ex System State Report (Q110) message Train ID field provides the train ID of the of the train sending the ITC-ATO Ex System State Report (Q110) message. This is the train ID assigned by the RR receiving the ITC-ATO Ex System State Report (Q110) message and may differ from train IDs assigned to the same train by different RRs.

a) *When ITC-ATOSS BO receives an ITC-ATO Ex System State Report (Q110) message ITC-ATOSS BO shall use the ITC-ATO Ex System State Report (Q110) message Train ID field as the train ID of the corresponding train.*

3.3.1.6 Exception Report (Q111) Message, Version 1

ITC-ATO Ex sends the Exception Report (Q111) message to the ITC-ATOSS BO to inform the back office of an exception condition and provide details.

3.3.1.6.1. Exception Report (Q111) EMP Header Parameters

Message-specific EMP header values for the ITC-ATO Ex Exception Report (Q111) message are specified in Table 37.

Table 37: Exception Report (Q111) EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type		2	uint	Q111
Message Version		1	uint	1
110	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q111-1
QoS	Class	3 bits	uint	TBC-IRS-Q111-2
	Priority	3 bits	uint	TBC-IRS-Q111-3
	Network Preference	3 bits	uint	TBC-IRS-Q111-4
	Special Handling	4 bits	uint	TBC-IRS-Q111-5
	Service Request	3 bits	uint	TBC-IRS-Q111-6

3.3.1.6.1.1 Exception Report (Q111) EMP Header Data Length Field

The Exception Report (Q111) message contains several variable-length fields and so the size of the message body must be calculated at run time. The size of an Exception Report (Q111) message body is the sum of:

- 16 bytes for fields 1-6.
- The value of field 6 for the size of field 7
- 15 bytes for fields 8-10
- The value of field 10 for the size of field 11
- 1 byte for field 12
- The value of field 12 for the size of field 13
- 1 byte for field 14
- The value of field 14 for the size of field 15
- 11 bytes for fields 16-19
- The value of field 19 for the size of field 20
- 1 byte for field 21
- The value of field 21 for the size of field 22
- 1 byte for field 23
- The value of field 23 for the size of field 24
- 11 bytes for fields 25-28

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.6.1.2 Exception Report (Q111) EMP Header Number Field

The Exception Report (Q111) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.6.2. Exception Report (Q111) Message Body

A summary of the Exception Report (Q111) message body is given in Table 38. Detailed descriptions and requirements follow.

Table 38: System State Report (Q111) Message Body

ID	Field	Size, (bytes)	Data Type	Description
1	Condition ID	4	uint	The unique ID used for tracking a reported condition from the MCD
2	Condition Code	2	enum	The type of condition being reported
3	Time of Exception Code	4	uint	Timestamp at which an exception was initially detected or when its characteristics were last updated.
4	Severity	1	enum	The severity of the reported condition.
5	Train ID SCAC	4	SCAC	SCAC of the railroad of which assigned the Train ID
6	Train ID Length	1	uint	Train ID length
7	Train ID	varies	string	The Train ID for each operating railroad on the train's intended route.
8	Lead Locomotive ID	10	U	Locomotive ID of the lead locomotive.
9	Head End Milepost	4	MP	Multiply by 0.0001 to convert from stored value to milepost number.
10	Head End Milepost Prefix Length	1	uint	Head end milepost prefix length up to five characters
11	Head End Milepost Prefix	varies	string	Head end milepost prefix
12	Head End Milepost Suffix Length	1	uint	Head end milepost suffix length up to five characters
13	Head End Milepost Suffix	varies	string	Head end milepost suffix
14	Head End Track Name Length	1	uint	Head end track name length up to 32 characters
15	Head End Track Name	varies	string	Head end track name
16	Head End Railroad SCAC	4	string	Railroad SCAC of the railroad that operates the head end subdivision/district, left justified, space filled.
17	Head End PTC Subdivision/District ID	2	uint	Current PTC subdivision/district ID for the lead-end ranging between 0 and 9999 inclusively.
18	Rear End Milepost	4	MP	Multiply by 0.0001 to convert from stored value to milepost number.
19	Rear End Milepost Prefix Length	1	uint	Rear end milepost prefix length up to five characters
20	Rear End Milepost Prefix	varies	string	Rear end milepost prefix
21	Rear End Milepost Suffix Length	1	uint	Rear end milepost suffix length up to five characters
22	Rear End Milepost Suffix	varies	string	Rear end milepost suffix
23	Rear End Track Name Length	1	uint	Rear end track name length up to 32 characters
24	Rear End Track Name	varies	string	Rear end track name

ID	Field	Size, (bytes)	Data Type	Description
25	Rear End Railroad SCAC	4	string	Railroad SCAC of the railroad that operates the rear end subdivision/district, left justified, space filled.
26	Rear End PTC Subdivision/District ID	2	uint	Current PTC subdivision/district ID for the rear-end ranging between 0 and 9999 inclusively.
27	Direction of Travel	1	enum	HOT direction of travel at time of exception
28	Coordination Number	4	uint	Coordination number for use in Exception Report ACK (Q011) message.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 39. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 39: Exception Report (Q111) Message Field Ranges

ID	Field	Range
1	Condition ID	0x00000010 to 0xFFFFFFFF
5	Train ID SCAC	Capital letters, left-justified, space filled Must contain at least two letters
6	Train ID Length	0 to 30
10	Head End Milepost Prefix Length	0 to 5
12	Head End Milepost Suffix Length	0 to 5
14	Head End Track Name Length	1 to 32
16	Head End SCAC	Capital letters, left-justified, space filled Must contain at least two letters
17	Head End PTC Subdivision/District ID	0 to 9999
19	Rear End Milepost Prefix Length	0 to 5
21	Rear End Milepost Suffix Length	0 to 5
23	Rear End Track Name Length	1 to 32
25	Rear End SCAC	Capital letters, left-justified, space filled Must contain at least two letters
26	Rear End PTC Subdivision/District ID	0 to 9999
27	Direction of Travel	0 to 1 (Valid enumeration values)

3.3.1.6.3. Exception Report (Q111) Message Reliable Messaging Properties

The Exception Report (Q111) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 40.

Table 40: Exception Report (Q111) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Exception Report ACK (Q011)
Number of Retries	TBC-IRS-Q111-7
Retry Interval	TBC-IRS-Q111-8

3.3.1.6.4. Exception Report (Q111) Message Field Generation, Requirements

Requirements placed on ITC-ATO Ex regarding populating the fields in an Exception Report (Q111) message body are given in this section.

3.3.1.6.4.1 Exception Report (Q111) Message Condition ID Field, Generation Requirements

The Exception Report (Q111) message Condition ID contains the exception condition ID of the exception being reported. The exception condition ID is a unique 32-bit unsigned integer which is assigned upon the detection of a new condition as described in the ITC-ATO Ex Subsystem requirements. Values 0 to 15 are reserved and may not be used as exception condition IDs.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Condition ID field with the exception condition ID of the exception being reported.*

3.3.1.6.4.2 Exception Report (Q111) Message Condition Code Field, Generation Requirements

The Exception Report (Q111) message Condition Code field indicates the type of condition being reported. The possible condition codes are defined in the ITC-ATO Ex Subsystem requirements.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Condition Code field with the condition code for the reported condition.*

3.3.1.6.4.3 Exception Report (Q111) Message Time of Exception Code Field, Generation Requirements

The Exception Report (Q111) message Time of Exception Code field contains UTC timestamp indicating the time at which the reported condition was created or last updated. The time stamp is provided in the form of seconds since January 1, 1970. Like POSIX time stamps, the timestamp assumes a day length of exactly 86,400 seconds. Leap seconds are ignored, with a leap second having the same time as the second before it. Unlike POSIX time stamps, this time stamp is an unsigned integer. It cannot represent times prior to January 1, 1970, and can represent times after the year 2038.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Time of Exception Code field with a value indicating the time at which the reported condition was created or last updated, encoded as the number of seconds passed since January 1st, 1970.*

3.3.1.6.4.4 Exception Report (Q111) Message Severity Field, Generation Requirements

The Exception Report (Q111) message Severity field contains the severity of the exception reported in the Exception Report (Q111) message. The severity of exceptions is defined in the ATO Ex Subsystem Requirements.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, the ITC-ATO Ex shall populate the Exception Report (Q111) message Severity field with severity of the condition being reported.*

3.3.1.6.4.5 Exception Report (Q111) Message Train ID SCAC Field, Generation Requirements

The Exception Report (Q111) message Train ID SCAC field contains the SCAC of the railroad that assigned the train given in the Exception Report (Q111) message Train ID field. If the train ID is not available this is the SCAC of the ITC-ATOSS BO to which the Exception Report (Q111) message is being sent.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Train ID SCAC field with the SCAC of the railroad that assigned the train ID.*

3.3.1.6.4.6 Exception Report (Q111) Message Train ID Length Field, Generation Requirements

The Exception Report (Q111) message Train ID Length field contains the length, in bytes, of the following Exception Report (Q111) message Train ID field.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Train ID Length field with the length, in bytes, of the Exception Report (Q111) message Train ID field.*

3.3.1.6.4.7 Exception Report (Q111) Message Train ID Field, Generation Requirements

The Exception Report (Q111) message Train ID is a variable-length alphanumeric value assigned by the operating railroad per RR operating practices. The format of this identifier is not standardized across railroads. This string does not include a null termination.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Train ID field with the train ID assigned by the operating railroad.*

3.3.1.6.4.8 Exception Report (Q111) Message Lead Locomotive ID Field, Generation Requirements

The Exception Report (Q111) message Locomotive ID field is populated with is populated with the ID of the lead locomotive of the train reporting the exception. This is a string containing locomotive unit data as described in Section 1.6.2. The Exception Report (Q111) message Locomotive ID field is provided by ITC-ATO Ex's internal configuration dataset.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Locomotive ID field with the ID of the lead locomotive as provided by the internal ITC-ATO Ex configuration dataset.*

3.3.1.6.4.9 Exception Report (Q111) Message Head End Milepost Field, Generation Requirements

The Exception Report (Q111) message Head End Milepost field is populated with the location of the HOT at the time the exception occurred. The HOT location is provided as an MP data type which, when multiplied by 0.0001, represents the milepost location of the head end of the train, accurate to 1/1000 of a mile.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Milepost field with the location of the HOT.*

3.3.1.6.4.10 Exception Report (Q111) Message Head End Milepost Prefix Length Field, Generation Requirements

The Exception Report (Q111) message Head End Milepost Prefix Length field is populated with the length of the Exception Report (Q111) message Head End Milepost Prefix field. If the track segment does not have a prefix the Exception Report (Q111) message Head End Milepost Prefix Length field will be 0 and no Exception Report (Q111) message Head End Milepost Prefix field will be present.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Milepost Prefix Length field with the length of the Exception Report (Q111) message Head End Milepost Prefix field.*

3.3.1.6.4.11 Exception Report (Q111) Message Head End Milepost Prefix Field, Generation Requirements

The Exception Report (Q111) message Head End Milepost Prefix field is populated with a string containing the milepost prefix of the track segment on which the HOT is located. The Exception Report (Q111) message Head End Milepost Prefix field is not null terminated and cannot exceed five characters in length.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Milepost Prefix field with an ASCII string containing only the Head End Milepost Prefix.*

b) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall not populate the Exception Report (Q111) message Head End Milepost Prefix field with more than five characters.*

3.3.1.6.4.12 Exception Report (Q111) Message Head End Milepost Suffix Length Field, Generation Requirements

The Exception Report (Q111) message Head End Milepost Suffix Length field is populated with the length of the Exception Report (Q111) message Head End Milepost Suffix field. If the track segment does not have a suffix the Exception Report (Q111) message Head End Milepost Suffix Length field will be 0 and no Exception Report (Q111) message Head End Milepost Suffix field will be present.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Milepost Suffix Length field with the length of the Exception Report (Q111) message Head End Milepost Suffix field.*

3.3.1.6.4.13 Exception Report (Q111) Message Head End Milepost Suffix Field, Generation Requirements

The Exception Report (Q111) message Head End Milepost Suffix field is populated with a string containing the suffix of the track segment on which the HOT is located. The Exception Report (Q111) message Head End Milepost Suffix field is not null terminated and cannot exceed five characters in length.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Milepost Suffix field with an ASCII string containing only the HOT Milepost Suffix.*

b) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall not populate the Exception Report (Q111) message Head End Milepost Suffix field with more than five characters.*

3.3.1.6.4.14 Exception Report (Q111) Message Head End Track Name Length Field, Generation Requirements

The Exception Report (Q111) message Head End Track Name Length field is populated with the length of the Exception Report (Q111) Head End Track Name field.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Track Name Length field with the length of the Exception Report (Q111) message Head End Track Name field.*

3.3.1.6.4.15 Exception Report (Q111) Message Head End Track Name Field, Generation Requirements

The Exception Report (Q111) message Head End Track Name field is populated with a string containing the name of the track where the HOT was located at the time the exception occurred. The Exception Report (Q111) message Head End Track Name field is not null terminated and cannot exceed 32 characters in length.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Track Name field with the name of the track where the HOT was located at the time the exception occurred.*

b) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall not populate the Exception Report (Q111) message Head End Track Name field with more than 32 characters.*

3.3.1.6.4.16 Exception Report (Q111) Message Head End Railroad SCAC Field, Generation Requirements

The Exception Report (Q111) message Head End Railroad SCAC field is populated with a SCAC data type that contains the Operating Railroad's SCAC where the HOT was located.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End Railroad SCAC field with the SCAC of the track where the HOT was located at the time the exception occurred.*

3.3.1.6.4.17 Exception Report (Q111) Message Head End PTC Subdivision/District ID Field, Generation Requirements

The Exception Report (Q111) message Head End PTC Subdivision/District ID field is populated with the PTC Subdivision/District ID of where the HOT was located.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Head End PTC Subdivision/District ID field with the PTC Subdivision/District ID of where the HOT was located at the time the exception occurred.*

3.3.1.6.4.18 Exception Report (Q111) Message Rear End Milepost Field, Generation Requirements

The Exception Report (Q111) message Rear End Milepost field is populated the location of the EOT at the time the exception occurred. The EOT location is provided as an MP data type that, when multiplied by 0.0001, represents the milepost location of the rear end of the train, accurate to 1/1000 of a mile.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Milepost field with the location of the EOT at the time the exception occurred.*

3.3.1.6.4.19 Exception Report (Q111) Message Rear End Milepost Prefix Length Field, Generation Requirements

The Exception Report (Q111) message Rear End Milepost Prefix Length field is populated with the length of the Exception Report (Q111) message Rear End Milepost Prefix field. If the track segment does not have a prefix the Exception Report (Q111) message Rear End Milepost Prefix Length field will be 0 and no Exception Report (Q111) message Rear End Milepost Prefix field will be present.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Milepost Prefix Length field with the length of the Exception Report (Q111) message Rear End Milepost Prefix field.*

3.3.1.6.4.20 Exception Report (Q111) Message Rear End Milepost Prefix Field, Generation Requirements

The Exception Report (Q111) message Rear End Milepost Prefix field is populated with a string containing the milepost prefix of the track segment on which the EOT was located at the time of the exception. The Exception Report (Q111) message Rear End Milepost Prefix field cannot exceed five characters in length.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Milepost Prefix field with an ASCII string containing only the Rear End Milepost Prefix.*

b) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall not populate the Exception Report (Q111) message Rear End Milepost Prefix field with more than five characters.*

3.3.1.6.4.21 Exception Report (Q111) Message Rear End Milepost Suffix Length Field, Generation Requirements

The Exception Report (Q111) message Rear End Milepost Suffix Length field is populated with the length of the Exception Report (Q111) message Rear End Milepost Suffix field. If the track segment

does not have a suffix the Exception Report (Q111) message Rear End Milepost Suffix Length field will be 0 and no Exception Report (Q111) message Rear End Milepost Suffix field will be present.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Milepost Suffix Length field with the length of the Exception Report (Q111) message Rear End Milepost Suffix field.*

3.3.1.6.4.22 Exception Report (Q111) Message Rear End Milepost Suffix Field, Generation Requirements

The Exception Report (Q111) message Rear End Milepost Suffix field is populated with a string containing the suffix of the track segment on which the EOT was located. The Exception Report (Q111) message Rear End Milepost Suffix field cannot exceed five characters.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Milepost Suffix field with an ASCII string containing only the EOT Milepost Suffix.*

b) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall not populate the Exception Report (Q111) message Rear End Milepost Suffix field with more than five characters.*

3.3.1.6.4.23 Exception Report (Q111) Message Rear End Track Name Length Field, Generation Requirements

The Exception Report (Q111) message Rear End Track Name Length field is populated with the length of the Exception Report (Q111) Rear End Track Name field.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Track Name Length field with the length of the Exception Report (Q111) message Rear End Track Name field.*

3.3.1.6.4.24 Exception Report (Q111) Message Rear End Track Name Field, Generation Requirements

The Exception Report (Q111) message Rear End Track Name field is populated with a string containing the name of the track where the EOT was located at the time the exception occurred.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Track Name field with the name of the track where the EOT was located at the time the exception occurred.*

3.3.1.6.4.25 Exception Report (Q111) Message Rear End Railroad SCAC Field, Generation Requirements

The Exception Report (Q111) message Rear End Track Name field is populated with a string containing the name of the track where the EOT was located. The Exception Report (Q111) message Rear End Track Name field is not null terminated and cannot exceed 32 characters in length.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End Track Name field with the name of the track where the EOT was located.*

b) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall not populate the Exception Report (Q111) message Rear End Track Name field with more than 32 characters.*

3.3.1.6.4.26 Exception Report (Q111) Message Rear End PTC Subdivision/District ID Field, Generation Requirements

The Exception Report (Q111) message Rear End PTC Subdivision/District ID field is populated with the PTC Subdivision/District ID of where the Rear End of the train was located when the exception occurred.

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Rear End PTC Subdivision/District ID field with the PTC Subdivision/District of where the EOT was located when the exception occurred.*

3.3.1.6.4.27 Exception Report (Q111) Message Direction of Travel Field, Generation Requirements

The Exception Report (Q111) message Direction of Travel field indicates the direction of travel of the HOT, as reported by ITC-PTC OB, at the time the Exception Report (Q111) message was generated. The Exception Report (Q111) Direction of Travel field enumeration values are given in Table 41.

Table 41: Exception Report (Q111) Message Direction of Travel Field Enumeration Values

Value	Direction of Travel
0	Train is Stopped
1	Increasing Milepost Direction
2	Decreasing Milepost Direction

a) *When ITC-ATO Ex generates an Exception Report (Q111) message, ITC-ATO Ex shall populate the Exception Report (Q111) message Direction of Travel field with the direction the HOT was moving as reported by the ITC-PTC OB at the time the Exception Report (Q111) message was generated using the enumeration values given in Table 41.*

3.3.1.6.4.28 Exception Report (Q111) Message Coordination Number Field, Generation Requirements

The Exception Report (Q111) message Coordination Number field is generated according to the numbering process described in Section 3.4.3.

3.3.1.6.5. Exception Report (Q111) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Exception Report (Q111) message fields are given in this section.

3.3.1.6.5.1 Exception Report (Q111) Message Condition ID Field, Use Requirements

The Exception Report (Q111) message Condition ID field is used by ITC-ATOSS BO to identify the specific condition that caused the Exception Report (Q111) message to be sent. The exception condition ID is a unique 32-bit unsigned integer which is assigned upon the detection of a new condition as described in the ITC-ATO Ex Subsystem requirements. Values 0 to 15 are reserved and may not be used as exception condition IDs.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Condition ID field to identify the specific condition that caused the Exception Report (Q111) message to be sent.*

3.3.1.6.5.2 Exception Report (Q111) Message Condition Code Field, Use Requirements

The Exception Report (Q111) message Condition Code field is used by ITC-ATOSS BO to identify the type of condition that is being reported by the Exception Report (Q111) message. The possible condition codes are defined in the ITC-ATO Ex Subsystem requirements.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Condition Code field to identify the type of condition that caused the Exception Report (Q111) message to be sent.*

3.3.1.6.5.3 Exception Report (Q111) Message Time of Exception Code Field, Use Requirements

The Exception Report (Q111) message Time of Exception Code field provides the ITC-ATOSS BO with the time that the condition was reported or last updated. The time stamp is provided in the form of seconds since January 1, 1970. Like POSIX time stamps, the timestamp assumes a day length of exactly 86,400 seconds. Leap seconds are ignored, with a leap second having the same time as the second before it. Unlike POSIX time stamps, this time stamp is an unsigned integer. It cannot represent times prior to January 1, 1970 and can represent times after the year 2038.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Time of Exception Code to identify when the condition was reported or last updated, encoded as the number of seconds passed since January 1, 1970.*

3.3.1.6.5.4 Exception Report (Q111) Message Severity Field, Use Requirements

The Exception Report (Q111) message Severity field provides ITC-ATOSS BO with the severity of the reported condition. The severity of exceptions is defined in the ATO Ex Subsystem Requirements.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Severity field to identify the severity of the reported condition.*

3.3.1.6.5.5 Exception Report (Q111) Message Train ID SCAC Field, Use Requirements

The Exception Report (Q111) message Train ID SCAC field provides ITC-ATOSS BO with the SCAC of the railroad that assigned the train given in the Exception Report (Q111) message Train ID field.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the SCAC contained in the Exception Report (Q111) message Train ID SCAC field as the SCAC of the following train ID.*

3.3.1.6.5.6 Exception Report (Q111) Message Train ID Length Field, Use Requirements

The Exception Report (Q111) message Train ID Length field helps ITC-ATOSS BO interpret the Exception Report (Q111) message by providing ITC-ATOSS BO with the length of the following Exception Report (Q111) message Train ID field. If the train ID is not available, the Exception Report (Q111) message Train ID Length field will be set to 0 and the Exception Report (Q111) message Train ID field will not be present.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the value contained in the Exception Report (Q111) message Train ID Length field as the length, in bytes, of the following Exception Report (Q111) message Train ID field.*

3.3.1.6.5.7 Exception Report (Q111) Message Train ID Field, Use Requirements

The Exception Report (Q111) message Train ID field provides ITC-ATOSS BO the train ID of the reporting train, as assigned by the RR receiving the Exception Report (Q111) message. If the train ID is not available, the Exception Report (Q111) message Train ID field will not be present.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Train ID field as the train ID of the reporting train.*

3.3.1.6.5.8 Exception Report (Q111) Message Lead Locomotive ID Field, Use Requirements

The Exception Report (Q111) message Locomotive ID field provides the locomotive ID of the lead locomotive of the reporting train. In the event that an ATO train is registered with the back office but does not yet have a train ID (e.g., during train initialization) this allows for positive identification of the ATO train being reported.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Lead Locomotive ID field as the locomotive ID of the lead locomotive of the reporting train.*

3.3.1.6.5.9 Exception Report (Q111) Message Head End Milepost Field, Use Requirements

The Exception Report (Q111) message Head End Milepost field provides the location of the HOT at the time the exception occurred. The HOT location is provided as an MP data type which, when multiplied by 0.0001, represents the milepost location of the head end of the reporting train, accurate to 1/1000 of a mile.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the value given in the Exception Report (Q111) message Head End Milepost field to calculate the location of the HOT at the time the exception occurred.*

3.3.1.6.5.10 Exception Report (Q111) Message Head End Milepost Prefix Length Field, Use Requirements

The Exception Report (Q111) message Head End Milepost Prefix Length field helps ITC-ATOSS BO interpret the Exception Report (Q111) message by providing ITC-ATOSS BO with the length of the following Exception Report (Q111) message Head End Milepost Prefix field. If there is no milepost prefix the Exception Report (Q111) message Head End Milepost Prefix Length field will be set to 0 and no Exception Report (Q111) message Head End Milepost Prefix field will be present.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the value contained in the Exception Report (Q111) message Head End Milepost Prefix Length field as the length, in bytes, of the following Exception Report (Q111) message Head End Milepost Prefix field.*

3.3.1.6.5.11 Exception Report (Q111) Message Head End Milepost Prefix Field, Use Requirements

The Exception Report (Q111) message Head End Milepost Prefix field provides ITC-ATOSS BO with the milepost prefix of the track segment on which the HOT is located. If there is no milepost prefix the Exception Report (Q111) message Head End Milepost Prefix field will not be present.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Head End Milepost Prefix field to identify the milepost prefix of the track segment on which the HOT was located at the time the exception occurred.*

3.3.1.6.5.12 Exception Report (Q111) Message Head End Milepost Suffix Length Field, Use Requirements

The Exception Report (Q111) message Head End Milepost Suffix Length field helps ITC-ATOSS BO interpret the Exception Report (Q111) message by providing ITC-ATOSS BO with the length of the following Exception Report (Q111) message Head End Milepost Suffix field. If there is no milepost suffix the Exception Report (Q111) message Head End Milepost Suffix Length field will be set to 0 and no Exception Report (Q111) message Head End Milepost Suffix field will be present.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the value contained in the Exception Report (Q111) message Head End Milepost Suffix Length field as the length, in bytes, of the following Exception Report (Q111) message Head End Milepost Suffix field.*

3.3.1.6.5.13 Exception Report (Q111) Message Head End Milepost Suffix Field, Use Requirements

The Exception Report (Q111) message Head End Milepost Suffix field provides ITC-ATOSS BO with the milepost suffix of the track segment on which the HOT is located.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Head End Milepost Suffix field to identify the milepost suffix of the track segment on which the HOT is located.*

3.3.1.6.5.14 Exception Report (Q111) Message Head End Track Name Length Field, Use Requirements

The Exception Report (Q111) message Head End Track Name Length field helps ITC-ATOSS BO interpret the Exception Report (Q111) message by providing ITC-ATOSS BO with the length of the following Exception Report (Q111) message Head End Track Name field.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) Head End Track Name Length field as the length, in bytes, of the following Exception Report (Q111) message Head End Track Name field.*

3.3.1.6.5.15 Exception Report (Q111) Message Head End Track Name Field, Use Requirements

The Exception Report (Q111) message Head End Track Name field provides ITC-ATOSS BO with the name of the track where the HOT was located at the time the exception occurred.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Head End Track Name field to identify the name of the track where the HOT was located at the time the exception occurred.*

3.3.1.6.5.16 Exception Report (Q111) Message Head End Railroad SCAC Field, Use Requirements

The Exception Report (Q111) message Head End Railroad field provides ITC-ATOSS BO with the SCAC of the track on which the HOT was located at the time the exception occurred.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, the ITC-ATOSS BO shall use the Exception Report (Q111) message Head End Railroad SCAC field as the SCAC of the operating railroad of the track on which the HOT was located at the time the exception occurred.*

3.3.1.6.5.17 Exception Report (Q111) Message Head End PTC Subdivision/District ID Field, Use Requirements

The Exception Report (Q111) message Head End PTC Subdivision/District ID field identifies the specific subdivision/district on which the HOT was located at the time the exception occurred.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, the ITC-ATOSS BO shall use the Exception Report (Q111) message Head End PTC Subdivision/District ID field to identify subdivision/district on which the HOT was located at the time the exception occurred.*

3.3.1.6.5.18 Exception Report (Q111) Message Rear End Milepost Field, Use Requirements

The Exception Report (Q111) message Rear End Milepost field provides the location of the EOT at the time the exception occurred. The EOT location is provided as an MP data type which, when multiplied by 0.0001, represents the milepost location of the head end of the reporting train, accurate to 1/1000 of a mile.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the value given in the Exception Report (Q111) message Rear End Milepost field to calculate the location of the EOT at the time the exception occurred.*

3.3.1.6.5.19 Exception Report (Q111) Message Rear End Milepost Prefix Length Field, Use Requirements

The Exception Report (Q111) message Rear End Milepost Prefix Length field helps ITC-ATOSS BO interpret the Exception Report (Q111) message by providing ITC-ATOSS BO with the length of the following Exception Report (Q111) message Rear End Milepost Prefix field. If there is no milepost prefix the Exception Report (Q111) message Rear End Milepost Prefix Length field will be set to 0 and no Exception Report (Q111) message Rear End Milepost Prefix field will be present.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the value contained in the Exception Report (Q111) message Rear End Milepost Prefix Length field as the length, in bytes, of the following Exception Report (Q111) message Rear End Milepost Prefix field.*

3.3.1.6.5.20 Exception Report (Q111) Message Rear End Milepost Prefix Field, Use Requirements

The Exception Report (Q111) message Rear End Milepost Prefix field provides ITC-ATOSS BO with the milepost prefix of the track segment on which the EOT is located.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Rear End Milepost Prefix field to identify the milepost prefix of the track segment on which the EOT is located.*

3.3.1.6.5.21 Exception Report (Q111) Message Rear End Milepost Suffix Length Field, Use Requirements

The Exception Report (Q111) message Rear End Milepost Suffix Length field helps ITC-ATOSS BO interpret the Exception Report (Q111) message by providing ITC-ATOSS BO with the length of the following Exception Report (Q111) message Rear End Milepost Suffix field. If there is no milepost suffix the Exception Report (Q111) message Rear End Milepost Suffix Length field will be set to 0 and no Exception Report (Q111) message Head End Milepost Suffix field will be present.

a) *When ITC-ATOSS BO receives an Exception Report (Q11) message, ITC-ATOSS BO shall use the value contained in the Exception Report (Q111) message Rear End Milepost Suffix Length field as the length, in bytes, of the following Exception Report (Q111) message Rear End Milepost Suffix field.*

3.3.1.6.5.22 Exception Report (Q111) Message Rear End Milepost Suffix Field, Use Requirements

The Exception Report (Q111) message Rear End Milepost Suffix field provides ITC-ATOSS BO with the milepost suffix of the track segment on which the EOT is located.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Rear End Milepost Suffix field to identify the milepost suffix of the track segment on which the EOT is located.*

3.3.1.6.5.23 Exception Report (Q111) Message Rear End Track Name Length Field, Use Requirements

The Exception Report (Q111) message Rear End Track Name Length field helps ITC-ATOSS BO interpret the Exception Report (Q111) message by providing ITC-ATOSS BO with the length, in bytes, of the following Exception Report (Q111) message Rear End Track Name field.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the value contained in the Exception Report (Q111) Rear End Track Name Length field as the length, in bytes, of the following Exception Report (Q111) message Rear End Track Name field.*

3.3.1.6.5.24 Exception Report (Q111) Message Rear End Track Name Field, Use Requirements

The Exception Report (Q111) message Rear End Track Name field provides ITC-ATOSS BO with the name of the track on which the EOT was located at the time the exception occurred.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, ITC-ATOSS BO shall use the Exception Report (Q111) message Rear End Track Name field to identify the name of the track on which the EOT was located at the time the exception occurred.*

3.3.1.6.5.25 Exception Report (Q111) Message Rear End Railroad SCAC Field, Use Requirements

The Exception Report (Q111) message Rear End Railroad field provides ITC-ATOSS BO with the SCAC of the operating railroad of the track on which the EOT was located at the time the exception occurred.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, the ITC-ATOSS BO shall use the Exception Report (Q111) message Rear End Railroad SCAC field to identify the SCAC of the operating railroad of the track on which the EOT was located at the time the exception occurred.*

3.3.1.6.5.26 Exception Report (Q111) Message Rear End PTC Subdivision/District ID Field, Use Requirements

The Exception Report (Q111) message Rear End PTC Subdivision/District ID field identifies the specific subdivision/district on which the EOT is located at the time the exception occurred.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, the ITC-ATOSS BO shall use the Exception Report (Q111) message Rear End PTC Subdivision/District ID field to identify subdivision/district on which the EOT is located at the time the exception occurred.*

3.3.1.6.5.27 Exception Report (Q111) Message Direction of Travel Field, Use Requirements

The Exception Report (Q111) message Direction of Travel field provides ITC-ATOSS BO with the direction of travel the HOT at the time the condition was reported.

a) *When ITC-ATOSS BO receives an Exception Report (Q111) message, the ITC-ATOSS BO shall, using the enumeration values in Table 41, use the Exception Report (Q111) message Direction of Travel field as the direction the HOT was traveling at the time the condition was reported.*

3.3.1.6.5.28 Exception Report (Q111) Message Coordination Number Field, Use Requirements

The Exception Report (Q111) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.1.7 Information Request ACK (Q114) Message, Version 1

ITC-ATO Ex sends the Information Request ACK (Q114) message to the ITC-ATOSS BO to notify ITC-ATOSS BO of the receipt of the Information Request (Q014) message.

3.3.1.7.1. Information Request ACK (Q114) EMP Header Parameters

Message-specific EMP header values for the Information Request ACK (Q111) message are specified in Table 42.

Table 42: Exception Report (Q111) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q114
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q114-1
QoS	Class	3 bits	uint	TBC-IRS-Q114-2
	Priority	3 bits	uint	TBC-IRS-Q114-3
	Network Preference	3 bits	uint	TBC-IRS-Q114-4
	Special Handling	4 bits	uint	TBC-IRS-Q114-5
	Service Request	3 bits	uint	TBC-IRS-Q114-6

3.3.1.7.1.1 Information Request ACK (Q114) EMP Header Data Length Field

The Information Request ACK (Q114) message only contains static fields, so the message body is always the same size of 5 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.7.1.2 Information Request ACK (Q114) EMP Header Number Field

The Information Request ACK (Q114) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.7.2. Information Request ACK (Q114) Message Body

A summary of the Information Request ACK (Q114) message body is given in Table 43. Detailed descriptions and requirements follow.

Table 43: Information Request ACK (Q114) Message Body

ID	Field	Size, bytes	Data Type	Description
1	ACK Status	1	enum	ACK Status. See Table 45.
2	Coordination Number	4	uint	Coordination number from Exception Report (Q111) message to which this message is a reply.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 44. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 44: Information Request ACK (Q114) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.7.3. Information Request ACK (Q114) Message Field Generation, Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in an Information Request ACK (Q114) message body are given in this section.

3.3.1.7.3.1 Information Request ACK (Q114) Message ACK Status Field, Generation Requirements

The Information Request ACK (Q114) Message ACK Status field indicates if the Information Request (Q114) message is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 45: Information Request ACK (Q114) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – Information Request (Q014) message successfully received
1	NACK – message discarded

3.3.1.7.3.2 Information Request ACK (Q114) Message Coordination Field, Generation Requirements

The Information Request ACK (Q114) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.7.4. Information Request ACK (Q114) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Information Request ACK (Q114) message fields are given in this section.

3.3.1.7.4.1 Information Request ACK (Q114) Message ACK Status Field, Use Requirements

The Information Request ACK (Q114) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.7.4.2 Information Request ACK (Q114) Message Coordination Field, Generation Requirements

The Information Request ACK (Q114) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.8 Information Retrieval (Q115) Message, Version 1

ITC-ATO Ex sends the Information Retrieval (Q115) message to the ITC-ATOSS BO to provide the information requested in an Information Request (Q014) message.

3.3.1.8.1. Information Retrieval (Q115) EMP Header Parameters

Message-specific EMP header values for the Information Retrieval (Q115) message are specified in Table 46.

Table 46: Information Retrieval (Q115) EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type		2	uint	Q115
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q115-1
QoS	Class	3 bits	uint	TBC-IRS-Q115-2
	Priority	3 bits	uint	TBC-IRS-Q115-3
	Network Preference	3 bits	uint	TBC-IRS-Q115-4
	Special Handling	4 bits	uint	TBC-IRS-Q115-5
	Service Request	3 bits	uint	TBC-IRS-Q115-6

3.3.1.8.1.1 Information Retrieval (Q115) EMP Header Data Length Field

The Information Retrieval (Q115) message EMP Header Data Length field contains the length, in bytes, of the message body.

In order to calculate the value stored in the EMP data length field, the size of the Information Retrieval (Q115) message body must be calculated dynamically at run time. This size is the sum of:

- 10 bytes for fields 1-4
- The value of field 4 for the size of field 5
- 5 bytes for fields 6-7
- The value of field 7 for the size of field 8
- 6 bytes for fields 9-10

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.8.1.2 Information Retrieval (Q115) EMP Header Number Field

The Information Retrieval (Q115) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.8.2. Information Retrieval (Q115) Message Body

A summary of the Information Retrieval (Q115) message body is given in Table 47. Detailed descriptions and requirements follow.

Table 47: Information Retrieval (Q115) Message Body

ID	Field	Size, bytes	Data Type	Description
1	Condition ID	4	uint	The unique ID of the condition about which information is being reported
2	Condition Code	1	enum	The type of condition about which information is being reported
3	Train ID SCAC	4	SCAC	SCAC of the railroad of which assigned the train ID
4	Train ID Length	1	uint	Train ID length
5	Train ID	Varies	string	The Train ID assigned by the RR to which information is being reported.
6	Information Type	1	enum	Type of information being provided
7	Information Size	4	uint	Size, in bytes, of the information being provided
8	Information	Varies	binary	The requested information.
9	Request Number	2	uint	Request number of the associated Information Request (Q014) Message.
10	Coordination Number	4	uint	Coordination number for use in Information Request ACK (Q114) message.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 48. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 48: Information Retrieval (Q115) Message Field Ranges

ID	Field	Range
1	Condition ID	0, 0x00000010 – 0xFFFFFFFF
3	Train ID SCAC	Capital letters, left-justified, space filled Must contain at least two letters
6	Information Type	1 to 3, 253 to 255

3.3.1.8.3. Information Retrieval (Q115) Message Reliable Messaging Properties

The Information Retrieval (Q115) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 49.

Table 49: Information Retrieval (Q115) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Information Retrieval ACK (Q015)
Number of Retries	TBC-IRS-Q115-7
Retry Interval	TBC-IRS-Q115-8

3.3.1.8.4. Information Retrieval (Q115) Message Field Generation, Requirements

Requirements placed on ITC-ATO Ex regarding populating the fields in an Information Retrieval (Q115) message body are given in this section.

3.3.1.8.4.1 Information Retrieval (Q115) Message Condition ID Field, Generation Requirements

The Information Retrieval (Q115) message Condition ID field contains the condition ID, a unique 32-bit unsigned integer which is used to identify the specific exception condition about which information is being provided. This is the condition ID originally received in the Information Request (Q014) message Condition ID field. When no condition ID is associated with the specific Information Request (Q014) message being answered, the Information Request (Q014) Condition ID field will be set to 0 to indicate "not applicable" and the Information Retrieval (Q115) message Condition ID field in the resulting Information Retrieval (Q115) message will also be set to 0 to indicate "not applicable." Setting the Information Retrieval (Q115) message Condition ID field to 0 does not indicate a lack of conditions triggered by the provided information.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message answering a request for information associated with a specific condition, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Condition ID field with the Condition ID of the condition about which information is being provided.*

b) *When ITC-ATO Ex generates an Information Retrieval (Q115) message answering a request for information not associated with a specific condition, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Condition ID field with 0.*

3.3.1.8.4.2 Information Retrieval (Q115) Message Condition Code Field, Generation Requirements

The Information Retrieval (Q115) message Condition Code field indicates the condition code associated with the information being provided, if applicable, and is set to 0 if it is not applicable. This value is the same as the value of the Information Request (Q014) message Condition Code field in the Information

Request (Q014) message which triggered the Information Retrieval (Q115) message being sent. The condition codes are defined in the ITC-ATO Ex Subsystem Requirements.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message providing information associated with a specific condition, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Condition Code field with the condition code for the associated condition.*

b) *When ITC-ATO Ex generates an Information Retrieval (Q115) message providing information not associated with a specific condition, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Condition Code field with 0.*

3.3.1.8.4.3 Information Retrieval (Q115) Message Train ID SCAC Field, Generation Requirements

The Information Retrieval (Q115) message Train ID SCAC field contains the SCAC of the railroad that assigned the train ID given in the Information Retrieval (Q115) message Train ID field.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Train ID SCAC field with the SCAC of the railroad that assigned the train ID.*

3.3.1.8.4.4 Information Retrieval (Q115) Message Train ID Length Field, Generation Requirements

The Information Retrieval (Q115) message Train ID Length field contains the length, in bytes of the following Information Retrieval (Q115) message Train ID field.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Train ID Length field with the length of the following Information Retrieval (Q115) message Train ID field.*

3.3.1.8.4.5 Information Retrieval (Q115) Message Train ID Field, Generation Requirements

The Information Retrieval (Q115) message Train ID field provides the train's identification number. The train's identification number is a variable number of alpha-numeric characters containing a railroad-assigned identifier. This string does not include a null termination.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message, ITC-ATO Ex shall set the Information Retrieval (Q115) message Train ID field to the train's identification number.*

3.3.1.8.4.6 Information Retrieval (Q115) Message Information Type Field, Generation Requirements

The Information Retrieval (Q115) message Information Type field specifies the type of information being provided by the Sensor Platform. The possible types of information are listed in Table 50. A reply of "ITC-ATO SP unable to provide information of the requested type" indicates that the specific ITC-ATO SP does not have the hardware and/or software necessary for capturing the requested information. A reply of "requested information unavailable" indicates that the requested information is not saved in ITC-ATO SP's record; this may be because it was deleted, or it may be because it was never recorded. A reply of "nonsensical request" indicates that the Information Requested (Q014) message is illogical. Examples of nonsensical requests include requesting only audio and specifying an image size and a requesting information at a location on track that does not exist.

Table 50: Information Retrieval (Q115) Message Information Type Enumeration Values

Value	Description
0	Reserved
1	JPEG image
2	MPEG-4 video
3	MP3 audio
253	ITC-ATO SP unable to provide information of the requested type
254	Requested information unavailable
255	Nonsensical request

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Information Type field with the type of information being provided in the Information Retrieval (Q115) message Information field using the enumeration values given in Table 50.*

3.3.1.8.4.7 Information Retrieval (Q115) Message Information Size Field, Generation Requirements

The Information Retrieval (Q115) message Information Size field contains the size, in bytes of the following Information Retrieval (Q115) message Information field. If no information can be provided in the Information Retrieval (Q115) message Information field, the Information retrieval (Q115) Information Size field will be populated with 0.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message with the requested information, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Information Size field with the size of the following Information Retrieval (Q115) message Information field.*

b) *If ITC-ATO Ex generates an Information Retrieval (Q115) message and the requested information cannot be provided, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Information Size field with a value of 0.*

3.3.1.8.4.8 Information Retrieval (Q115) Message Information Field, Generation Requirements

The Information Retrieval (Q115) message Information field contains the requested information, encoded as the file type specified in the Information Retrieval (Q115) message Information Type field. If the requested information is not available, the Information Retrieval (Q115) message Information Size field is set to 0 and the Information Retrieval (Q115) message Information field is not present.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message providing the requested information, ITC-ATO Ex shall include the requested information in the Information Retrieval (Q115) message Information field.*

3.3.1.8.4.9 Information Retrieval (Q115) Message Request Number Field, Generation Requirements

The Information Retrieval (Q115) message Request Number field contains the request identification number received in the Information Request (Q014) message Request Number field of the Information Request (Q014) message being answered. This allows BODS to associate the information requests with information retrievals.

a) *When ITC-ATO Ex generates an Information Retrieval (Q115) message, ITC-ATO Ex shall populate the Information Retrieval (Q115) message Request Number field with the value*

received in the Information Request (Q014) message Request Number field of the Information Request (Q014) message being answered.

3.3.1.8.4.10 Information Retrieval (Q115) Message Coordination Number Field, Generation Requirements

The Information Retrieval (Q115) message Coordination Number field is generated according to the numbering process described in Section 3.4.3.

3.3.1.8.5. Information Retrieval (Q115) Message Field Use Requirements

Requirement placed on ITC-ATOSS BO regarding the verification of the Information Retrieval (Q115) message fields are given in this section.

3.3.1.8.5.1 Information Retrieval (Q115) Message Condition ID Field, Use Requirements

The Information Retrieval (Q115) message Condition ID field is used by ITC-ATOSS BO to identify the specific condition associated with the information being provided, if applicable. It is set to 0 if not applicable.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the Information Retrieval (Q115) message Condition ID field to identify the specific condition associated with the information being provided.*

3.3.1.8.5.2 Information Retrieval (Q115) Message Condition Code Field, Use Requirements

The Information Retrieval (Q115) message Condition Code field is used by ITC-ATOSS BO to identify the type of condition associated with the information being provided, if applicable. It is set to 0 if not applicable.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the Information Retrieval (Q115) Condition Code field to identify the type of condition associated with the information being provided, if any.*

3.3.1.8.5.3 Information Retrieval (Q115) Message Train ID SCAC Field, Use Requirements

The Information Retrieval (Q115) message Train ID SCAC field provides ITC-ATOSS BO with the SCAC of the railroad that assigned the train ID.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the SCAC contained in the Information Retrieval (Q115) message as the SCAC of the train ID.*

3.3.1.8.5.4 Information Retrieval (Q115) Message Train ID Length Field, Use Requirements

The Information Retrieval (Q115) message Train ID Length field helps ITC-ATOSS BO interpret the Information Retrieval (Q115) message by providing ITC-ATOSS BO with the length, in bytes, of the following Information Retrieval (Q115) Train ID field.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the Information Retrieval (Q115) message Train ID Length field as the length, in bytes, of the following Information Retrieval (Q115) message Train ID field.*

3.3.1.8.5.5 Information Retrieval (Q115) Message Train ID Field, Use Requirements

The Information Retrieval (Q115) message Train ID field provides ITC-ATOSS BO the train ID of the reporting train.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the Information Retrieval (Q115) message Train ID field as the train ID of the reporting train.*

3.3.1.8.5.6 Information Retrieval (Q115) Message Information Type Field, Use Requirements

The Information Retrieval (Q115) message Information Type field provides ITC-ATOSS BO with an enumeration describing the type of information being sent.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall, using the enumeration values in Table 50, use the Information Retrieval (Q115) message Information Type field to identify the type of information being reported in the Information Retrieval (Q115) message.*

3.3.1.8.5.7 Information Retrieval (Q115) Message Information Size Field, Use Requirements

The Information Retrieval (Q115) message Information Size field provides ITC-ATOSS BO with the size, in bytes, of the following Information Retrieval (Q115) message Information field.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the Information Retrieval (Q115) message Information Size field as the size, in bytes, of the following Information Retrieval (Q115) message Information field.*

3.3.1.8.5.8 Information Retrieval (Q115) Message Information Field, Use Requirements

The Information Retrieval (Q115) message Information field provides ITC-ATOSS BO the requested information encoded as the file type specified in the Information Retrieval (Q115) message Information Type field.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the information provided by the Information Retrieval (Q115) message Information field as the information originally requested from the Information Request (Q014) message, encoded as the file type specified in the Information Retrieval (Q115) message Information Type field.*

3.3.1.8.5.9 Information Retrieval (Q115) Message Request Number Field, Use Requirements

The Information Retrieval (Q115) message Request Number Field provides ITC-ATOSS BO with the number request number from the Information Request (Q014) message that triggered the Information Retrieval (Q115) message. This allows ITC-ATOSS BO to associate the Information Retrieval (Q115) message with the original Information Request (Q014) message of which the Information Retrieval (Q115) is replying.

a) *When ITC-ATOSS BO receives an Information Retrieval (Q115) message, ITC-ATOSS BO shall use the Information Retrieval (Q115) message Request Number field to associate the Information Retrieval (Q115) message with the original Information Request (Q014) message.*

3.3.1.8.5.10 Information Retrieval (Q115) Message Coordination Number Field, Use Requirements

The Information Retrieval (Q115) message Coordination Number field is generated according to the numbering process described in Section 3.4.3.

3.3.1.9 Condition Resolution ACK (Q116)

ITC-ATO Ex sends the Condition Resolution ACK (Q116) message to the ITC-ATOSS BO to notify ITC-ATOSS BO of the receipt of a Condition Resolution (Q016) message.

3.3.1.9.1. Condition Resolution ACK (Q116) EMP Header Parameters

Message-specific EMP header values for the Condition Resolution ACK (Q116) message are specified in Table 51.

Table 51: Condition Resolution ACK (Q116) EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type		2	uint	Q116
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q116-1
QoS	Class	3 bits	uint	TBC-IRS-Q116-2
	Priority	3 bits	uint	TBC-IRS-Q116-3
	Network Preference	3 bits	uint	TBC-IRS-Q116-4
	Special Handling	4 bits	uint	TBC-IRS-Q116-5
	Service Request	3 bits	uint	TBC-IRS-Q116-6

3.3.1.9.1.1 Condition Resolution ACK (Q116) EMP Header Data Length Field

The Condition Resolution ACK (Q116) message only contains static fields, so the message is always the same size of 5 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.1.9.1.2 Condition Resolution ACK (Q116) EMP Header Number Field

The Condition Resolution ACK (Q116) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.9.2. Condition Resolution ACK (Q116) Message Body

A summary of the Condition Resolution ACK (Q116) message body is given in Table 52. Detailed descriptions and requirements follow.

Table 52: Condition Resolution ACK (Q116) Message Body

ID	Field	Size, bytes	Data Type	Description
1	ACK Status	1	enum	ACK Status. See Table 54.
2	Coordination Number	4	uint	Coordination number from Condition Resolution ACK (Q116) message to which this message is a reply.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 53. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 53: Condition Resolution ACK (Q116) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.9.3. Condition Resolution ACK (Q116) Message Field Generation, Requirements

Requirements placed on ITC-ATO Ex in regard to populating the fields in a Condition Resolution ACK (Q116) message body are given in this section.

3.3.1.9.3.1 Condition Resolution ACK (Q116) Message ACK Status Field, Generation Requirements

The Condition Resolution ACK (Q116) Message ACK Status field indicates if the Condition Resolution ACK (Q116) message being generated is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 54: Condition Resolution ACK (Q116) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – Condition Resolution (Q016) message successfully received
1	NACK – message discarded

3.3.1.9.3.2 Condition Resolution ACK (Q116) Message Coordination Field, Generation Requirements

The Condition Resolution ACK (Q116) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.9.4. Condition Resolution ACK (Q116) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Condition Resolution ACK (Q116) message fields are given in this section.

3.3.1.9.4.1 Condition Resolution ACK (Q116) Message ACK Status Field, Use Requirements

The Condition Resolution ACK (Q116) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.9.4.2 Condition Resolution ACK (Q116) Message Coordination Field, Use Requirements

The Condition Resolution ACK (Q116) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.2 ITC-ATOSS BO to ITC-ATO Ex Messages

This section documents all messages sent by ITC-ATOSS BO to ITC-ATO Ex. The following message type (ID) assignments are currently made:

Table 55: ITC-ATOSS BO to ITC-ATO Ex Messages

Message Type (ID)	Version	Description
Q000	1	ITC-ATOSS BO to ITC-ATO Ex Poll
Q001	1	ITC-ATO Ex to ITC-ATOSS BO Poll Ack
Q002	1	ITC-ATOSS BO Poll Registration Confirmation
Q003	1	ITC-ATO Ex/ITC-ATO SP Configuration Version List
Q010	1	ITC-ATO Ex System State Report ACK
Q011	1	Exception Report ACK
Q014	1	Information Request
Q015	1	Information Retrieval ACK
Q016	1	Condition Resolution

3.3.2.1 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message is sent by as part of the polling process. The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message also contains operational information for use by ITC-ATO Ex.

3.3.2.1.1. ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message EMP Header Parameters

Message-specific EMP header values for the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message are specified in Table 56.

Table 56: ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q000
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q000-1
QoS	Class	3 bits	uint	TBC-IRS-Q000-2
	Priority	3 bits	uint	TBC-IRS-Q000-3
	Network Preference	3 bits	uint	TBC-IRS-Q000-4
	Special Handling	4 bits	uint	TBC-IRS-Q000-5
	Service Request	3 bits	uint	TBC-IRS-Q000-6

3.3.2.1.1.1 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message EMP Header Data Length Field

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message EMP Header Data Length field contains the length, in bytes, of the message body. The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message contains a record loop which is repeated a variable number of times. The loop is preceded by a counter indicating the number of times the record is repeated.

In order to calculate the value stored in the EMP data length field, the size of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message body must be calculated at run time for each ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message generated.

This size is the sum of:

- 5 bytes for field IDs 1 and 2.
- 3 bytes multiplied by the value of field ID 2 for dynamic fields 2.1 and 2.2.
- 5 bytes for field IDs 3-5.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.1.1.2 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message EMP Header Number Field

The EMP message number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.1.2. ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Body

A summary of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message body is given in Table 57. Detailed descriptions and requirements follow.

Table 57: ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Body

ID	Field	Size, bytes	Data Type	Description
1	Railroad SCAC	4	SCAC	Railroad SCAC of the railroad to which the poll registration was sent
2	Subdivision/District Record Counter	1	uint	Number of subdivisions/districts
<Start subdivision/district record loop>				Repeat once for each subdivision/district
2.1	Subdivision/District ID	2	enum	PTC subdivision/district identification
2.2	ATO Office State	1	enum	Current state of ITC-ATOSS BO. See Table 60
<End subdivision/district record loop>				
3	ITC-ATO Ex Configuration Data Integrity Code	1	uint	Data integrity code of ITC-ATO Ex configuration datasheet
4	ITC-ATO SP Configuration Data Integrity Code	1	uint	Data integrity code of ITC-ATOSS BO configuration datasheet
5	Coordination Number	4	uint	Coordination number from the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message being acknowledged

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 58. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 58: ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left-justified, space filled. Must contain at least two letters
2.1	Subdivision/District ID	0 to 9999
2.2	ATO Office State	0 to 4, 255 (Valid enumeration values)

3.3.2.1.3. ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Reliable Messaging Properties

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 59.

Table 59: ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	ITC-ATOSS BO to ITC-ATO Ex Poll ACK (Q101) message
Number of Retries	TBC-IRS-Q000-7
Retry Interval	TBC-IRS-Q000-8

3.3.2.1.4. ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message body are given in this section.

3.3.2.1.4.1 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Railroad SCAC Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Railroad SCAC field provides the SCAC of the ITC-ATOSS BO sending the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATOSS BO shall set the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Railroad SCAC field to the SCAC of ITC-ATOSS BO.*

3.3.2.1.4.2 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Subdivision/District Record Counter Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District Record Counter field contains the number of subdivisions/districts ITC-ATO Ex has registered with the sending ITC-ATOSS BO. Each ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District record consists of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) dynamic fields Subdivision/District ID and ATO Office State. The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District record is repeated once for each subdivision/district ITC-ATO Ex has registered with the sending ITC-ATOSS BO. If there are no registered subdivisions/districts (e.g., during initialization), the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District Record Counter will be 0, and there will be no ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District records present.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATOSS BO shall set the Subdivision/District Record Counter field to the number of subdivisions/districts ITC-ATO Ex has registered with ITC-ATOSS BO.*

b) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATOSS BO shall repeat the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District record once for each subdivision/district ITC-ATO Ex has registered with ITC-ATOSS BO.*

3.3.2.1.4.3 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Subdivision/District ID Dynamic Field, Generation Requirements

Each instance of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District ID dynamic field provides one PTC subdivision/district ID for one subdivision/district ITC-ATO Ex has registered with the receiving ITC-ATOSS BO.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATOSS BO shall set each instance of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District ID dynamic field to the PTC subdivision/district ID of the corresponding subdivision/district.*

3.3.2.1.4.4 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message ATO Office State Field, Generation Requirements

The ATO Office State field reports the current operating state of the ITC-ATOSS BO as defined in the ITC-ATOSS BO Subsystem Requirements. The valid values of these enumerations are listed in Table 60.

Table 60: ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message ATO Office State Field Enumeration Values

Value	ATO Office State
0	Not Enabled
1	Enabled
2	Attended
3	Shadow
4	Passive
255	Error

a) When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATOSS BO shall set the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ATO Office State field to the current ATO Office State using the enumerations listed in Table 60.

3.3.2.1.4.5 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message ITC-ATO Ex Configuration Data Integrity Code Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ITC-ATO Ex Configuration Data Integrity Code field provides the data integrity code calculated for the ITC-ATO Ex configuration dataset. The data integrity code is used to confirm the dataset validity and detect file corruption. Calculation of the ITC-ATO Ex configuration dataset data integrity code by ITC-ATOSS BO is described in the ITC-ATOSS BO Subsystem Requirements document.

a) When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATOSS BO shall set the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ITC-ATO Ex Configuration Data Integrity Code field to the most recently calculated Data Integrity Code of the ITC-ATO Ex configuration dataset.

3.3.2.1.4.6 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message ITC-ATO SP Configuration Data Integrity Code Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ITC-ATO SP Configuration Data Integrity Code field provides the data integrity code calculated for the ITC-ATO SP configuration dataset. The data integrity code is used to continually confirm dataset validity during automated operations. Calculation of the ITC-ATO Ex configuration dataset data integrity code by ITC-ATOSS BO is described in the ITC-ATOSS BO Subsystem Requirements document.

a) When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATOSS BO shall set the ITC-ATOSS BO Poll (Q000) message ITC-ATO SP Configuration Data Integrity Code field to the most recently calculated data integrity code of the ITC-ATO SP configuration dataset.

3.3.2.1.4.7 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Coordination Number Field, Generation Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message coordination number is generated according to the numbering process described in Section 3.4.3.

3.3.2.1.5. ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Use Requirements

Requirements placed on ITC-ATO Ex regarding the verification and use of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message fields are given in this section.

3.3.2.1.5.1 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Railroad SCAC Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Railroad SCAC field provides the SCAC of the ITC-ATOSS BO which sent the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message and is the SCAC of the subdivision/districts contained in the same message.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO to ITC-ATO Ex Poll (Q00) message, ITC-ATO Ex shall use the ITC-ATOSS BO to ITC-ATO Ex (Q000) message Railroad SCAC field as the SCAC of the subdivision/district contained in the same message.*

3.3.2.1.5.2 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Subdivision/District Record Counter Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District Record Counter field provides ITC-ATO Ex with the number of subdivisions/districts the ATO train has registered with the ITC-ATOSS BO sending the message. The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District ID Record Counter field is also provided to assist ITC-ATO Ex in correctly unpacking the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATO Ex shall use the value contained in the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District Record Counter field as the number of subdivision/districts reregistered with the sending ITC-ATOSS BO.*

b) *When ITC-ATO receives an ITC-ATOSS Bo to ITC-ATO Ex Poll (Q000) message, ITC-ATO Ex shall extract the number of subdivision/district ID records indicated by the ITC-ATOSS to ITC-ATO Ex Poll (Q000) message Subdivision/District Record Counter field.*

3.3.2.1.5.3 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Subdivision/District ID Dynamic Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District ID dynamic field provides the subdivision/district ID for a specific subdivision/district of which ITC-ATOSS BO recognizes as being registered by the receiving ITC-ATO Ex.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATO Ex shall use each instance of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Subdivision/District ID dynamic field as confirmation that ITC-ATO Ex has the indicated subdivision/district registered with the sending ITC-ATOSS BO.*

3.3.2.1.5.4 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message ATO Office State Dynamic Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ATO Office State dynamic field provides ITC-ATO Ex with the current ATO Office state of the corresponding subdivision/district.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATO Ex shall, using the enumeration values given in Table 60, use the ATO System State value contained in each instance of the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ATO Office State dynamic field as the state of the ATO Office for the corresponding subdivision/district.*

3.3.2.1.5.5 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message ITC-ATO Ex Configuration Data Integrity Code Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ITC-ATO Ex Configuration Data Integrity Code field provides ITC-ATO Ex with a data integrity code calculated across the ITC-ATO Ex configuration dataset. This value is used to verify the ITC-ATO Ex configuration integrity.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATO Ex shall use the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ITC-ATO Ex Configuration Data Integrity Code field to confirm dataset validity and detect file corruption of the ITC-ATO Ex configuration dataset.*

3.3.2.1.5.6 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message ITC-ATO SP Configuration Data Integrity Code Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ITC-ATO SP Configuration Data Integrity Code field provides ITC-ATO Ex with a data integrity code calculated across the ITC-ATO SP configuration dataset. This value is used to verify the ITC-ATO SP configuration integrity.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message, ITC-ATO Ex shall use the ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message ITC-ATO SP Configuration Data Integrity Code field to confirm dataset validity and detect file corruption of the ITC-ATO SP configuration dataset.*

3.3.2.1.5.7 ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) Message Coordination Number Field, Use Requirements

The ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.2.2 ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message, Version 1

The ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message is part of the reliable message process described in Section 3.4.4 and is used as the acknowledge for the ITC-ATO Ex to ITC-ATOSS BO Poll Ex Poll (Q100) message.

3.3.2.2.1. ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) EMP Header Parameters

Message-specific EMP header values for the ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q101) message are specified in Table 61.

Table 61: ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q001
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q001-1
QoS	Class	3 bits	uint	TBC-IRS-Q001-2
	Priority	3 bits	uint	TBC-IRS-Q001-3
	Network Preference	3 bits	uint	TBC-IRS-Q001-4
	Special Handling	4 bits	uint	TBC-IRS-Q001-5
	Service Request	3 bits	uint	TBC-IRS-Q001-6

3.3.2.2.1.1 ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) EMP Header Data Length Field

The ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message only contains static fields, so the message is always the same size of 5 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.2.1.2 ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) EMP Header Number Field

The ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) EMP Header Number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.2.2. ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message Body

A summary of the ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message body is given in Table 62. Detailed descriptions and requirements follow.

Table 62: ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	ACK Status	1	enum	ACK Status. See Table 64.
2	Coordination Number	4	uint	Coordination number from ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message to which this message is a reply.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 63. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 63: ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.2.2.3. ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message Field Generation, Requirements

Requirements placed on ITC-ATOSS BO regarding populating the fields in an ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message body are given in this section.

3.3.2.2.3.1 ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message ACK Status Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message ACK Status field indicates if the ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 64: ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message successfully received
1	NACK – message discarded

3.3.2.2.3.2 ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message Coordination Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.2.2.4. ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message Field Use Requirements

Requirements placed on ITC-ATO Ex regarding the verification and use of the ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message fields are given in this section.

3.3.2.2.4.1 ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message ACK Status Field, Use Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.2.2.4.2 ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) Message Coordination Field, Generation Requirements

The ITC-ATO Ex to ITC-ATOSS BO Poll ACK (Q001) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.2.3 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message

Each operating railroad ITC-ATOSS BO sends an ITC-ATOSS BO Poll Registration Confirmation (Q002) message to ITC-ATO Ex. The ITC-ATOSS BO Poll Registration Confirmation (Q002) message confirms receipt of the ITC-ATOSS BO Poll Registration (Q102) message and starts the polling process.

3.3.2.3.1. ITC-ATOSS BO Poll Registration Confirmation (Q002) EMP Header Parameters

Message-specific EMP header values for the ITC-ATOSS BO Poll Registration Confirmation (Q002) message are specified in Table 65.

Table 65: ITC-ATOSS BO Poll Registration Confirmation (Q002) Message EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q002
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q002-1
QoS	Class	3 bits	uint	TBC-IRS-Q002-2
	Priority	3 bits	uint	TBC-IRS-Q002-3
	Network Preference	3 bits	uint	TBC-IRS-Q002-4
	Special Handling	4 bits	uint	TBC-IRS-Q002-5
	Service Request	3 bits	uint	TBC-IRS-Q002-6

3.3.2.3.1.1 ITC-ATOSS BO Poll Registration Confirmation (Q002) EMP Header Data Length Field

In order to calculate the value stored in the EMP data length field, the size of the ITC-ATOSS BO Poll Registration Confirmation (Q002) message body must be calculated at run time for each ITC-ATOSS BO Poll Registration Confirmation (Q002) message generated. This size is the sum of:

- 7 bytes for field IDs 1-4.
- 2 bytes multiplied by the value of field ID 4 for dynamic field ID 4.1.
- 4 bytes for field ID 5.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.3.1.2 ITC-ATOSS BO Poll Registration Confirmation (Q002) EMP Header Number Field

The ITC-ATOSS BO Poll Registration Confirmation (Q002) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.3.2. ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Body

A summary of the ITC-ATOSS BO Poll Registration Confirmation (Q002) message body is given in Table 66. Detailed descriptions and requirements follow.

Table 66: ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Body

ID	Field	Size, bytes	Data Type	Description
1	ACK Status	1	enum	ITC-ATOSS BO Poll Registration (Q102) message ACK Status. See Table 68.
2	Railroad SCAC	4	SCAC	Railroad SCAC of the railroad to which the ITC-ATOSS BO Poll Registration (Q102) message was sent.
3	Reason for Sending	1	enum	See Table 69.
4	Subdivision/District Record Counter	1	uint	Number of subdivisions/districts
<Start subdivision/district record loop>				Repeat once for each subdivision/district
4.1	Subdivision/District ID	2	enum	PTC subdivision/district identification
<End subdivision/district record loop>				
5	Coordination Number	4	uint	Message coordination number from ITC-ATOSS BO Poll Registration (Q102) message to which this is a reply.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 67. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 67: ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 2 (Valid enumeration values)
2	Railroad SCAC	Capital letters, left-justified, space filled Must contain at least two letters
3	Reason for Sending	0 to 5 (Valid enumeration values)
4.1	Subdivision/District ID	0 to 9999

3.3.2.3.3. ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an ITC-ATOSS BO Poll Registration Confirmation (Q002) message body are given in this section.

3.3.2.3.3.1 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message ACK Status Field, Generation Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message ACK Status field indicates whether the ITC-ATOSS BO Poll Registration Confirmation (Q002) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 68: ITC-ATOSS BO Poll Registration Confirmation (Q002) Message ACK Status Field Enumeration Values

Value	ACK Status
0	ACK – ITC-ATOSS BO Poll Registration (Q102) message successfully received
1	NACK – message discarded
2	NACK – Unsupported IRS version

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATOSS BO shall set the ITC-ATOSS BO Poll Registration Confirmation (Q002) message ACK Status field using the enumeration values listed in Table 68.*

3.3.2.3.3.2 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Railroad SCAC Field, Generation Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Railroad SCAC field provides the SCAC of the railroad ITC-ATOSS BO sending the ITC-ATOSS BO Poll Registration Confirmation (Q003) message.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATOSS BO shall set the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Railroad SCAC field to the SCAC of the sending ITC-ATOSS BO.*

3.3.2.3.3.3 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Reason for Sending Field, Generation Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Reason for Sending field indicates why the ITC-ATOSS BO Poll Registration Confirmation (Q002) message was sent. Enumeration values are given in Table 69.

Table 69: ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Reason for Sending Field Enumeration Values

Value	Reason for Sending
0	Not used
1	Confirm receipt of valid poll registration
2	Confirm receipt of valid poll deregistration
3	NACK – invalid subdivision/district list
4	NACK – invalid PTC subdivision/district ID
5	NACK – other

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATOSS BO shall populate the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Reason for Sending field with the reason the message was sent using the enumeration values given in Table 69.*

3.3.2.3.3.4 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Subdivision/District Record Counter Field, Generation Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District Record Counter field contains the number of subdivisions/districts the receiving ITC-ATO Ex has successfully registered with ITC-ATOSS BO. Each ITC-ATOSS BO Poll Registration Confirmation (Q002) message

Subdivision/District record consists only of the ITC-ATOSS BO Poll Registration Confirmation Message dynamic field Subdivision/District ID. The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District record is repeated once for each subdivision/district ITC-ATO Ex has registered with ITC-ATOSS BO. If there are no registered subdivisions/districts the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District Record Counter will be 0 and there will be no ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District ID records present.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATOSS BO shall set the Subdivision/District Record Counter to the number of subdivisions/districts the receiving ITC-ATO Ex has registered with ITC-ATOSS BO.*

b) *When ITC-ATOSS BO generates an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATOSS BO shall repeat the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District record once for each subdivision/district ITC-ATO Ex has registered with ITC-ATOSS BO.*

3.3.2.3.3.5 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Subdivision/District ID Dynamic Field, Generation Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District ID dynamic field shows the PTC subdivision/district ID of one subdivision/districts that the receiving ITC-ATO Ex has registered with ITC-ATOSS BO.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATOSS BO shall populate each instance of the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District ID dynamic field with the PTC subdivision/district with a subdivision/district that the receiving ITC-ATO Ex has registered with ITC-ATOSS BO.*

3.3.2.3.3.6 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Coordination Number Field, Generation Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.2.3.4. ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the use of the ITC-ATOSS BO Poll Registration Confirmation (Q002) message are given in this section.

3.3.2.3.4.1 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message ACK Status Field, Use Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message ACK Status Field is used to support to the reliable messaging process described in Section 3.4.4.

3.3.2.3.4.2 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Railroad SCAC Field, Use Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Railroad SCAC field contains the SCAC of the ITC-ATOSS BO which send the ITC-ATOSS BO Poll Registration (Q102) message. This is the SCAC of the associated subdivision/districts.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATO Ex shall use the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Railroad SCAC field as the SCAC of the associated subdivision/districts.*

3.3.2.3.4.3 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Reason for Sending Field, Use Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Reason for Sending field contains the reason the ITC-ATOSS BO Poll Registration Confirmation (Q002) message was sent.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO Poll Registration Confirmation (Q002) message ITC-ATO Ex shall, using the enumeration values given in Table 69, interpret the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Reason for Sending field as the reason the ITC-ATOSS Poll Registration Confirmation (Q002) message was sent.*

3.3.2.3.4.4 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Subdivision/District Record Counter, Use Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District Record Counter field provides ITC-ATO Ex with the number of subdivision/districts ITC-ATO Ex has registered with the sending ITC-ATOSS BO. The ITC-ATOSS BO Poll Registration Confirmation (Q200) message Subdivision/District Record Counter field also assists ITC-ATO Ex in correctly unpacking the ITC-ATOSS BO Poll Registration Confirmation (Q002) message by providing the number of times the Subdivision/District ID Record Loop is repeated.

a) *When ITC-ATO Ex receives an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATO Ex shall use the value contained in the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District Record Counter field as the number of subdivisions/districts ITC-ATO Ex currently has registered with the sending ITC-ATOSS BO.*

b) *When ITC-ATO Ex receives an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATO Ex shall extract the number of ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District ID records indicated by the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District Record Counter field.*

3.3.2.3.4.5 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Subdivision/District ID Dynamic Field, Use Requirements

Each instance of the ITC-ATOSS BO Poll Registration Confirmation (Q002) message Subdivision/District ID dynamic field identifies one subdivision/district of which the ITC-ATO Ex has registered with the sending ITC-ATOSS BO.

a) *When ITC-ATO Ex Receives an ITC-ATOSS BO Poll Registration Confirmation (Q002) message, ITC-ATO Ex shall use each instance of the ITC-ATOSS BO Poll Registration Confirmation*

(Q0002) message Subdivision/District ID dynamic field to identify a subdivision/district that the ITC-ATO Ex has registered with the sending ITC-ATOSS BO.

3.3.2.3.4.6 ITC-ATOSS BO Poll Registration Confirmation (Q002) Message Coordination Number Field, Use Requirements

The ITC-ATOSS BO Poll Registration Confirmation (Q002) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.2.4 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message

ITC-ATOSS BO sends the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message to ITC-ATO Ex to provide configuration version information for both the ITC-ATO Ex and ITC-ATO SP subsystems. The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message is sent in response to the ITC-ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message.

3.3.2.4.1. ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) EMP Header Parameters

Message-specific EMP header values for the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message are specified in Table 70.

Table 70: ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q003
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q003-1
QoS	Class	3 bits	uint	TBC-IRS-Q003-2
	Priority	3 bits	uint	TBC-IRS-Q003-3
	Network Preference	3 bits	uint	TBC-IRS-Q003-4
	Special Handling	4 bits	uint	TBC-IRS-Q003-5
	Service Request	3 bits	uint	TBC-IRS-Q003-6

3.3.2.4.1.1 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) EMP Header Data Length Field

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q004) message contains the length, in bytes, of the message body. ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q004) message contains multiple record loops which are repeated a variable number of times. Each loop is preceded by a counter indicating the number of times the record is repeated.

In order to calculate the value stored in the EMP data length field, the size of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message body must be calculated dynamically at run time. This size is the sum of:

- 5 bytes for field IDs 1 and 2.
- 2 bytes times the value of field 2 for fields 2.1-2.2
- The sum of the values of each instance of field ID 2.2 for the variable-length field 2.3.
- 1 byte times the value of field 2 for field 2.4
- The sum of the values of each instance of field ID 2.4 for the variable-length field 2.5.
- 1 byte times the value of field 2 for field 2.6
- 1 byte times the total number of instances of the Fileset Version record for field 2.6.1
- The sum of the values of all instances of field 2.6.1 for field 2.6.2
- 5 bytes times the total number of instances of the Fileset Version record for fields 2.6.3 and 2.6.4.
- 4 bytes for field 3.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.4.1.2 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) EMP Header Number Field

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.4.2. ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Body

A summary of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message body is given in Table 71. Detailed descriptions and requirements follow. The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message contains a nested record loop. The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Fileset Version record loop resides inside the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record loop, and there is a complete ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record loop inside each iteration of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Repository record loop.

Table 71: ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	Railroad SCAC	4	SCAC	SCAC of the ITC-ATOSS BO sending this message
2	Repository Record Counter	1	uint	Number of repositories (just 6)
<Start Repository record loop>				Repeat once for each repository
2.1	Subsystem ID	1	enum	Subsystem name enumeration
2.2	Vendor ID Length	1	uint	String length of the Vendor ID up to 50 characters
2.3	Vendor ID	varies	string	Vendor identification
2.4	Repository Name Length	1	uint	String length of repository name up to 50 characters
2.5	Repository Name	varies	ASCII	Name of repository
2.6	Fileset Version Record Counter	1	uint	Number of versions for the repository (2)
<Start Fileset Version record loop>				Repeat once for each fileset
2.6.1	Fileset Version Length	1	uint	String length of version up to 20 characters
2.6.2	Fileset Version	varies	ASCII	Version string
2.6.3	Fileset Data Integrity Code	4	uint	Data integrity code calculated across this fileset
2.6.4	Fileset Status	1	uint	Fileset status: preferred or acceptable. See Table 74.
<End Fileset Version record loop>				
<End Repository record loop>				
3	Configuration Version List Data Integrity Code	4	uint	Data integrity code calculated over all of the above fields

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 72. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 72: ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left-justified, space filled Must contain at least two letters
2	Repository Record Counter	6
2.1	Subsystem ID	0, 1 (Valid enumeration values)
2.2	Vendor ID Length	1 to 20
2.4	Repository Name Length	17,19
2.5	Repository Name	The only valid values are: • ITC-ATO Ex Common • ITC-ATO Ex Config • ITC-ATO Ex Software • ITC-ATO SP Common • ITC-ATO SP Config • ITC-ATO SP Software
2.6	Fileset Version Record Counter	1 to 2
2.6.1	Fileset Version Length	1 to 20
2.6.4	Fileset Status	1 to 2 (Valid enumeration values)

3.3.2.4.3. ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message body are given in this section.

3.3.2.4.3.1 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Railroad SCAC Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Railroad SCAC field provides the SCAC of the ITC-ATOSS BO sending the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Railroad SCAC field to the SCAC of ITC-ATOSS BO sending the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message.*

3.3.2.4.3.2 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Repository Record Counter Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Record Counter field contains the number of repositories from which ITC-ATOSS BO is sending fileset validation information. Each ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Record consists of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message dynamic fields Subsystem ID, Vendor ID Length, Vendor ID, Repository Name Length, Repository Name, Fileset Version Record Counter, and one complete Fileset Version record loop. The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Record is repeated once for each repository.

There is one complete instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record loop inside each ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record. Each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Fileset Version record loop will contain fileset validation information related to the specific repository with which it is associated and is expected to differ from other ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record loops within the same message. See Section 3.3.2.4.3.8 for details on the contents of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record.

Note: The current design requires exactly three repositories to be sent for ITC-ATO Ex and exactly three to be sent for ITC-ATO SP. As a result, this field always has a value of 6.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Repository Record Counter field to the number of repositories from which ITC-ATOSS BO is sending ITC-ATO Ex/ITC-ATO SP fileset validation information.*

b) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall repeat the ITC-ATO Ex/ITC-ATOSS BO Configuration*

Version List (Q003) message Repository record once for each repository from which ITC-ATOSS BO is sending ITC-ATO Ex/ITC-ATO SP fileset validation information.

3.3.2.4.3.3 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Subsystem ID Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Subsystem ID dynamic field specifies which subsystem the containing ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record applies to. The possible values for this enumeration are given in Table 73.

Table 73: ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Subsystem ID Dynamic Field Enumeration Values

Value	Description
0	ITC-ATO Ex
1	ITC-ATO SP

a) When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message ITC-ATOSS BO shall populate the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Subsystem ID dynamic field with the corresponding subsystem using the enumeration values given in Table 73.

3.3.2.4.3.4 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Vendor ID Length Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID Length dynamic field contains the length, in bytes, of the vendor ID in the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field.

a) When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Vendor ID Length dynamic field to the length of the vendor ID in the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field.

3.3.2.4.3.5 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Vendor ID Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field provides the vendor ID of the specific subsystem of which the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record applies to.

a) When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall populate the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field with the vendor ID of corresponding subsystem.

3.3.2.4.3.6 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Repository Name Length Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name Length dynamic field contains the length, in bytes, of the repository name in the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name dynamic field.

Note: The current design concept only allows the repository names listed in Table 72 to be used. As a result, the only valid values of this field are the lengths of those names.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Repository Name Length dynamic field to the length of the repository name in the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name dynamic field.*

3.3.2.4.3.7 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Repository Name Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name dynamic field provides the name of the repository providing the fileset validation information within the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record. This name is provided as a non-null-terminated string.

Note: The current design concept only allows the repository names listed in Table 72 to be used.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Repository Name dynamic field to the name of the repository providing the fileset validation information within the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record.*

3.3.2.4.3.8 ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Version Record Counter Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Record Counter dynamic field contains the number of times the associated ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record loop is repeated. One ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record consists of one each of the dynamic fields ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Length, Fileset Version, Fileset Data Integrity Code, and Fileset Status.

Each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Record Counter dynamic field only provides the number of ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version records in the associated Fileset Version record loop and does not necessarily provide the total number of ATO Ex/ITC-ATO SP Configuration Version Records in the entire ITC-ATO EX/ITC-ATO SP Configuration Version List (Q003) message. Each ITC-ATO Ex/ ITC-ATO SP Configuration Version List (Q003) message Fileset Version record contains one set of preferred or acceptable fileset version information.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance of the ATO Ex/ITC-ATO SP Configuration Version List (Q003) Fileset Version Record Counter dynamic field to the number of sets of ITC-ATO Ex/ITC-ATO SP fileset validation information being sent in the corresponding record loop.*

b) *When ITC-ATOSS BO generates an instance of an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Record Counter dynamic field, ITC-ATOSS BO shall repeat the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record once for each associated set of ITC-ATO Ex/ITC-ATO SP fileset validation information.*

3.3.2.4.3.9 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Version Length Dynamic Field, Generation Requirements

Each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Length dynamic field contains the length of the fileset version stored in the associated ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version dynamic field.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Length dynamic field to the length of the associated ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version dynamic field.*

3.3.2.4.3.10 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Version Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version dynamic field contains the fileset version string describing a valid preferred or acceptable ITC-ATO Ex/ITC-ATO SP fileset. This is a variable-length ASCII string without a null termination.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Fileset Version dynamic field to the fileset version string of the associated ITC-ATO Ex/ITC-ATO SP fileset.*

3.3.2.4.3.11 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Data Integrity Code Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Data Integrity Code dynamic field contains a cryptographic data integrity code calculated across the fileset described by the containing ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Record. This cryptographic data integrity code is calculated as described in a forthcoming AAR data integrity code standard.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall populate each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Data Integrity Code to the cryptographic data integrity code calculated across the associated ITC-ATO Ex/ITC-ATO SP fileset.*

3.3.2.4.3.12 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Status Dynamic Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Status dynamic field states if the status of the associated ATO Ex/ITC-ATO SP fileset version is preferred or acceptable. Enumeration values are shown in Table 74.

Table 74: ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Status Dynamic Field Enumeration Values

Value	Description
0	Not Used
1	Preferred
2	Acceptable

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Fileset Version dynamic field to the status of the associated fileset using the enumeration values given in Table 74.*

3.3.2.4.3.13 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Configuration Version List Data Integrity Code Field, Generation Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Configuration Version List Data Integrity Code field provides the data integrity code calculated across all the fields in the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message body, excluding itself. This data integrity code is retained by ITC-ATO Ex and used to detect both file updates and file corruption. Calculation of this data integrity code is described in a forthcoming AAR data integrity code standard.

a) *When ITC-ATOSS BO generates an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATOSS BO shall set each instance of the ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Configuration Version List Data Integrity Code field to the data integrity code of the ATO Ex/ITC-ATO SP Configuration Version List.*

3.3.2.4.4. ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the ATO Ex/ITC-ATO SP Configuration Version List (Q003) message are given in this section.

3.3.2.4.4.1 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Railroad SCAC Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Railroad SCAC field provides the SCAC of the ITC-ATOSS BO sending the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message to the ITC-ATO Ex.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Railroad SCAC field as the SCAC of the ITC-ATOSS BO providing the associated configuration information.*

3.3.2.4.4.2 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Repository Record Counter Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Record Counter field provides the number of repositories for which ITC-ATOSS BO is sending fileset validation information and is used by ITC-ATO Ex to correctly unpack the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the value contained in the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Record Counter field as the number of repositories ITC-ATOSS BO is sending fileset validation information for.*

b) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall extract the number of ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository records indicated by the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Record Counter field.*

3.3.2.4.4.3 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Subsystem ID Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Subsystem ID dynamic field provides the subsystem ID for a specific subsystem for which ITC-ATOSS BO is providing fileset validation information.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the subsystem ID contained in each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Subsystem ID dynamic field to identify the subsystem for which ITC-ATOSS BO is providing fileset information for in the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record.*

3.3.2.4.4.4 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Vendor ID Length Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID Length dynamic field helps ITC-ATO Ex interpret the ITC-ATO Ex/ITC-ATO SP Configuration Version (Q003) message by providing ITC-ATO Ex with the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the value contained in each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version (Q003) message Vendor ID Length dynamic field as the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field.*

3.3.2.4.4.5 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Vendor ID Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field provides the vendor ID for the subsystem for which ITC-ATOSS BO is providing fileset validation

information in the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the vendor ID contained in each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Vendor ID dynamic field to identify the vendor for the subsystem for which ITC-ATOSS BO is providing fileset validation information for in the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record.*

3.3.2.4.4.6 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Repository Name Length Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name Length dynamic field helps ITC-ATO Ex interpret the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message by providing ITC-ATO Ex with the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name dynamic field.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the value contained in each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name Length dynamic field as the length of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name dynamic field.*

3.3.2.4.4.7 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Repository Name Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository Name provides the name of the repository of which ITC-ATOSS BO is providing fileset validation information for in the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the value contained in each instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version (Q003) message Repository Name dynamic field as the name of the repository for which ITC-ATOSS BO is providing fileset validation information in the corresponding ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Repository record.*

3.3.2.4.4.8 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Version Record Counter Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Record Counter dynamic field provides the number of fileset versions being provided in the following ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version record loop, which is also the number of fileset versions being provided for the corresponding repository. The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Record counter is also used by ITC-ATO Ex to correctly unpack the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Record Counter dynamic field as the number of valid fileset versions being provided for the corresponding repository.*

b) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SPO Configuration Version List (Q003) message, ITC-ATO Ex shall extract the number of fileset versions indicated by the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Record Counter dynamic field.*

3.3.2.4.4.9 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Version Length Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version (Q003) message Fileset Version Length dynamic field helps ITC-ATO interpret the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message by providing ITC-ATO Ex with the length, in bytes, of the following ITC-ATO Ex/ITC-ATO SP Configuration Version List(Q003) message Fileset Version field.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the value contained in the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version Length dynamic field as the length, in bytes, of the following instance of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version dynamic field.*

3.3.2.4.4.10 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Version Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version dynamic filed provides ITC-ATO Ex with the fileset version of the corresponding fileset.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Version dynamic field as the version of the corresponding fileset.*

3.3.2.4.4.11 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Data Integrity Code Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Data Integrity Code dynamic field provides ITC-ATO Ex with a data integrity code used to verify the validity of the corresponding fileset.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Data Integrity Code dynamic field as the data integrity code for verification of the integrity of the corresponding fileset.*

3.3.2.4.4.12 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Fileset Status Dynamic Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Status dynamic field provides ITC-ATO Ex with the status of the corresponding fileset.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall, using the enumeration values in Table 74, use the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Fileset Status dynamic field as the status of the corresponding fileset.*

3.3.2.4.4.13 ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) Message Configuration Version List Data Integrity Code Field, Use Requirements

The ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Configuration Version List Data Integrity Code field provides a data integrity code calculated across all the fields in the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message body, excluding itself. This data integrity code is used to detect corruption of the fileset information.

a) *When ITC-ATO Ex receives an ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message, ITC-ATO Ex shall use the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message Configuration Version List Data Integrity Code field for verification of the ITC-ATO Ex/ITC-ATO SP Configuration Version List (Q003) message.*

3.3.2.5 ITC-ATO Ex System State Report ACK (Q010) Message

ITC-ATOSS BO sends the ITC-ATO Ex System State Report ACK (Q010) message to ITC-ATO Ex to confirm receipt of the System State Report (Q110) message. This is done as part of the reliable messaging process described in Section 3.4.4.

3.3.2.5.1. ITC-ATO Ex System State Report ACK (Q010) EMP Header Parameters

Message-specific EMP header values for the ITC-ATO Ex System State Report ACK (Q010) message are specified in Table 75.

Table 75: ITC-ATO Ex System State Report ACK (Q010) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q010
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q010-1
QoS	Class	3 bits	uint	TBC-IRS-Q010-2
	Priority	3 bits	uint	TBC-IRS-Q010-3
	Network Preference	3 bits	uint	TBC-IRS-Q010-4
	Special Handling	4 bits	uint	TBC-IRS-Q010-5
	Service Request	3 bits	uint	TBC-IRS-Q010-6

3.3.2.5.1.1 ITC-ATO Ex System State Report ACK (Q010) EMP Header Data Length Field

The ITC-ATO Ex System State Report ACK (Q010) message contains only static fields, so the message is always the same size of 5 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.5.1.2 ITC-ATO Ex System State Report ACK (Q010) EMP Header Number Field

The ITC-ATO Ex System State Report ACK (Q010) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.5.2. ITC-ATO Ex System State Report ACK (Q010) Message Body

A summary of the ITC-ATO Ex System State Report ACK (Q010) message body is given in Table 76. Detailed descriptions and requirements follow.

Table 76: ITC-ATO Ex System State Report ACK (Q010) Message Body

ID	Field	Size, bytes	Data Type	Description
1	ACK Status	1	enum	ACK status. See Table 78.
2	Coordination number	4	uint	Coordination number from the ITC-ATO Ex System State Report (Q110) message being acknowledged

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 77. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 77: ITC-ATO Ex System State Report ACK (Q010) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.2.5.3. ITC-ATO Ex System State Report ACK (Q010) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an ITC-ATO Ex System State Report ACK (Q010) message body are given in this section.

3.3.2.5.3.1 ITC-ATO Ex System State Report ACK (Q010) Message ACK Status Field, Generation Requirements

The ITC-ATO Ex System State Report ACK (Q010) message ACK Status field indicates whether the ITC-ATO Ex System State Report ACK (Q010) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 78: ITC-ATO Ex System State Report ACK (Q010) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – ITC-ATO Ex System State Report (Q110) message successfully received
1	NACK – message discarded

3.3.2.5.3.2 ITC-ATO Ex System State Report ACK (Q010) Message Coordination Number Field, Generation Requirements

The ITC-ATO Ex System State Report ACK (Q010) message coordination number is generated according to the numbering process described in Section 3.4.3.

3.3.2.5.4. ITC-ATOSS BO System State Report ACK (Q010) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the ITC-ATO Ex System State Report ACK (Q010) message are given in this section.

3.3.2.5.4.1 ITC-ATO Ex System State Report ACK (Q010) Message ACK Status Field, Use Requirements

The ITC-ATO Ex System State Report ACK (Q010) message ACK Status Field is used to support to the reliable messaging process described in Section 3.4.4.

3.3.2.5.4.2 ITC-ATO Ex System State Report ACK (Q010) Message Coordination Number Field, Use Requirements

The ITC-ATO Ex System State Report ACK (Q010) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.2.6 Exception Report ACK (Q011) Message, Version 1

ITC-ATOSS BO sends the Exception Report ACK (Q011) message to the ITC-ATO Ex to notify ITC-ATO Ex of the receipt of an Exception Report (Q111) message.

3.3.2.6.1. Exception Report ACK (Q011) EMP Header Parameters

Message-specific EMP header values for the Exception Report ACK (Q011) message are specified in Table 79.

Table 79: Exception Report ACK (Q011) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q011
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q011-1
QoS	Class	3 bits	uint	TBC-IRS-Q011-2
	Priority	3 bits	uint	TBC-IRS-Q011-3
	Network Preference	3 bits	uint	TBC-IRS-Q011-4
	Special Handling	4 bits	uint	TBC-IRS-Q011-5
	Service Request	3 bits	uint	TBC-IRS-Q011-6

3.3.2.6.1.1 Exception Report ACK (Q011) EMP Header Data Length Field

The Exception Report ACK (Q011) message only contains static fields, so the message is always the same size of 5 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.6.1.2 Exception Report ACK (Q011) EMP Header Number Field

The Exception Report ACK (Q011) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.6.2. Exception Report ACK (Q011) Message Body

A summary of the Exception Report ACK (Q011) message body is given in Table 80. Detailed descriptions and requirements follow.

Table 80: Exception Report ACK (Q011) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	ACK Status	1	enum	ACK status. See Table 82.
2	Coordination Number	4	uint	Coordination number from Exception Report (Q111) message to which this message is a reply.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 81. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 81: Exception Report ACK (Q011) Message Field Ranges

ID	Field	Range
1	Ack Status	0 to 1 (Valid enumeration values)

3.3.2.6.3. Exception Report ACK (Q011) Message Field Generation, Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an Exception Report ACK (Q011) message body are given in this section.

3.3.2.6.3.1 Exception Report ACK (Q011) Message ACK Status Field, Generation Requirements

The Exception Report ACK (Q011) Message ACK Status field indicates if the Exception Report (Q011) message is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 82: Exception Report ACK (Q011) Message ACK Status Field

Value	Description
0	ACK – Exception Report (Q111) message successfully received
1	NACK – message discarded

3.3.2.6.3.2 Exception Report ACK (Q011) Message Coordination Field, Generation Requirements

The Exception Report ACK (Q011) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.2.6.4. Exception Report ACK (Q011) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Exception Report ACK (Q011) message are given in this section.

3.3.2.6.4.1 Exception Report ACK (Q011) Message ACK Status Field, Use Requirements

The Exception Report ACK (Q011) message ACK Status Field is used to support to the reliable messaging process described in Section 3.4.4.

3.3.2.6.4.2 Exception Report ACK (Q010) Message Coordination Number Field, Use Requirements

The Exception Report ACK (Q011) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.2.7 Information Request (Q014) Message, Version 1

ITC-ATOSS BO sends the Information Request (Q014) message to the ITC-ATO Ex to request information collected by the ITC-ATOSS OB. Information is requested based on one, and only one of:

- Condition ID and code
- Location of data collection
- Time of data collection

The ability of the ITC-ATOSS BO to request a specific piece of information does not imply a requirement for the ITC-ATOSS OB to collect, archive, and provide that information. Requirements for the OB to gather and archive are given in the ITC-ATO Ex and ITC-ATO SP subsystem requirement documents.

3.3.2.7.1. Information Request (Q014) EMP Header Parameters

Message-specific EMP header values for the Information Request (Q014) message are specified in Table 83.

Table 83: Information Request (Q014) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q014
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q014-1
QoS	Class	3 bits	uint	TBC-IRS-Q014-2
	Priority	3 bits	uint	TBC-IRS-Q014-3
	Network Preference	3 bits	uint	TBC-IRS-Q014-4
	Special Handling	4 bits	uint	TBC-IRS-Q014-5
	Service Request	3 bits	uint	TBC-IRS-Q014-6

3.3.2.7.1.1 Information Request (Q014) EMP Header Data Length Field

The Information Request (Q014) message only contains static fields, so the message is always the same size of 49 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.7.1.2 Information Request (Q014) EMP Header Number Field

The Information Request (Q014) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.7.2. Information Request (Q014) Message Body

A summary of the Information Request (Q014) message body is given in Table 84. Detailed descriptions and requirements follow.

Note: to make position-based information requests the operating RR ITC-ATOSS BO must maintain a copy of the PTC track data files. The version of the file version currently in use the train is provided in the ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message.

Table 84: ITC-ATOSS BO Information Request (Q014) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	Condition ID	4	uint	The ID about which information is being requested, if applicable.
2	Condition Code	2	enum	A uint indicating the type of condition being reported as defined in the MCD, if applicable.
3	Information Type	1	enum	Type of information being requested
4	Data Resolution	1	enum	Resolution of information being requested
5	Begin SCAC	4	SCAC	SCAC of the railroading the point on track at which information collection began, if applicable
6	Begin Subdivision/District ID	2	uint	Subdivision/district ID of the point on track at which information collection began, if applicable
7	Begin Block ID	4	uint	PTC Block ID of the point on track at which information collection began, if applicable
8	Begin Position Offset	4	uint	Position offset of the point on track at which information collection began, if applicable
9	End SCAC	4	SCAC	SCAC of the railroad owning the point on track at which information collection ended, if applicable
10	End Subdivision/District ID	2	uint	Subdivision/district ID of the point on track at which information collection ended, if applicable
11	End Block ID	4	uint	Block ID of the point on track at which information collection ended, if applicable
12	End Position Offset	4	uint	Position offset of the point on track at which information collection ended, if applicable
13	Begin Time	4	uint	Timestamp at which collection of the requested information began, if applicable
14	End Time	4	uint	Timestamp at which collection of the requested information ended, if applicable
15	Request Number	2	uint	A unique identifier used to associate each information request with the reply.
16	Coordination Number	4	uint	Coordination number for use in Information Request ACK (114) message.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 85. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 85: Information Request (Q014) Message Field Ranges

ID	Field	Range
2	Condition ID	0, 0x00000010 to 0xFFFFFFFF
3	Information Type	1 to 13(Valid enumeration values)
4	Data Resolution	0 to 10 (Valid enumeration values)
5	Begin SCAC	Capital letters, left-justified, space filled Must contain at least two letters
6	Begin Subdivision/District ID	0 to 9999
7	Begin Block ID	1000 to 999999
9	End SCAC	Capital letters, left-justified, space filled Must contain at least two letters
10	End Subdivision/District ID	0 to 9999
11	End Block ID	1000 to 999999

3.3.2.7.3. Information Request (Q014) Message Reliable Messaging Properties

The Information Request (Q014) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 86.

Table 86: Information Request (Q014) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Information Request ACK (Q114)
Number of Retries	TBC-IRS-Q014-7
Retry Interval	TBC-IRS-Q014-8

3.3.2.7.4. Information Request (Q014) Message Field, Generation Requirements

Requirements placed on ITC-ATOSS BO regarding populating the fields in an Information Request (Q014) message body are given in this section.

The Information Request (Q014) message may specify the information to be collected by time, by location, or by association with a specific condition ID. When one of these fields are specified, the other two are not. The several Information Request (Q014) message time and location fields include provisions for indicating when they are unused. When a still image is requested by location the start and end location will be the same; when a still image is requested by time the start and end time will be the same.

a) When ITC-ATOSS BO generates an Information Request (Q014) message ITC-ATOSS BO shall request information using one and only one of time, location, or condition ID.

3.3.2.7.4.1 Information Request (Q014) Message Condition ID Field, Generation Requirements

The Information Request (Q014) message Condition ID field contains a unique 32-bit unsigned integer that is used to identify the specific exception condition about which information is being requested. The

condition identification numbers are assigned by ITC-ATO Ex as described in the ITC-ATO Ex subsystem requirements document. When information not associated with a specific condition is requested ITC-ATOSS BO sets the Information Request (Q014) message Condition ID to 0 to indicate "Not Applicable." Condition IDs 1 to 15 are reserved.

a) *When ITC-ATOSS BO generates an Information Request (Q014) message requesting information associated with a specific condition, ITC-ATOSS BO shall populate the Information Request (Q014) message Condition ID field with the unique identifier corresponding to the condition about which information is being requested.*

b) *When ITC-ATOSS BO generates an Information Request (Q014) message requesting information not associated with a specific condition, ITC-ATOSS BO shall populate the Information Request (Q014) message Condition ID field with 0.*

3.3.2.7.4.2 Information Request (Q014) Message Condition Code Field, Generation Requirements

The Information Request (Q014) message Condition Code field is associated with the information being requested, if applicable. Condition codes are defined in the ITC-ATO Ex subsystem requirements document. When information not associated with a specific condition is requested ITC-ATOSS BO sets the Information Request (Q014) message Condition Code field to 0 to indicate "Not Applicable."

a) *When ITC-ATOSS BO generates an Information Request (Q014) message requesting information associated with a specific condition, ITC-ATOSS BO shall populate the Information Request (Q014) message Condition Code field with the condition code describing the reported condition.*

b) *When ITC-ATOSS BO generates an Information Request (Q014) message requesting information not associated with a specific condition, ITC-ATOSS BO shall populate the Information Report (Q014) message Condition Code field with 0.*

3.3.2.7.4.3 Information Request (Q014) Message Information Type Field, Generation Requirements

The Information Request (Q014) message Information Type field contains an enumeration describing the type of information being requested.

Note: the ability of the ITC-ATOSS BO to request information of a specific type does not imply that every ITC-ATO SP will be able to provide information of that type. If a specific ITC-ATO SP is unable to provide the requested information the resulting Information Retrieval (Q115) message will indicated "ITC-ATO SP unable to provide information of the requested type."

Table 87: Information Request (Q014) Message Information Type Field Enumeration Values

Value	Description
0	Reserved
1	Still photo, visible light, centered on track centerline
2	Still photo, visible light, centered on cause of specified condition ID
3	Still photo, short-wave infrared, centered on track centerline
4	Still photo, short-wave infrared, centered on cause of specified condition ID
5	Still photo, long-wave (thermal) infrared, centered track centerline
6	Still photo, long-wave (thermal) infrared, centered on cause of specified condition ID
7	Video, visible light, centered along track centerline
8	Video, visible light, tracking cause of specified condition ID

Value	Description
9	Video, short-wave infrared, centered on track centerline
10	Video, short-wave infrared, tracking cause of specified condition ID
11	Video, long-wave (thermal) infrared, centered on track centerline
12	Video, long-wave (thermal) infrared, tracking cause of specified condition ID
13	Audio

a) *When ITC-ATOSS BO generates an Information Request (Q014) message ITC-ATOSS BO shall populate the Information Request (Q014) message Information Type field with the type of information being requested using the enumeration values given in Table 87.*

3.3.2.7.4.4 Information Request (Q014) Message Data Resolution Field, Generation Requirements

The Information Request (Q014) message Data Resolution field specifies the resolution of information to be provided, if applicable.

Note: Due to bandwidth limitations, the higher resolutions are expected to be used for only for still images.

Note: The ability of ITC-ATOSS BO to request a specific resolution does not imply that every ITC-ATOSS SP will be able to provide the requested resolution. An information request may be fulfilled using information of a different resolution based on the specific ITC-ATO SP and on how it was configured.

Table 88: Information Request (Q014) Message Data Resolution Field Enumeration Values

Value	Description
0	Not applicable
1	Very low definition (160 x 120)
2	Low definition (352 x 240, 352 x 288, or 340 x 210)
3	480p (352 x 480, 704 x 480, or 720 x 408 depending on ITC-ATO SP capability)
4	720 p (640 x 720, 960 x 720, or 1,280 x 720 depending on ITC-ATO SP capability)
5	1,080 p (960 x 1,080, 1,280 x 1,080,1,440 x 1,080, or 1,920 x 1,080, depending on ITC-ATO SP capability)
6	4 k (2,880 x 2,160 or 3,840 x 2,160, depending on ITC-ATO SP capability)
7	8 k (7,680 x 4,320)
8	16 k (15,360 x 8,640)
9	Adjust quality for current bandwidth
10	Maximum resolution

a) *When ITC-ATOSS BO generates an Information Request (014) message ITC-ATOSS BO shall populate the Information Request (Q014) message Data Resolution field with the resolution being requested using the enumeration values given in Table 88.*

3.3.2.7.4.5 Information Request (Q014) Message Begin SCAC Field, Generation Requirements

The Information Request (Q014) message Begin SCAC field provides the SCAC of the owning railroad of the point on track at which data collection began, if applicable. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message Begin SCAC field is populated with four spaces (ASCII 0x20).

a) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin SCAC field with the SCAC of the owning railroad of the point on track at which collection of the requested information began.*

b) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin SCAC field with four ASCII space (0x20) characters.*

3.3.2.7.4.6 Information Request (Q014) Message Begin Subdivision/District ID Field, Generation Requirements

The Information Request (Q014) message Begin Subdivision/District ID field provides the PTC subdivision/district ID of the subdivision/district of the point on track at which data collection began, if applicable. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message Subdivision/District ID field is populated with 0xFFFF to indicate "not applicable."

Note: While S-9503 allows any 16-bit number to be used as a PTC subdivision/district ID, S-9501 limits PTC subdivision/district IDs to 4 base-10 digits. As a result, 0xFFFF is not a valid subdivision/district ID.

a) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin Subdivision/District ID field with the PTC subdivision/district ID of the point on track at which collection of the requested information began.*

b) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin Subdivision/District ID field with 0xFFFF.*

3.3.2.7.4.7 Information Request (Q014) Message Begin Block ID Field, Generation Requirements

The Information Request (Q014) message Begin Block ID field provides the PTC Block ID of the track segment of the point on track at which data collection began, if applicable. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message Begin Block ID field is populated with 0xFFFFFFFF to indicate "not applicable."

a) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin Block ID field with the ID of the track segment of the point on track at which collection of the requested information began.*

b) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin Block ID field with 0xFFFFFFFF.*

3.3.2.7.4.8 Information Request (Q014) Message Begin Position Offset Field, Generation Requirements

The Information Request (Q014) message Begin Position Offset field provides the offset into the track segment of the point on track at which data collection began, if applicable. This offset is measured in feet from the lowest milepost end of the PTC track segment. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message Begin Position Offset field is populated with 0xFFFFFFFF.

a) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin Position Offset field with the distance, in feet, from the low milepost end of the PTC track segment to the point on track at which collection of the requested information began.*

b) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin Position Offset field with 0xFFFFFFFF.*

3.3.2.7.4.9 Information Request (Q014) Message End SCAC Field, Generation Requirements

The Information Request (Q014) message End SCAC field provides the SCAC of the owning railroad of the point on track at which data collection ended, if applicable. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message End SCAC field is populated with four spaces (ASCII 0x20).

a) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End SCAC field with the SCAC of the owning railroad of the point on track at which collection of the requested information ended.*

b) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End SCAC field with four ASCII space (0x20) characters.*

3.3.2.7.4.10 Information Request (Q014) Message End Subdivision/District ID Field, Generation Requirements

The Information Request (Q014) message End Subdivision/District ID field provides the PTC subdivision/district ID of the subdivision/district of the point on track at which data collection ended, if applicable. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message Subdivision/District ID field is populated with 0xFFFF to indicate “not applicable.”

Note: While S-9503 allows any 16-bit number to be used as a PTC subdivision/district ID, S-9501 limits PTC subdivision/district IDs to 4 base-10 digits. As a result, 0xFFFF is not a valid subdivision/district ID.

a) *When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014)*

message End Subdivision/district ID field with the PTC subdivision/district ID of the point on track at which collection of the requested information ended.

b) When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Subdivision/district ID field with 0xFFFF.

3.3.2.7.4.11 Information Request (Q014) Message End Block ID Field, Generation Requirements

The Information Request (Q014) message End Block ID field provides the PTC Block ID of the track segment of the point on track at which data collection ended, if applicable. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message End Block ID field is populated with 0xFFFFFFFF to indicate "not applicable."

a) When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End Block ID field with the SCAC of the owning railroad of the point on track at which collection of the requested information ended.

b) When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End Block ID field with 0xFFFFFFFF.

3.3.2.7.4.12 Information Request (Q014) Message End Position Offset Field, Generation Requirements

The Information Request (Q014) message End Position Offset field provides the offset into the track segment of the point on track at which data collection ended, if applicable. This offset is measured in feet from the lowest milepost end of the PTC track segment. When the information is being requested on a basis other than location, such as start & stop time, the Information Request (Q014) message End Position Offset field is populated with 0xFFFFFFFF to indicate "not applicable."

a) When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End Position Offset field with the distance, in feet, from the low milepost end of the PTC track segment to the point on track at which collection of the requested information ended.

b) When ITC-ATOSS BO generates an Information Request (Q014) message in which the location of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End Position Offset field with 0xFFFFFFFF.

3.3.2.7.4.13 Information Request (Q014) Message Begin Time Field, Generation Requirements

The Information Request (Q014) message Begin Time field contains an unsigned integer representing the UTC time at which collection of the information being requested began, if applicable. This unsigned integer is the number of seconds elapsed since midnight, January 1, 1970. When the information is being requested on a basis other than time, such as location, the Information Request (Q014) message Begin Time field will be populated with 0.

a) When ITC-ATOSS BO generates an Information Request (Q014) message in which the time of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014)

message Begin Time field with the UTC time at which the information being requested was collected.

b) When ITC-ATOSS BO generates an Information Request (Q014) message in which the time of data collection is specified, the Information Request (Q014) message Begin Time field shall be the number of seconds passed since January 1, 1970.

c) When ITC-ATOSS BO generates an Information Request (Q014) message in which the time of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message Begin Time field with 0.

3.3.2.7.4.14 Information Request (Q014) Message End Time Field, Generation Requirements

The Information Request (Q014) message End Time field contains an unsigned integer representing the UTC time at which collection of the information being requested ended, if applicable. This integer is the number of seconds elapsed since midnight, January 1, 1970. When the information is being requested on a basis other than time, such as location, the Information Request (Q014) message End Time field will be populated with 0.

a) When ITC-ATOSS BO generates an Information Request (Q014) message in which the time of data collection is specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End Time field with the UTC time at which the information being requested was collected.

b) When ITC-ATOSS BO generates an Information Request (Q014) message in which the time of data collection is specified, the Information Request (Q014) message End Time field shall be the number of seconds passed since January 1st, 1970.

c) When ITC-ATOSS BO generates an Information Request (Q014) message in which the time of data collection is not specified, ITC-ATOSS BO shall populate the Information Request (Q014) message End Time field with 0.

3.3.2.7.4.15 Information Request (Q014) Message Request Number Field, Generation Requirements

The Information Request (Q014) message Request Number field contains an ITC-ATOSS BO-assigned value for use in associating the resulting Information Retrieval (Q115) number with the information request that triggered it.

a) When ITC-ATOSS BO generates an Information Request (Q014) message, ITC-ATOSS BO shall populate the Information Request (Q014) message Request Number field with a unique value.

3.3.2.7.4.16 Information Request (Q014) Message Coordination Number Field, Generation Requirements

The Information Request (Q014) message Coordination Number field is generated according to the numbering process described in Section 3.4.3.

3.3.2.7.5. Information Request (Q014) Message Field Use Requirements

Requirements placed on ITC-ATO Ex regarding the verification and use of the Information Request (Q014) message fields are given in this section.

3.3.2.7.5.1 Information Request (Q014) Message Condition ID Field, Use Requirements

The Exception Request (Q014) message Condition ID field is used by the ITC-ATO Ex to identify the specific condition information that is being requested by the Information Request (Q014) message. When the Exception Request (Q014) message Condition ID field is set to 0 it indicates that the condition ID is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Exception Request (Q014) message Condition ID field to identify the specific condition that ITC-ATOSS BO is requesting information for using the Information Request (Q014) message.*

3.3.2.7.5.2 Information Request (Q014) Message Condition Code Field, Use Requirements

The Information Request (Q014) message Condition Code field is used by ITC-ATO Ex to identify the type of condition that that is being requested by the Information Request (Q014) message. When the Information Request (Q014) message Condition Code field is set to 0 it indicates that the condition code is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Condition Code filed to identify the type of condition that is being requested by the Information Requestion(Q014) message.*

3.3.2.7.5.3 Information Request (Q014) Message Information Type Field, Use Requirements

The Information Request (Q014) message Information Type field contains an enumeration describing the type of information being requested.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Information Type field to identify the type of information being requested by the Information Request (Q014) message, using the enumeration values given in Table 87.*

3.3.2.7.5.4 Information Request (Q014) Message Data Resolution Field, Use Requirements

The Information Request (Q014) message Data Resolution field provides ITC-ATO Ex the resolution of information to be provided by the Information Retrieval (Q115) message, when applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Data Resolution field to determine the resolution of the information to be provided by the Information Retrieval (Q115) message, using the enumeration values given in Table 88.*

3.3.2.7.5.5 Information Request (Q014) Message Begin SCAC Field, Use Requirements

The Information Request (Q014) message Begin SCAC field provides ITC-ATO Ex with the SCAC of the owning railroad of the point on track at which data collection will began, if applicable. The Information Request (Q014) message Begin SCAC field is set to 4 ASCII spaces (0x20) if the information request is not position-based, in which case the begin SCAC is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Begin SCAC field as the SCAC of the owning railroad of the point on track at which ITC-ATO Ex will begin data collection, if applicable.*

3.3.2.7.5.6 Information Request (Q014) Message Begin Subdivision/District ID Field, Use Requirements

The Information Request (Q014) message Begin Subdivision/District ID field provides ITC-ATO Ex with the PTC subdivision/district ID of the subdivision/district of the point on track at which data collection will began, if applicable. The Information Request (Q014) message Begin Subdivision/District ID field is set to 0xFFFF when the information request is not position-based, in which case the begin subdivision/district ID is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Begin Subdivision/District ID field as the PTC subdivision/district of the point of track at which ITC-ATO Ex will begin data collection, if applicable.*

3.3.2.7.5.7 Information Request (Q014) Message Begin Block ID Field, Use Requirements

The Information Request (Q014) message Begin Block ID field provides ITC-ATO Ex with the PTC Block ID of the track segment of the point on track at which data collection will began, if applicable. The Information Request (Q014) message Begin Block ID field is set to 0xFFFFFFFF when the information request is not position-based, in which case the begin block ID is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Begin Block ID field as the Block ID of the track segment at the point on track of which ITC-ATO Ex will begin data collection, if applicable.*

3.3.2.7.5.8 Information Request (Q014) Message Begin Position Offset Field, Use Requirements

The Information Request (Q014) message Begin Position Offset field provides ITC-ATO Ex with the offset into the track segment of the point on track at which data collection will began, if applicable. The Information Request (Q014) message Begin Position Offset field contains 0xFFFFFFFF when the information request is not position-based, in which case the begin position offset is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Begin Position Offset field as the offset position into the track segment of the point on track at which data collection will begin, if applicable.*

3.3.2.7.5.9 Information Request (Q014) Message End SCAC Field, Use Requirements

The Information Request (Q014) message End SCAC field provides ITC-ATO Ex with the SCAC of the owning railroad of the point on track at which data collection will end, if applicable. The Information Request (Q014) message End SCAC field is set to 4 ASCII spaces (0x20) when the information request is not position-based, in which case the end SCAC is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message End SCAC field as the SCAC of the owning railroad of the point on track at which ITC-ATO Ex will end data collection, if applicable.*

3.3.2.7.5.10 Information Request (Q014) Message End Subdivision/District ID Field, Use Requirements

The Information Request (Q014) message End Subdivision/District ID field provides ITC-ATO Ex with the PTC subdivision/district ID of the subdivision/district of the point on track at which data collection

will end, if applicable. The Information Request (Q014) message End Subdivision/District ID field contains 0xFFFF when the information request is not position-based, in which case the end subdivision/district ID is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message End Subdivision/District ID field as the PTC subdivision/district of the point of track at which ITC-ATO Ex will end data collection, if applicable.*

3.3.2.7.5.11 Information Request (Q014) Message End Block ID Field, Use Requirements

The Information Request (Q014) message End Block ID field provides ITC-ATO Ex with the PTC Block ID of the track segment of the point on track at which data collection will end, if applicable. The Information Request (Q014) message End Block ID field contains 0xFFFFFFFF when the information request is not position-based, in which case the end block ID is not applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message End Block ID field as the Block ID of the track segment at the point on track of which ITC-ATO Ex will end data collection, if applicable.*

3.3.2.7.5.12 Information Request (Q014) Message End Position Offset Field, Use Requirements

The Information Request (Q014) message End Position Offset field provides ITC-ATO Ex with the offset into the track segment of the point on track at which data collection will end, if applicable.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message End Position Offset field as the offset position into the track segment of the point on track at which data collection will end, if applicable.*

3.3.2.7.5.13 Information Request (Q014) Message Begin Time Field, Use Requirements

The Information Request (Q014) message Begin Time field provides ITC-ATO Ex with the UTC time at which collection of the information being requested will begin, if applicable. This unsigned integer is the number of seconds elapsed since midnight, January 1, 1970. When the information is being requested on a basis other than time, such as location, the Information Request (Q014) message Begin Time field will be populated with 0.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message Begin Time field to identify the time at which collection of the information being requested began, if applicable.*

3.3.2.7.5.14 Information Request (Q014) Message End Time Field, Use Requirements

The Information Request (Q014) message End Time field provides ITC-ATO Ex with the UTC time at which collection of the information being requested will ended, if applicable. This unsigned integer is the number of seconds elapsed since midnight, January 1, 1970. When the information is being requested on a basis other than time, such as location, the Information Request (Q014) message End Time field will be populated with 0.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the Information Request (Q014) message End Time field to identify the time at which collection of the information being requested ended, if applicable.*

3.3.2.7.5.15 Information Request (Q014) Message Request Number Field, Use Requirements

The Information Request (Q014) message Request Number field provides ITC-ATO Ex with the ITC-ATOSS BO-assigned value given in the Information Request (Q014) message Request Number field which will allow ITC-ATOSS BO to associate the Information Request (Q014) message with the data returned in the Information Retrieval (Q115) message.

a) *When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex shall use the value assigned in the Information Request (Q014) message Request Number field to as the request number for the resulting Information Request (Q014) message.*

3.3.2.7.5.16 Information Request (Q014) Message Coordination Number Field, Use Requirements

The Information Request (Q014) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.2.8 Information Retrieval ACK (Q015) Message, Version 1

ITC-ATOSS BO sends the Information Retrieval ACK (Q015) message to the ITC-ATO Ex to notify ITC-ATO Ex of the receipt of an Information Retrieval (Q115) message.

3.3.2.8.1. Information Retrieval ACK (Q015) EMP Header Parameters

Message-specific EMP header values for the Information Retrieval ACK (Q015) message are specified in Table 89.

Table 89: Information Retrieval ACK (Q015) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q015
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q015-1
QoS	Class	3 bits	uint	TBC-IRS-Q015-2
	Priority	3 bits	uint	TBC-IRS-Q015-3
	Network Preference	3 bits	uint	TBC-IRS-Q015-4
	Special Handling	4 bits	uint	TBC-IRS-Q015-5
	Service Request	3 bits	uint	TBC-IRS-Q015-6

3.3.2.8.1.1 Information Retrieval ACK (Q015) EMP Header Data Length Field

The Information Retrieval ACK (Q015) message only contains static fields, so the message is always the same size of 5 bytes. Requirements for setting the EMP header size are given in section EMP Header Variable Header Size Field.

Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.8.1.2 Information Retrieval ACK (Q015) EMP Header Number Field

The Information Retrieval ACK (Q015) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.8.2. Information Retrieval ACK (Q015) Message Body

A summary of the Information Retrieval ACK (Q015) message body is given in Table 90. Detailed descriptions and requirements follow.

Table 90: Information Retrieval ACK (Q015)

ID	Field	Size (bytes)	Data Type	Description
1	ACK Status	1	enum	ACK status, see Table 92
2	Coordination Number	4	uint	Coordination number from Information Retrieval (Q115) message to which this message is a reply.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 91. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 91: Information Retrieval ACK (Q015) Message

ID	Field	Range
1	ACK Status	0 to 1 (Valid enumeration values)

3.3.2.8.3. Information Retrieval ACK (Q015) Message Field Generation, Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an Information Retrieval ACK (Q015) message body are given in this section.

3.3.2.8.3.1 Information Retrieval ACK (Q015) Message ACK Status Field, Generation Requirements

The Information Retrieval ACK (Q015) Message ACK Status field indicates if the Information Retrieval (Q015) message is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 92: Information Retrieval ACK (Q015) Message ACK Status Field

Value	Description
0	ACK – Information Retrieval (Q115) message successfully received
1	NACK – message discarded

3.3.2.8.3.2 Information Retrieval ACK (Q015) Message Coordination Field, Generation Requirements

The Information Retrieval ACK (Q015) message Coordination Number field is used to support the reliable messaging process described in Section 3.4.4.

3.3.2.8.4. Information Retrieval ACK (Q015) Message Field Use Requirements

Requirements placed on ITC-ATO Ex regarding the verification and use of the Information Retrieval ACK (Q015) message are given in this section.

3.3.2.8.4.1 Information Retrieval ACK (Q015) Message ACK Status Field, Use Requirements

The Information Retrieval ACK (Q015) message ACK Status Field is used to support to the reliable messaging process described in Section 3.4.4.

3.3.2.8.4.2 Information Retrieval ACK (Q015) Message Coordination Number Field, Use Requirements

The Information Retrieval ACK (Q015) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.3.2.9 Condition Resolution (Q016), Version 1

At their discretion, BODS Personnel may remotely resolve a condition. When they do so, the ITC-ATOSS BO generates a Condition Resolution (Q016) message.

3.3.2.9.1. Condition Resolution (Q016) EMP Header Parameters

Message-specific EMP header values for the Condition Resolution (Q016) message are specified in Table 93.

Table 93: Condition Resolution (Q016) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	Q016
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-Q016-1
QoS	Class	3 bits	uint	TBC-IRS-Q016-2
	Priority	3 bits	uint	TBC-IRS-Q016-3
	Network Preference	3 bits	uint	TBC-IRS-Q016-4
	Special Handling	4 bits	uint	TBC-IRS-Q016-5
	Service Request	3 bits	uint	TBC-IRS-Q016-6

3.3.2.9.1.1 Condition Resolution (Q016) EMP Header Data Length Field

The Condition Resolution (Q016) message only contains static fields, so the message is always the same size of 13 bytes. Requirements for setting the EMP header Data Length field are given in Section 3.2.1.5.

3.3.2.9.1.2 Condition Resolution (Q016) EMP Header Number Field

The Condition Resolution (Q016) EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.9.2. Condition Resolution (Q016) Message Body

A summary of the Condition Resolution (Q016) message body is given in Table 94. Detailed descriptions and requirements follow.

Table 94: Condition Resolution (Q016) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	Condition ID	4	uint	The ID about which information is being requested, if applicable.
2	Condition Code	2	enum	The condition code of the condition being resolved.
3	Condition Status	1	enum	New status of the condition
4	Railroad SCAC	4	SCAC	Railroad SCAC of the operating railroad
5	Response Required	1	enum	The response required prior to changing condition to a less-restrictive state.
6	Coordination Number	4	uint	Coordination number for use in Condition Resolution ACK (Q116) message.

Range limitations other than those inherent to the data type placed on the above fields are provided in Table 95. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values.

Requirements for these ranges to be enforced by the receiving subsystem are given in Section 3.5.

Table 95: Condition Resolution (Q016) Message Field Ranges

ID	Field	Range
1	Condition ID	0, 0x00000010 to 0xFFFFFFFF
3	Condition Status	0 to 2 (Valid enumeration values)
4	Railroad SCAC	Capital letters, left-justified, space filled Must contain at least two letters
6	Response Required	0 to 1 (Valid enumeration values)

3.3.2.9.3. Condition Resolution (Q016) Message Reliable Messaging Properties

The Condition Resolution (Q016) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 96.

Table 96: Condition Resolution (Q016) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Condition Resolution ACK (Q116)
Number of Retries	TBC-IRS-Q016-7
Retry Interval	TBC-IRS-Q016-8

3.3.2.9.4. Condition Resolution (Q016) Message Field, Generation Requirements

Requirements placed on ITC-ATOSS BO regarding populating the fields in a Condition Resolution (Q016) message body are given in this section.

3.3.2.9.4.1 Condition Resolution (Q016) Message Condition ID Field, Generation Requirements

The Condition Resolution (Q016) message Condition ID field contains a unique 32-bit unsigned integer that is used to identify the specific exception condition about which a resolution is being transmitted.

The condition identification numbers are assigned by ITC-ATO Ex as described in the ITC-ATO Ex Subsystem Requirements document. Condition IDs 1 to 15 are reserved.

a) *When ITC-ATOSS BO generates a Condition Resolution (Q016) message ITC-ATOSS BO shall populate the Condition Resolution (Q016) message Condition ID field with the condition ID of the condition being resolved.*

3.3.2.9.4.2 Condition Resolution (Q016) Message Condition Code Field, Generation Requirements

The Condition Resolution (Q016) message Condition Code field contains the condition code of the condition being resolved. The condition ID of a condition remains the same over time while the condition code may change. For example, if an OOI is first identified as unknown, and then resolved into livestock, the condition ID will remain the same while the condition code will change from indicating "Unknown object" to indicating "Livestock." Condition codes are described detail in the ITC-ATO Ex Subsystem Requirements and ITC-ATO SP Requirements documents.

When a Condition Resolution (Q016) message is sent it resolves the condition only for the specified condition ID / condition code pair. If the condition code changes the new condition ID / condition code pair must be resolved separately. Likewise, it does not resolve conditions with the same condition code but a different condition ID.

a) *When ITC-ATOSS BO generates a Condition Resolution (Q016) message ITC-ATOSS BO shall populate the Condition Resolution (Q016) message Condition Code field with the condition code of the condition being resolved.*

3.3.2.9.4.3 Condition Resolution (Q016) Message Condition Status Field, Generation Requirements

The Condition Resolution (Q016) message Condition Status field contains the new status of the condition, as shown in Table 97.

Table 97: Condition Resolution (Q016) Message Condition Status Field Enumeration Values

Value	Description
0	Active
1	Resolve condition
2	Resolve after confirmation of response via HMI

a) *When ITC-ATOSS BO generates a Condition Resolution (Q016) message, ITC-ATOSS BO shall populate the Condition Resolution (Q016) message Condition Status field with the condition status specified by ITC-ATO BODS, using the enumeration values given in Table 97.*

3.3.2.9.4.4 Condition Resolution (Q016) Message Railroad SCAC Field, Generation Requirements

The Condition Resolution (Q016) message Railroad SCAC field provides the railroad SCAC of the ITC-ATOSS BO sending the Condition Resolution (Q016) message.

a) *When ITC-ATOSS BO generates a Condition Resolution (Q016) message, ITC-ATOSS BO shall set the Condition Resolution (Q016) message Railroad SCAC field to the SCAC of the ITC-ATOSS BO generating the Condition Resolution (Q016) message.*

3.3.2.9.4.5 Condition Resolution (Q016) Message Response Required Field, Generation Requirements

The Condition Resolution (Q016) message Response Required field specifies if a field worker or attendant must accept the resolution via the HMI prior to the condition being resolved.

Table 98: Condition Resolution (Q016) Message Response Required Field Enumeration Values

Value	Description
0	No Response
1	Attendant or utility worker response required on HMI

a) When ITC-ATOSS BO generates a Condition Resolution (Q016) message, ITC-ATOSS BO shall populate the Condition Resolution (Q016) message Response Required field with the response requirement specified by ATO BODS using the enumeration values given in Table 98.

3.3.2.9.4.6 Condition Resolution (Q016) Message Coordination Number Field, Generation Requirements

The Condition Resolution (Q016) message Coordination Number field is generated according to the numbering process described in Section 3.4.3.

3.3.2.9.5. Condition Resolution (Q016) Message Field Use Requirements

Requirements placed on ITC-ATO Ex regarding the verification and use of the Condition Resolution (Q016) message fields are given in this section.

3.3.2.9.5.1 Condition Resolution (Q016) Message Condition ID Field, Use Requirements

The Condition Resolution (Q016) message Condition ID field is used by the ITC-ATO Ex to identify the specific condition of which is being resolved.

a) When ITC-ATO Ex receives a Condition Resolution (Q016) message, ITC-ATO Ex shall use the Condition Resolution (Q016) message Condition ID field to identify the specific being resolved.

3.3.2.9.5.2 Condition Resolution (Q016) Message Condition Code Field, Use Requirements

The Condition Resolution (Q016) message Condition Code field is used by ITC-ATO Ex to identify the condition code of the condition being resolved.

a) When ITC-ATO Ex receives a Condition Resolution (Q016) message, ITC-ATO Ex shall use the Condition Resolution (Q016) message Condition Code field to identify the condition code of the condition being resolved.

3.3.2.9.5.3 Condition Resolution (Q016) Message Condition Status Field, Use Requirements

The Condition Resolution (Q016) message Condition Status field provides ITC-ATO Ex with the status of the corresponding condition.

a) When ITC-ATO Ex receives a Condition Resolution (Q016) message, ITC-ATO Ex shall, using the enumeration values in Table 97, use the Condition Resolution (Q016) message Condition Status field as the status of the corresponding condition.

3.3.2.9.5.4 Condition Resolution (Q016) Message Railroad SCAC Field, Use Requirements

The Condition Resolution (Q016) message Railroad SCAC field provides the SCAC of the ITC-ATOSS BO sending the Condition Resolution (Q016) message to the ITC-ATO Ex.

a) *When ITC-ATO Ex receives a Condition Resolution (Q016) message, ITC-ATO Ex shall use the Condition Resolution (Q016) message Railroad SCAC field as an indication of the SCAC of the ITC-ATOSS BO sending the Condition Resolution (Q016) message.*

3.3.2.9.5.5 Condition Resolution (Q016) Message Response Required Field, Use Requirements

The Condition Resolution (Q016) message Response Required field provides ITC-ATO Ex with the response of ITC-ATOSS BO to the corresponding condition.

a) *When ITC-ATO Ex receives a Condition Resolution (Q016) message, ITC-ATO Ex shall, using the enumeration values in Table 98, use the Condition Resolution (Q016) message Response Required field as the indication of the type of response required.*

3.3.2.9.5.6 Condition Resolution (Q016) Message Coordination Number Field, Use Requirements

The Condition Resolution (Q016) message Coordination Number field is used according to the numbering process described in Section 3.4.3.

3.4 Message Generation Functions

When a message is generated, the data contained within the message must be valid and up to date, within the constraints of the subsystem generating the message. When a subsystem generates a message, it may also be in the process of calculating new values of which would be included in the message. The subsystem will populate messages with the old values until the new values become available at which point any new messages generated will be populated with the new values.

Some messages include an enumeration value, flag, or other value to indicate the presence of invalid data in a specific field; record loops may have the record set to 0 if valid records cannot be provided. A field is set to indicate invalid data only when the corresponding subsystem requirements allow for it. At all other times the field is populated with valid data.

3.4.1 Data Validity

When a message is generated, the data contained within the message must be valid and up to date, within the constraints of the subsystem generating the message. When a subsystem generates a message, it may also be in the process of calculating new values of which would be included in the message. The subsystem will populate messages with the old values until the new values become available at which point any new messages generated will be populated with the new values.

Some messages include an enumeration value, flag, or other value to indicate the presence of invalid data in a specific field; record loops may have the record set to 0 if valid records cannot be provided. A field is set to indicate invalid data only when the corresponding subsystem requirements allow for it. At all other times the field is populated with valid data.

3.4.2 Message Numbering

The message number is stored in the EMP header Message Number field and is used to discard duplicate messages and to place each individual message within a sequence. When a session between ITC-ATO Ex and ITC-ATOSS BO is established the first message sent of any message type (ID) is set to 0. For

the remainder of the session, each new message of the same message type (ID) increments the EMP header Message Number of the previous message number by 1. As described in Section 3.5.1.1.6 the receiving application then discards any message received of which has an EMP header Message Number less than or equal to the EMP header Message Number of the most recently received message of that message type (ID).

The message number is not incremented when a message is resent as part of the reliable messaging process. A new message is not generated; the original is simply retransmitted. This allows the receiving subsystem to discard any duplicate messages if either the transmission infrastructure or the reliable messaging process result in duplicate messages.

a) *When an application generates the first message of a specific message type (ID), the application shall set the EMP header Message number field to 0.*

b) *When an application generates another message of a specific message type (ID), the application shall set the EMP header Message Number field to 1 greater than the EMP header Message Number field of the previous message of the same message type (ID).*

3.4.3 Coordination Numbers

Coordination numbers are used to associate replies to the requesting message. When an unsolicited message may trigger a reply, the unsolicited message contains a new coordination number. Every new coordination number must be unique within a session; this includes coordination numbers used in messages of a different type (ID). Each reply contains the coordination number of the message being replied to. This allows association of the reply to the message that triggered the reply even if several messages of the same type were received at the same time.

a) *When an application generates an unsolicited message, and the message contains a coordination number, the application shall set the coordination number to a unique value.*

b) *When an application replies to a message, and the reply contains a coordination number, the application shall set the coordination number of the reply to the coordination number of the message being replied to.*

3.4.4 Reliable Messaging Processes

The communication link between ITC-ATO Ex and ITC-ATOSS BO is not considered completely reliable. Some messages in this IRS include an application-layer reliable messaging process to ensure message delivery. When a message includes reliable delivery, reliable messaging properties are included in the message description and the message is referred to as a reliable message. The message description will specify the number of retries, the retry interval, and the acknowledge message. The acknowledge message description describes the configuration of the acknowledge message to serve as an ACK or NACK. Some acknowledge messages deliver data in addition to the ACK status; these messages do not have ACK in the message name. Some messages that deliver data in addition to the ACK status may be sent either as an ACK or unsolicited. If a message that may serve as an ACK is sent unsolicited, the ACK status field will include an option to identify unsolicited messages.

If an ACK is not received within the retry interval, or if a NACK is received, the sending application will resend the original message, and again wait for an ACK. This will be repeated until an ACK is

received or the retry limit is reached. If the retry limit is reached, and an ACK not received within the retry interval following the last retry, a delivery failure has occurred. Procedures on handling this failure are given in the ITC-ATO Ex Subsystem Requirements document and ITC-ATOSS BO Subsystem requirements document.

Because the ACK itself may be lost the receiving subsystem must resend the ACK if a duplicate reliable message is received. This may result in multiple ACKs being sent for one message both due to loss of the original ACK and due to message duplication by ITCM. Duplicate ACKs contain the same coordination number and are discarded by the subsystem receiving them.

A NACK is normally generated when a reliable message is discarded by the receiving application. The only case in which discarding a message does not generate a NACK is the reception of a message defined in this IRS from a subsystem not part of the ITC-ATO Ex-to-ITC-ATOSS BO interface established during session initialization. Such messages are discarded without a NACK as part of the EMP header source address field verification in Section 3.5.1.1.10. In the requirements below, application, sending application, and receiving application are used as defined in Section 1.5 and refer only to ITC-ATO Ex and ITC-ATOSS BO.

A NACK may also be generated if an application is unable to fulfill a request. For example, during system initialization ITC-ATO Ex may request information from ITC-ATOSS BO that is not yet available. In such cases the NACK message will indicate the specific failure and will be handled according to the startup procedures.

a) *When an application successfully receives a reliable message from the sending application, and the reliable message is a request which can be fulfilled, the receiving application shall send an ACK in reply.*

b) *When an application successfully receives a reliable message from the sending application, and the reliable message is a request which cannot be fulfilled, the receiving application shall send a NACK indicating that the request cannot be fulfilled.*

c) *If, for any reason other than reception of a duplicate message, a receiving application discards a reliable message from a sending application, the receiving application shall send a NACK in reply.*

d) *If, due to the reception of a duplicate message, a receiving application discards a reliable message from a sending application, the receiving application shall send an ACK in reply.*

e) *When an application sends a reliable message to a receiving application, an ACK is not received within the retry interval, and the number of retries for that message has not been reached, the sending application shall resend the message.*

f) *An application shall not resend a reliable message more than the number of retries specified in the message description.*

g) *When a NACK is received by an application within the retry interval for the message the NACK is in response to, and the number of retries for that message has not been reached, the application shall resend the message.*

h) *When a sending application resends a message to a receiving application, the sending application shall update the EMP header message time field.*

i) *When a sending application resends a message to a receiving application, the sending application shall not alter any fields other than the EMP header message time field.*

j) *When an application generates an ACK then the application shall use the acknowledge message defined for the type of message to which the ACK is in response to.*

k) *When an application generates a NACK then the application shall use the acknowledge message defined for the type of message for which the NACK is in response to.*

l) *When an application generates an acknowledge message then the application shall use the enumeration values given in the ACK status enumeration table for the specific acknowledge message being generated.*

3.4.5 Maximum Messaging Rate

An application must not flood the interface with messages. Sending too many messages too quickly may overload the receiving application or the network. It is assumed that solicited messages, such as ACKs and data requests, will not be solicited at a rate higher than they can be processed. Unsolicited messages of the same message type (ID) are not to be sent at a rate greater than one per TBC-IRS-Q0-Q1-3 microseconds.

a) *An application shall not send more than one unsolicited message of the same message type (ID) in any interval of TBC-IRS-Q0-Q1-3 microseconds.*

3.4.6 Data Types

The data type for each field contained within a message is defined in the message body description. When an application generates a message, the application must encode the data in each field using the specified data type. When an application receives a message, the application assumes the data in each field was encoded as the specified data type.

a) *When an application populates a message field, the application shall populate the field with data of the data type specified for the field being populated.*

b) *When an application receives a message, the application shall interpret the contents of each field as being of the data type specified for the specific field being interpreted.*

3.5 Received Message Functions

This section documents the functions to be performed by an application when a message is received. These functions are intended to verify that received messages are free of transmission errors, are properly formed, and contain data which is within the valid range.

3.5.1 Message Verification

All messages must be verified before being accepted. Message verification is broken into three categories: EMP header verification, message body verification, and EMP footer verification.

3.5.1.1 EMP Header Verification

Verification of data contained in EMP header fields is a common procedure for all received messages.

3.5.1.1.1. EMP Header Protocol Version Field Verification

Once communication between ITC-ATO Ex and ITC-ATOSS BO has been established, both subsystems are expected to consistently use the same version of the EMP. If the EMP header version number changes during a session, an error has occurred, and the contents of the message cannot be trusted.

a) *If ITC-ATO Ex receives a message from ITC-ATOSS BO and the EMP header protocol version is not the version established during session initialization, ITC-ATO Ex shall discard that message.*

b) *If ITC-ATOSS BO receives a message from ITC-ATO Ex and the EMP header protocol version is not the version established during session initialization, ITC-ATOSS BO shall discard that message.*

3.5.1.1.2. EMP Header Message Type (ID) Field Verification

The EMP header message type (ID) field is used to identify the message type (ID), allowing the receiving application to correctly interpret the message.

a) *When a receiving application receives an interoperable message from a sending application, the receiving application shall use the value in the EMP header message type (ID) field as the message type (ID) of the received message.*

b) *If a receiving application receives an interoperable message from a sending application, and the value in the EMP header message type (ID) field does not match any message type (ID) described in this IRS, the receiving application shall discard the message.*

3.5.1.1.3. EMP Header Message Version Field Verification

The IRS version is selected during session initialization as described in Section 4.2. Once session initialization is complete, only messages in the active IRS version are accepted.

a) *When the IRS version synchronization procedure has not been completed, an application shall accept any interoperable message regardless of the contents of the EMP message version field.*

b) *When the IRS version synchronization procedure has been completed, an application shall discard any messages for which the EMP header message version field does not match the message version number given in the message description for the received message type (ID).*

3.5.1.1.4. EMP Header Flags Verification

During message verification the receiving application checks the EMP header Flags bits 3 and 4: Data Integrity for conformance with the IRS. The EMP header Flags bits 3 and 4: Data Integrity are treated as a single field storing values ranging from 0 to 3. If the EMP flags are not configured according to the requirements given in Section 3.2, and the requirements given in the description for the specific message received, the message should be rejected. Requirements for performing a CRC or HMAC check, if needed, are given in Section 3.5.1.3. Messages that do not support data integrity have the EMP footer Data Integrity field set to 0. If the footer is non-zero and no data integrity is specified in the EMP Header Flags field, then an error has occurred.

a) *If an application receives a message for which the message description specifies no data integrity and the EMP header Flags Data Integrity field is not set to 0, the application shall discard the message.*

b) *If an application receives a message for which the message description specifies a CRC and the EMP header Flags Data Integrity field is not set to 1, the application shall discard the message.*

c) *If an application receives a message for which the message description specifies an HMAC and the EMP header Flags Data Integrity is not set to 2, the application shall discard the message.*

d) *If an application receives a message in which the EMP header Flags Data Integrity field is set to 3, the application shall discard the message.*

3.5.1.1.5. EMP Header Data Length Field Verification

If the length of a received message does not match the provided data length, a message should be rejected. For example, if several bytes are lost in transmission, the length of the message will differ from the length given in the EMP header.

a) *If an application receives a message in which the EMP header Data Length field does not match the size, in bytes, of the body of the received message, the application shall discard the message.*

b) *If an application receives a message in which the value in the EMP header Data Length field does not match the size of the message calculated per the message description, the application shall discard the message.*

3.5.1.1.6. EMP Header Message Number Field Verification

The message numbering process is described in Section 3.4.2. If two messages with the same message type (ID) and the same message number are received, then either an error or a duplicate message has occurred, and the duplicate message is discarded. ITCM routing may result in duplicate messages and ITCM requires the receiving application to handle duplicate messages. The reliable messaging process also may result in duplicate messages. To allow for easy identification of duplicate messages, any message with an EMP header Message Number less than or equal to the most recently received message of the same message type (ID) is assumed to be either a duplicate or stale message.

The reliable messaging process described in Section 3.4.4 requires that an ACK be sent for each duplicate message received. This is the only case in which a discarded message may generate an ACK. If message duplication by ITCM results in multiple ACKs being received for a single message the duplicate ACKs will be discarded.

a) *If a receiving application receives a message which has an EMP header Message Number less than or equal to that of prior message with the same message type (ID), then the receiving application shall discard the message.*

3.5.1.1.7. EMP Header Message Time Field Verification

The EMP header message time field should be interpreted according to the EMP header time stamp format flag. A time stamp format flag of 0 indicates relative time, which is the time elapsed since the last message of that type was created. A time stamp format flag of 1 indicates absolute time, which is the UTC time of message creation.

a) *When an application receives a message in which the EMP header Flags bit 0: Time Stamp Format, is set to 1 the application shall interpret the EMP header Message Time field as the UTC time of message creation.*

b) *When an application receives a message in which the EMP header Flags bit 0: Time Stamp Format, is set to 1 the receiving application shall interpret the EMP header Message Time Field as the number of seconds elapsed since midnight, January 1, 1970.*

c) *When the EMP header Flags bit 0: Time Stamp Format, is set to 0 the receiving application shall interpret the EMP header Message Time Field as the number of seconds since the last message of the same type was created by the sending application.*

d) *If an application receives a message in which the EMP header Flags bit 0: Time Stamp Format, is set to 1, and the EMP header Message Time Field indicates that the message is older than TBC-IRS-Q0-Q1-3 seconds, the receiving application shall discard the message.*

3.5.1.1.8. EMP Header Routing Quality of Service Flags Verification

The QoS flags are used in message routing and do not concern the receiving system.

3.5.1.1.9. EMP Header Time to Live Field Verification

Time to live is used to prevent stale or corrupted messages from flooding the network; it does not concern the receiving system.

3.5.1.1.10. EMP Header Source Address Field Verification

Only messages from the sending application with which the receiving application is communicating should be accepted as part of the communication defined in this IRS. Any messages identified by this IRS, but not sent by the sending application, are assumed to be either erroneous or malicious and are discarded.

a) *If, as part of the Class D link established to support this interface, an application receives a message in which the EMP header source address is not a valid EMP address for the application with which the receiving application is communicating, the message shall be discarded.*

3.5.1.1.11. EMP Header Destination Address Field Verification

An application should only accept messages addressed to it. All other messages should be rejected.

a) *If an application receives a message, and the EMP header destination address is not a valid address for the receiving application, then the receiving application shall discard the message.*

3.5.1.2 Message Body Verification

When an application receives a message, the contents of the message must be checked for compliance with the listed valid ranges. Many fields do not have any range limits and any value of which can fit within the provided data type and size is presumed to be valid. Some fields have restrictions on their valid range and an out-of-range value renders the message invalid. If any fields within a message are out of range the message is invalid and must be discarded. Any range limits placed on fields within a message is listed in a Message Field Ranges table within the message body description.

a) *If an application receives a message containing one or more out-of-range values the application shall discard the message.*

3.5.1.3 EMP Footer Verification

The EMP footer contains a data integrity check value as specified in the EMP header flags see Section 3.2.1.4. A data integrity check is performed based on the setting of the data integrity flags. If no data integrity value is provided, the footer is set to 0. If the footer is non-zero and the data integrity flags indicate no data integrity check, it is likely that the flag bits themselves were corrupted. The selection of the data integrity check is specified on a message-by-message basis.

a) *If an application receives a message in which the data integrity field is set to zero, and a non-zero value is in the EMP footer, the application shall discard the message.*

b) *When an application receives a message in which the data integrity field is set to 1, the application shall perform a CRC check as specified in S-9354.*

c) *If a message fails a CRC check the application shall discard the failing message.*

d) *When an application receives a message, and the data integrity field is set to 2, the application shall perform an HMAC check.*

e) *If a message fails an HMAC check the application shall discard the failing message.*

4.0 ITC-ATO Ex & ITC-ATOSS BO Process Definitions

Process definitions herein provide an overview of the message flow for common messaging processes. For detailed descriptions and requirements to implement the process refer to the ITC-ATO Concept of Operation, ITC-ATO System requirements, ITC-ATO Ex Subsystem Requirements, and ITC-ATOSS BO Segment requirements documentation.

4.1 ITC-ATO Ex ITCM Class D Link

The session between ITC-ATO Ex and ITC-ATOSS BO is established during train initialization. ITC-ATO Ex establishes a Class D link with the ITCM Application Gateway using the parameters given in Table 7. This allows ITC-ATO Ex to send ITC-ATOSS BO messages via ITCM.

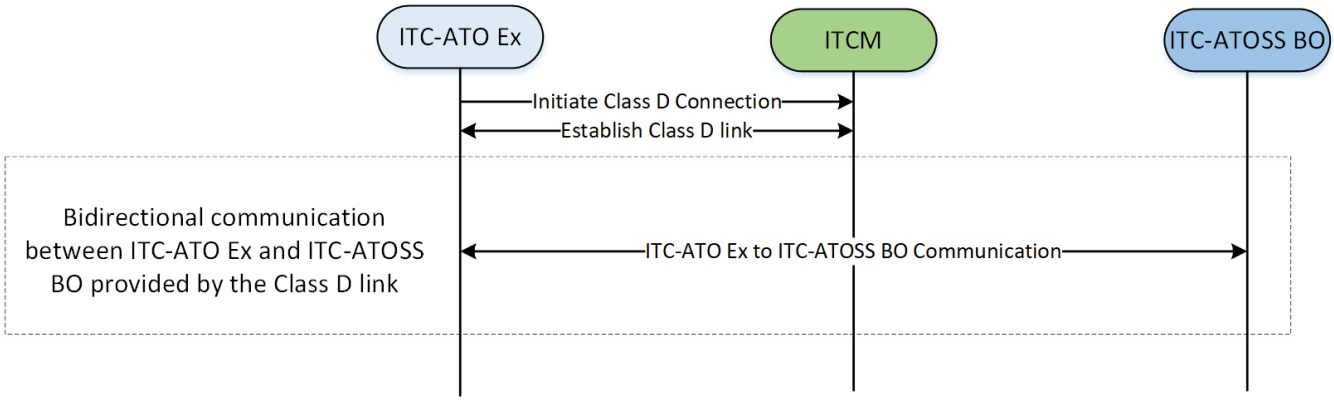

Figure 2: ITC-ATO Ex to ITCM Application Gateway Class D Link Process Flow Diagram

4.2 Interface Version Negotiation Process

Once ITC-ATO Ex establishes a Class D link with the ITCM Application Gateway, ITC-ATO Ex is able to send ITC-ATOSS BO messages via ITCM. Interface negotiation occurs when the first ATO Ex/ITC-

ATO SP Configuration Version List Request (Q103) message is sent by ITC-ATO Ex to ITC-ATOSS BO.

The interface version is established as follows:

1) ITC-ATO Ex sends ITC-ATOSS BO an ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message.
2) For the remainder of the session, ITC-ATO Ex and BOS conduct all communication using the IRS version given in the initial ATO Ex/ITC-ATO SP Configuration Version List Request (Q103) message.

Each ITC-ATOSS BO must support all interface versions for every ITC-ATO Ex deployment for which it may be the owning, operating, or employing RR.

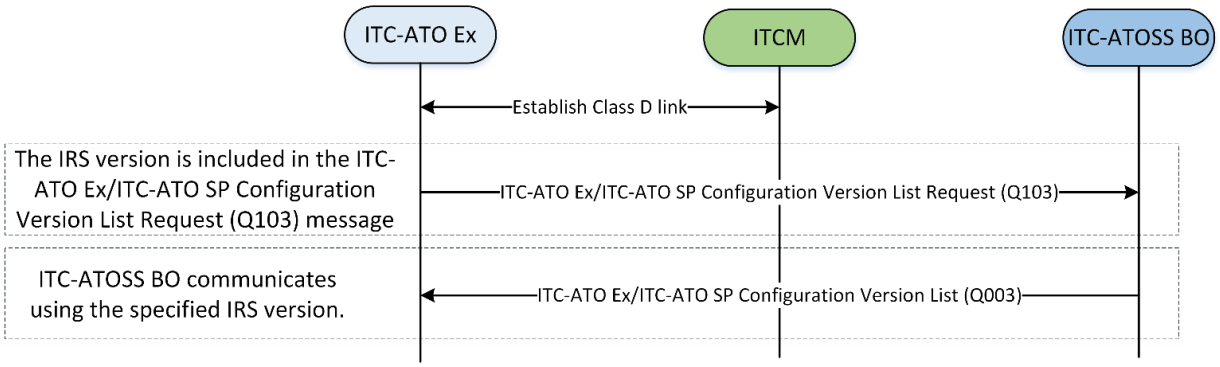

Figure 3: IRS Version Synchronization Process Flow Diagram

The ITC-ATO Ex System State Report (Q110) message is sent to the owning railroad's ITC-ATOSS BO prior to interface version negotiation, and so it also contains the IRS version. This allows ITC-ATOSS BO to correctly interpret the message but does not trigger the interface version negotiation process.

4.3 Polling Registration Process

ITC-ATO Ex is responsible for registering and deregistering each subdivision/district along the trains route. Each subdivision/district is registered only with the ITC-ATOSS BO of the railroad operating that subdivision/district.

To both begin and end the Polling Process with an ITC-ATOSS BO, ITC-ATO Ex sends it an ITC-ATOSS BO Poll Registration (Q102) message. The ITC-ATOSS BO Poll Registration (Q102) message provides the ITC-ATOSS BO with the information needed to begin or end the polling process. The information provided by ITC-ATO Ex includes:

- IRS Version Number
- Railroad SCAC
- Reason for Sending (either registering or deregistering)
- Each Subdivision/District being registered or deregistered
- Train identification information
- ITC-ATO Ex Configuration Version
- ITC-ATO SP Configuration Version

ITC-ATOSS responds to valid ITC-ATOSS Poll Registration (Q102) messages with an ITC-ATOSS BO Poll Registration Confirmation (Q002) message. During registration, the ITC-ATOSS BO Poll Registration Confirmation (Q002) message will inform ITC-ATO Ex if it can begin the Polling Process by setting the Reason for Sending field to “Registering.”

During deregistration, the ITC-ATOSS BO Poll Registration (Q102) message will indicate to ITC-ATOSS BO that it should not expect another poll message from ITC-ATO Ex and ITC-ATOSS BO will reply with an ITC-ATOSS BO Poll Registration Confirmation (Q002) message with its Reason for Sending field set to “Deregistering.”

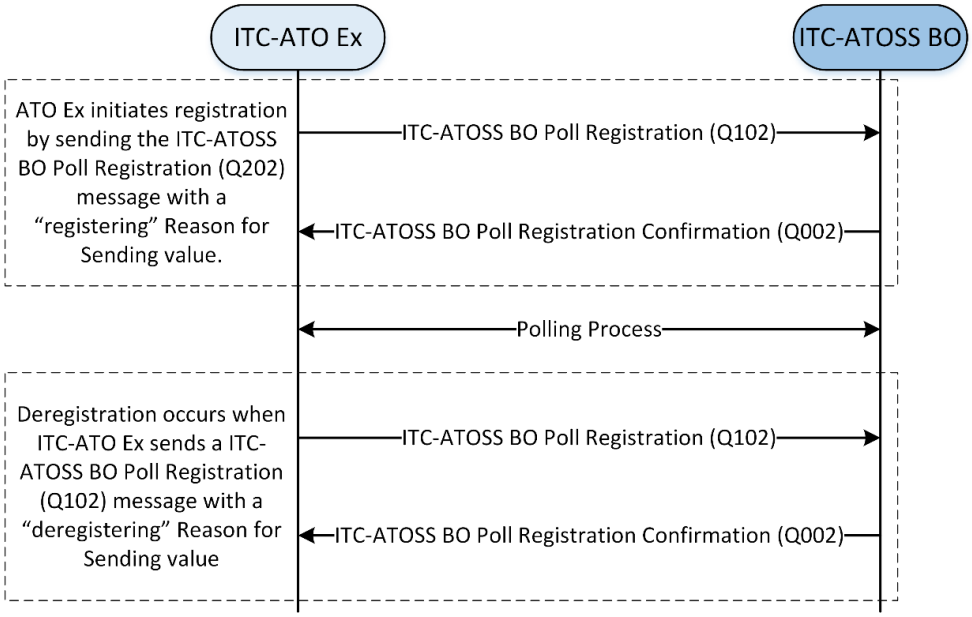

Figure 4: Poll Registration Diagram

4.4 Polling Process

ITC-ATO Ex sends an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message to each ITC-ATOSS BO a minimum of every TBC seconds, as defined in [ITC-ATO Ex Subsystem Requirement Document.] and ITC-ATOSS BO replies with an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message. This polling process serves three purposes:

1) Maintain a keep-alive message exchange between ITC-ATO Ex and the ITC-ATOSS BO,
2) Provide verification that ITC-ATO Ex datasets are synchronized with acceptable ITC-ATOSS BO datasets.
3) Ensure constant sharing of important status information.

Applications may send a poll message more frequently than every TBC seconds. This may be required by critical status changes, or an application may send a poll message early to guarantee that it is sent within a required time. Requirements defining conditions for application generation of status messages are defined within the respective subsystem requirements documents.

To implement the keep-alive functionality, each subsystem monitors for the poll message from the other. If either application does not successfully receive the corresponding poll message within the time limit

defined in [ITC-ATO Ex / ITC-ATOSS BO subsystem requirements documents], the application failing to receive the expected poll message will treat the absence of poll messages as a failure of the paired subsystem.

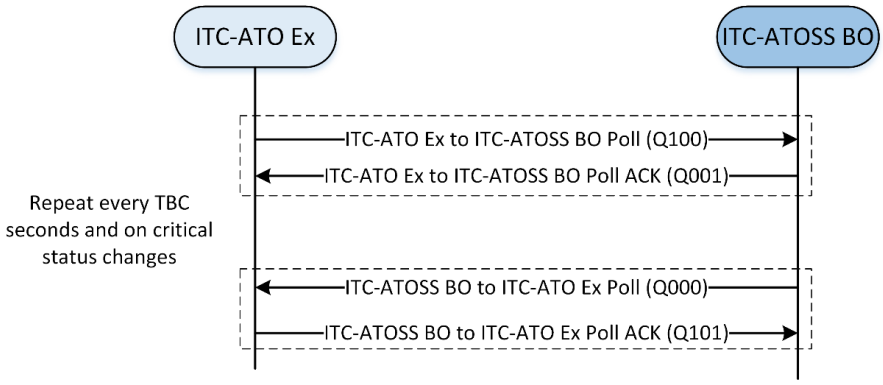

Figure 5: Poll Process Flow Diagram

4.4.1 Poll Message Reliability

Both poll messages are reliable messages. The ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) will be resent if an ITC-ATOSS BO to ITC-ATO Ex Poll (Q000) message is not received in reply. The ITC-ATOSS BO to ITC-ATO Ex BO Poll (Q000) will be resent if an ITC-ATO Ex to ITC-ATOSS BO Poll (Q100) message is not received in reply.

4.5 Exception Report Process

The Exception Report process is crucial for notifying ITC-ATOSS BO of conditions detected by ITC-ATO Ex and/or ITC-ATO SP. When a new or updated condition needs reported ITC-ATO Ex will send ITC-ATOSS BO an Exception Report (Q111) message with the following information:

- Condition ID and code, used to identify the reported condition
- Time the condition causing the exception was detected or updated
- Condition severity
- Train identification information
- Location of both the HOT and EOT
- The direction of travel of the HOT

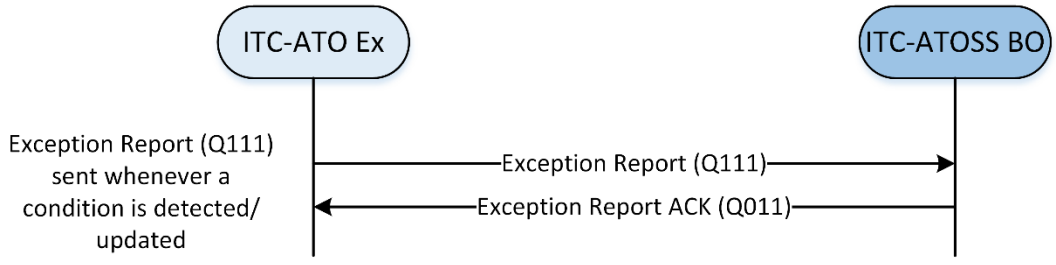

Figure 6: Exception Report Flow Diagram

4.6 Information Retrieval Process

The information retrieval process allows ITC-ATO Back Office Decision Support (BODS) personnel to request images, audio, and video from a train by sending an Information Request (Q014) message. Information is requested by one, and only one, of location, time, or condition ID. The Information Request (Q014) message provides ITC-ATO Ex with the information required to retrieve the information requested. This information consists of some, but not all, of:

- Condition data for requesting information associated with a specific condition
- The type of information to be retrieved (e.g., still photo, video, audio) and the quality/resolution
- Start and end locations specified as points on track
- Start and end time
- A request number, used by ITC-ATOSS BO to associate the information request with the data retrieved

When ITC-ATO Ex receives an Information Request (Q014) message, ITC-ATO Ex retrieves the requested data, if possible. ITC-ATO Ex then replies with an Information Retrieval (Q115) message containing:

- The condition information, if applicable.
- Train identification information
- An indication as to if the requested information was successfully retrieved
- The type and size of information that was successfully retrieved, if any
- Any information that was successfully retrieved, if any.
- The request number from the corresponding Information Request (Q014) message

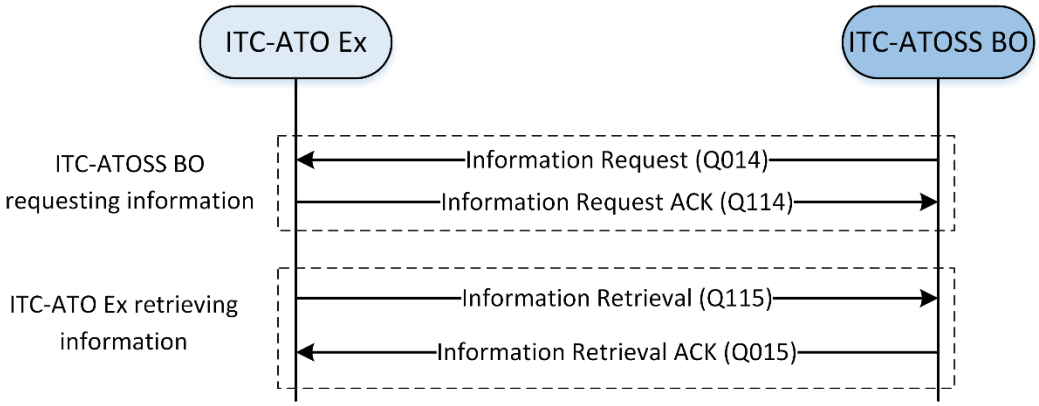

Figure 7: Information Request Flow Diagram

4.7 Condition Resolution Process

Some conditions may be resolved by ITC-ATO BODS personnel, possibly with the help of utility workers. When ITC-ATO BODS resolves a condition, they may interface with ITC-ATOSS BO to send a Condition Resolution (Q016) message informing ITC-ATO Ex of the condition resolution. The Condition Resolution (Q016) message provides the condition information, railroad SCAC and response required information needed for ITC-ATO Ex to mark a condition as resolved.

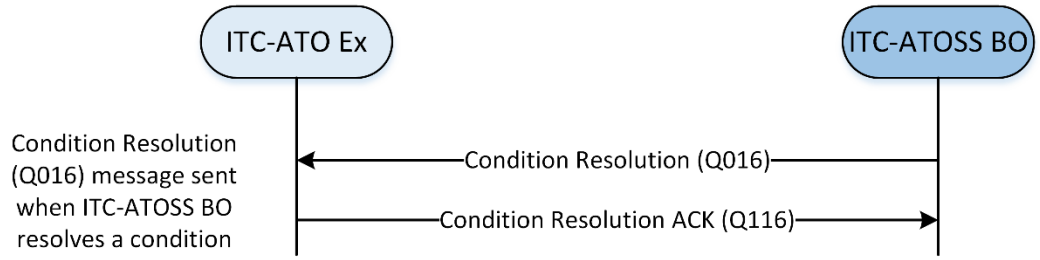

Figure 8. Condition Resolution Flow Diagram

4.8 System State Report Process

When ITC-ATO Ex's state changes it sends an ITC-ATO Ex System State Report (Q110) message to the ITC-ATOSS BO of each operating railroad. This informs ITC-ATO BOSS of the state changes and any errors related to the state transition. The ITC-ATO Ex System State Report (Q110) message provides the following information:

- The IRS version
- The SCAC of the ITC-ATOSS BO to which the message is sent.
- The reason for sending
- The previous and current ITC-ATO Ex states
- Train identification information

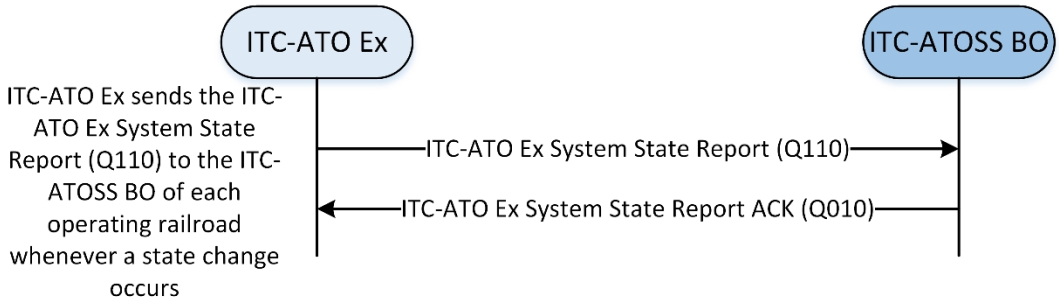

Figure 9: System State Report Flow Diagram

Appendix A-1. Configurable Parameters

Configurable parameters identified in this document are defined in the following tables. Table 99 provides general configurable parameters that are specific to this IRS but not to any one message.

Table 99: General Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-Q0-Q1-1	Maximum message age	N/A	60	s
TBC-IRS-Q0-Q1-3	Minimum time between unsolicited messages of the same type	N/A	1,000	µs

Table 100 contains configurable parameters specific to the Class D link established between the ITCM Application Gateway and ATO Ex.

Table 100: Class D Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-Q0-Q1-CD-1	TCP port for ITC-ATO Ex to ITCM Application Gateway link	1,028 to 49,150	TBD	N/A
TBC-IRS-Q0-Q1-CD-2	Log traffic (ATO Ex)	Yes/No	No	N/A
TBC-IRS-Q0-Q1-CD-3	Log traffic (ITC-ATOSS BO)	Yes/No	No	N/A
TBC-IRS-Q0-Q1-CD-4	Keep-alive interval	0 to 60,000	60,000	ms
TBC-IRS-Q0-Q1-CD-5	Keep-alive ACK timeout	0 to 60,000	30,000	ms
TBC-IRS-Q0-Q1-CD-6	Data ACK enabled	Yes/No	Yes	N/A
TBC-IRS-Q0-Q1-CD-7	Data ACK timeout	1 to 60,000	30,000	ms
TBC-IRS-Q0-Q1-CD-8	Data NACK retry limit	0 to 10	3	retries
TBC-IRS-Q0-Q1-CD-9	ACK timer delay	Yes/No	No	N/A
TBC-IRS-Q0-Q1-CD-10	Retransmit delay	0 to 10,000	5,000	ms
TBC-IRS-Q0-Q1-CD-11	Connection attempt timeout	0 to 60,000	60,000	ms
TBC-IRS-Q0-Q1-CD-12	Connection delay	0 to 60,000	60,000	ms
TBC-IRS-Q0-Q1-CD-13	Connection retry limit	-1 to 10,000 (-1=forever)	-1	retries
TBC-IRS-Q0-Q1-CD-14	Reconnection limit	-1 to 10,000 (-1=forever)	-1	retries

Table 101 contains configurable parameters specific to individual messages generated by ITC-ATO Ex for transmission to ITC-ATOSS BO.

Table 101: ITC-ATO Ex to ITC-ATOSS BO Message-Specific Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-Q100-1	Q100 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q100-2	Q100 EMP Class	0 to 7	0	N/A
TBC-IRS-Q100-3	Q100 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q100-4	Q100 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q100-5	Q100 EMP Special Handling	0 to 15	0	N/A

TBC	Description	Range	Default	Units
TBC-IRS-Q100-6	Q100 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q100-7	Q100 Number of Retries	N/A	3	retries
TBC-IRS-Q100-8	Q100 Retry Interval	N/A	3	s
TBC-IRS-Q101-1	Q101 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q101-2	Q101 EMP Class	0 to 7	0	N/A
TBC-IRS-Q101-3	Q101 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q101-4	Q101 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q101-5	Q101 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q101-6	Q101 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q102-1	Q102 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q102-2	Q102 EMP Class	0 to 7	0	N/A
TBC-IRS-Q102-3	Q102 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q102-4	Q102 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q102-5	Q102 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q102-6	Q102 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q102-7	Q102 Number of Retries	N/A	3	retries
TBC-IRS-Q102-8	Q102 Retry Interval	N/A	3	s
TBC-IRS-Q103-1	Q103 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q103-2	Q103 EMP Class	0 to 7	0	N/A
TBC-IRS-Q103-3	Q103 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q103-4	Q103 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q103-5	Q103 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q103-6	Q103 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q103-7	Q103 Number of Retries	N/A	3	retries
TBC-IRS-Q103-8	Q103 Retry Interval	N/A	3	s
TBC-IRS-Q110-1	Q110 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q110-2	Q110 EMP Class	0 to 7	0	N/A
TBC-IRS-Q110-3	Q110 EMP Priority	0 to 7	5	N/A
TBC-IRS-Q110-4	Q110 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q110-5	Q110 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q110-6	Q110 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q110-7	Q110 Number of Retries	N/A	3	retries
TBC-IRS-Q110-8	Q110 Retry Interval	N/A	3	s
TBC-IRS-Q111-1	Q111 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q111-2	Q111 EMP Class	0 to 7	0	N/A
TBC-IRS-Q111-3	Q111 EMP Priority	0 to 7	7	N/A
TBC-IRS-Q111-4	Q111 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q111-5	Q111 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q111-6	Q111 EMP Service Request	0 to 15	0	N/A

TBC	Description	Range	Default	Units
TBC-IRS-Q111-7	Q111 Number of Retries	N/A	3	retries
TBC-IRS-Q111-8	Q111 Retry Interval	N/A	3	s
TBC-IRS-Q114-1	Q114 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q114-2	Q114 EMP Class	0 to 7	0	N/A
TBC-IRS-Q114-3	Q114 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q114-4	Q114 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q114-5	Q114 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q114-6	Q114 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q114-7	Q114 Number of Retries	N/A	3	retries
TBC-IRS-Q114-8	Q114 Retry Interval	N/A	3	s
TBC-IRS-Q115-1	Q115 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q115-2	Q115 EMP Class	0 to 7	0	N/A
TBC-IRS-Q115-3	Q115 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q115-4	Q115 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q115-5	Q115 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q115-6	Q115 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q115-7	Q115 Number of Retries	N/A	3	retries
TBC-IRS-Q115-8	Q115 Retry Interval	N/A	3	s
TBC-IRS-Q116-1	Q116 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q116-2	Q116 EMP Class	0 to 7	0	N/A
TBC-IRS-Q116-3	Q116 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q116-4	Q116 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q116-5	Q116 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q116-6	Q116 EMP Service Request	0 to 15	0	N/A

Table 102 contains configurable parameters specific to individual messages generated by ITC-ATOSS BO for transmission to ATO Ex.

Table 102: ITC-ATOSS BO to ITC-ATO Ex Message-Specific Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-Q000-1	Q000 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q000-2	Q000 EMP Class	0 to 7	0	N/A
TBC-IRS-Q000-3	Q000 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q000-4	Q000 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q000-5	Q000 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q000-6	Q000 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q000-7	Q000 Number of Retries	N/A	3	retries
TBC-IRS-Q000-8	Q000 Retry Interval	N/A	3	s
TBC-IRS-Q001-1	Q001 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q001-2	Q001 EMP Class	0 to 7	0	N/A

TBC	Description	Range	Default	Units
TBC-IRS-Q001-3	Q001 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q001-4	Q001 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q001-5	Q001 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q001-6	Q001 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q002-1	Q002 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q002-2	Q002 EMP Class	0 to 7	0	N/A
TBC-IRS-Q002-3	Q002 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q002-4	Q002 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q002-5	Q002 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q002-6	Q002 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q003-1	Q003 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q003-2	Q003 EMP Class	0 to 7	0	N/A
TBC-IRS-Q003-3	Q003 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q003-4	Q003 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q003-5	Q003 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q003-6	Q003 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q010-1	Q010 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q010-2	Q010 EMP Class	0 to 7	0	N/A
TBC-IRS-Q010-3	Q010 EMP Priority	0 to 7	5	N/A
TBC-IRS-Q010-4	Q010 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q010-5	Q010 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q010-6	Q010 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q011-1	Q011 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q011-2	Q011 EMP Class	0 to 7	0	N/A
TBC-IRS-Q011-3	Q011 EMP Priority	0 to 7	7	N/A
TBC-IRS-Q011-4	Q011 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q011-5	Q011 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q011-6	Q011 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q014-1	Q014 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q014-2	Q014 EMP Class	0 to 7	0	N/A
TBC-IRS-Q014-3	Q014 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q014-4	Q014 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q014-5	Q014 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q014-6	Q014 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q014-7	Q014 Number of Retries	N/A	3	retries
TBC-IRS-Q014-8	Q014 Retry Interval	N/A	3	s
TBC-IRS-Q015-1	Q015 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q015-2	Q015 EMP Class	0 to 7	0	N/A
TBC-IRS-Q015-3	Q015 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q015-4	Q015 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q015-5	Q015 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q015-6	Q015 EMP Service Request	0 to 15	0	N/A

TBC	Description	Range	Default	Units
TBC-IRS-Q016-1	Q016 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-Q016-2	Q016 EMP Class	0 to 7	0	N/A
TBC-IRS-Q016-3	Q016 EMP Priority	0 to 7	4	N/A
TBC-IRS-Q016-4	Q016 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-Q016-5	Q016 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-Q016-6	Q016 EMP Service Request	0 to 15	0	N/A
TBC-IRS-Q016-7	Q016 Number of Retries	N/A	3	retries
TBC-IRS-Q016-8	Q016 Retry Interval	N/A	3	s

Appendix A-2. Supporting Information

Some messaging behaviors depend on the ITC-ATO Ex state. Operative and inoperative states are defined here to support the definition of messages and related messaging requirements. These definitions are only applicable within this document.

When ATO is in any of the states listed in Table 103 it is in an inoperative state; when ITC-ATO Ex is in any of the states listed in Table 104 it is in an operative state.

Table 103: ITC-ATO Ex Inoperative States

State	Description
0	Power up
1	Failed
2	ITC-ATO Ex non-init
3	ITC-ATO Ex initialization
4	Pre-arm setup
8	Automated exception
10	Attended exception
12	Manual setup
13	Attended setup
17	ATO cut-out

Table 104: ITC-ATO Ex Operative States

State	Description
5	Unarmed configured
6	Armed autonomous standby
7	Automated Active
9	Attended active
11	Manual control
14	Attended ready
15	ITM
16	Shadow

Appendix B.
ITC-ATOSS BO to ITC-PTC BO IRS

Automated Train Operation Interface Requirements Specification Development Summary Report: Appendix B. ITC-ATOSS BO to ITC-PTC BO IRS

Interface Requirement Specification

Draft

Revision 0.5

Prepared by Transportation Technology Center,

Inc. May 2021

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1.0 Scope

This document defines interoperable communication requirements to establish a bidirectional interface between the paired subsystems. This includes specifying the protocols used, message format, message contents, data types, messaging parameters, message generation requirements, message verification requirements, and message use requirements. It does not include specification of the physical communication link between the paired subsystems.

1.1 Document Identification

This document defines the interoperable message interface requirements for communication between the Interoperable Train Control Positive Train Control Back Office (ITC-PTC BO) and the Interoperable Train Control Automated Train Operation Back Office (ITC-ATOSS BO).

1.1.1 IRS Version Number

An interface version number is used by ATO subsystems to automatically distinguish between the interfaces implemented using this IRS revision and interfaces implemented using future IRS revisions. Any new revision of this IRS of which changes the interface will increment the interface version number by 1. Valid versions range from 1 to 255. Version 0 is reserved. The interface version number is a digital interface identification and is not the same thing as the IRS document revision number. An IRS revision of which does not change the interface, such as revisions to improve clarity, will not increment the interface version number.

The interface version number for this IRS is 1.

1.2 System Overview

The ATO system consists of four segments:

- ATO Back Office Segment
- ATO Onboard Segment
- ATO Field Segment
- Communication Segment (Interoperable Train Control Messaging, ITCM)

Each ATO system segment is composed of one or more subsystems. Figure 1 depicts the relationship of each ATO segment and subsystem. Only ATO SoS components (e.g., ITC-PTC OB, ATO Ex, ITC-EMS) and components that interact directly with ATO SoS (e.g., LIG, LCCM) are shown. This IRS documents the interface between ITC-PTC BO and ITC-ATOSS BO as shown in Figure 1.

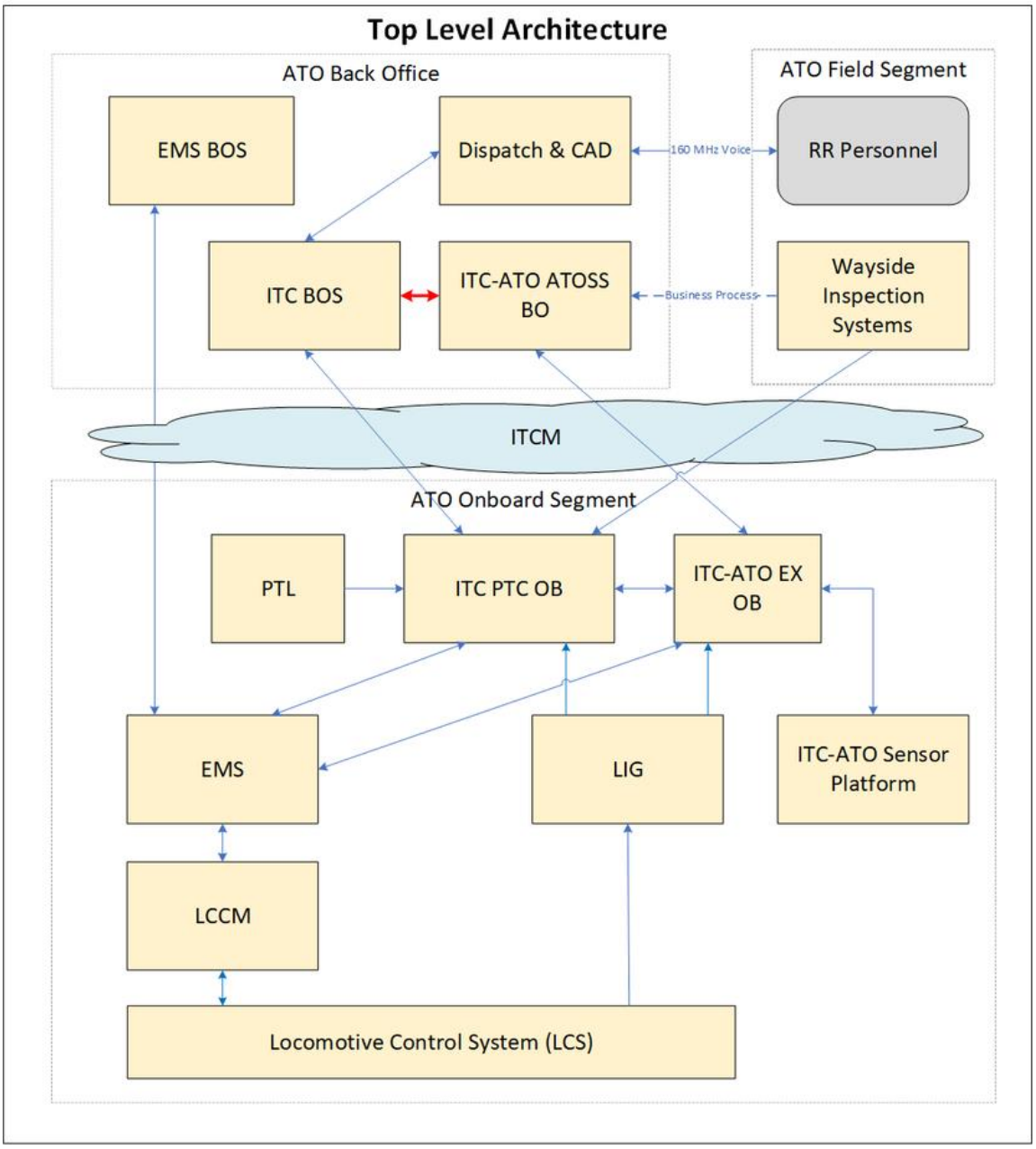

Figure 1: ATO Top Level Architecture

1.3 Document Overview

Interoperable protocol requirements, message definitions, message use, and messaging functions for the interface between ITC-PTC BO and ITC-ATOSS BO are defined within this document. This document is organized into four sections:

- Section 1 identifies the interfacing subsystems to which this IRS applies, provides an overview of the document, and an acronym list.
- Section 2 lists applicable standards and reference documents.

- Section 3 provides message definitions and messaging requirements.
- Section 4 provides message process narratives to place some messaging requirements in context.

Subsections of Section 3 generally contain two parts: narrative text and explicit requirements. The narrative text includes background information, goals and other supplemental information provided to clarify the requirements. In accordance with RFC 2119, the following terms are used to identify requirements, preferences or recommendations, and options:

- Absolute requirements contain the word “shall” and follow in a lettered list beneath the narrative text.
- Absolute prohibitions contain the term “shall not” and follow in a lettered list beneath the narrative text along with absolute requirements.
- Recommendations are identified as such and use the word “should” or “recommended” instead of “shall.” The use of “should” means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- Recommendations against an undesirable system feature or behavior are identified with the terms “should not” or "not recommended." The use of these terms means that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood, and the case carefully weighed before implementing any behavior described with this label.
- The terms “may” or “optional” indicate system features or behaviors that are truly optional.

1.4 Acronyms and Abbreviations

Table 1: Acronyms and Abbreviations

Abbreviation	Meaning
AAR	Association of American Railroads
AG	Application Gateway
ASCII	American Standard Code for Information Interchange
ATO Ex	Automated Train Operation Executive Subsystem
ATO	Automated Train Operation
ATO SP	Automated Train Operation Sensor Platform
BODS	Back Office Decision Support
BOS	Back Office System
CRL	Certificate Revocation List
CRC	Cyclic Redundancy Check
EOT	End of Train
EMP	Edge Message Protocol
EMS	Energy Management System
HMAC	Hashed Message Authentication Code
HOT	Head of Train
ID	Identification
IRS	Interface Requirements Specification
IP	Internet Protocol
I-ETMS®	Interoperable Electronic Train Management System®
ITCM	Interoperable Train Control Messaging

Abbreviation	Meaning
ITC-PTC	Interoperable Train Control Positive Train Control
LCCM	Locomotive Command and Control Module
LIG	Locomotive Interface Gateway
MCD	Master Condition Dataset
µs	microsecond
ms	milliseconds
min	minutes
N/A	Not Applicable
OOI	Object of Interest (Defined in Section 1.5)
OB	On Board
OPK	Operational Private Key
PTC	Positive Train Control
QoS	Quality of Service
RR	Railroad
ROW	Right of Way
s	Seconds
SCAC	Standard Carrier Alpha Code
TTL	Time To Live
TCD	Train and Crew Dataset
TCP	Transport Control Protocol
TLS	Transport Layer Security
UTC	Universal Time Coordinated

1.5 Terminology

The following definitions apply within all ATO IRSs.

Table 2: Terminology

Term	Definition
0x	A prefix used to denote a base-16 (hexadecimal) number
ACK	An acknowledge message indicating successful reception of a message.
Application	In this IRS, application refers to ITC-ATOSS BO and ITC-PTC BO. When a requirement refers to an application, the requirement applies to both ITC-ATOSS BO and ITC-PTC BO.
ATO-modified message	A message which is defined for non-ATO systems, such as ITC-PTC, and is modified for ATO use. Modifications may include additional enumeration values and/or additional message fields.
ATO SoS	The term ATO System of Systems (SoS) is used to define the collection of systems (i.e., ITC-PTC, ITC-EMS, and ITC-ATOSS) that interact and perform the functions necessary to support interoperable ATO train operations.
Clear distance	The distance along the track centerline of the train's route for which the foul volume has been verified to be clear of obstructions.
Discard	Discard is used in reference to a received message failing verification. When a requirement mandates that a system discards a message, it means that: • The receiving subsystem must not use the message for any purpose other than generating a NACK. • Other than generating a NACK, the receiving application behaves as though no message was received. For example, if a status message fails verification, it does not reset the polling process watchdog timer.

Term	Definition
	• If a reason is found to discard a message, the receiver ceases message verification. Discarding a message does not prohibit logging of the message or use of the message for debugging purposes.
Dynamic field	A dynamic field is a data element within a record.
Field	A field is one distinct data element within a message. Each field is individually defined within a message. Fields within the message body are given a numerical identifier called the field ID.
Inoperative state	A state not supporting ATO operation.
Intercept distance	The closest distance along the train route at which an OOI's trajectory prediction interval intersects the foul volume at the predicted location of the train.
NACK	A negative acknowledge message indicating an error in receipt of a message, or receipt of an invalid message.
Object of interest (OOI)	1. An object in the foul volume ahead of a train that presents a collision hazard to a train. 2. An object in the ROW that may move into the foul volume and present a collision hazard to a train. 3. A person or vehicle in the ROW. 4. An object in the foul volume of an adjacent track that presents a collision hazard to a train operating on the adjacent track.
Obstruction	An OOI within the foul volume.
Prediction interval	A standard statistical term used to refer to an interval in which a future observation is, to a given degree of certainty, predicted to fall. When referring to an OOI, the prediction interval is the volume in which a specific OOI is predicted to lie at a given time and with a given certainty. For example, a prediction might be made that: • An OOI will, in exactly 1 min 23.01 s, reside within a given spherical region. • The radius of this region is 7.13 ft. • The center of this region is 203 ft in front of the HOT and along the train route with a +8.3 ft horizontal offset and +3.7 ft vertical offset from the track centerline. • The probability of the OOI actually residing in this region at the given time is p=0.9999 This region is then used by ATO SP to calculate intercept probabilities. If any part of an OOI's prediction interval intersects the foul volume an intercept may occur, depending on the train's speed and acceleration. Note: The use of p=0.9999 is an example. Refer to the ATO SP Subsystem Requirements for information regarding required probabilities.
Receiving application	The application (either ITC-ATOSS BO or ITC-PTC BO) which is receiving a message
Record	A record is an atomic group of one or more dynamic data fields in which the group, as a whole, is repeated zero, one, or several times within one message.
Record loop	A contiguous set of 0, 1, or more records of the same type. A record loop is proceeded by a static field containing the number of records within the record loop.
Requesting message	A message to which a reply is expected
Reply	A message sent in response to another message; includes ACKs and NACKs.
Sending application	The application (either ITC-ATOSS BO or ITC-PTC BO) which is sending a message.

Term	Definition
Sense distance	The maximum distance along the track centerline of the train's route in which the sensor platform is capable of detecting all obstructions within the foul volume. Detection of an object within the sense distance does not necessarily include classification. The sense distance depends on environmental conditions, sensor platform capabilities, and sensor platform health.
Static field	A static field is a field which occurs once per message, is required in every message, and is located outside of record loops.
Umler®	An electronic resource maintained by Railinc which stores and provides critical data for North American transportation equipment, including characteristic information about train cars and locomotives.
Unsolicited message	An unsolicited message is a message sent without having been requested.

1.6 Data Types

Data type abbreviations used throughout this document are defined in the following two subsections.

1.6.1 Common Data Types

The common data types used in this document match data types frequently used in computer programming and electrical engineering.

Table 3: Common Data Types

Type	Description
binary	Raw binary data file of type specified in message
double	Double precision (8 byte) floating point number, IEEE 754 compatible
enum	Enumeration. The transmitted value will be an unsigned integer of the specified size. A mapping of value to meaning will be provided. Any values not specified are unused.
float	Single precision (4 byte) floating point number, IEEE 754 compatible
int	Signed (2's complement) integer of the specified size
string	ASCII coded text string. Null terminated unless otherwise specified.
uint	Unsigned integer of the specified size

1.6.2 Railroad-Specific Data Types

The following data types are specific to the railroad industry.

Table 4: Railroad-Specific Data Types

Type	Description
MP	Milepost. Stored as a 4-byte unsigned integer. Multiply by 0.0001 to convert from stored value to milepost number.
SCAC	Railroad standard carrier alpha code (SCAC). Encoded as a four-character ASCII string, left justified, space filled, no null termination.
U	Locomotive unit data field. 10 bytes ASCII encoded in form of "SCAC 12345" The SCAC may be two to four characters long and is left-justified, space filled. The locomotive number may be one to six numbers long and is right-justified, space filled.
ECEF	Earth-centered, earth-fixed Position (LSB = 1 centimeter) Byte 0-3 X Coordinate ± 0-900,000,000 cm Byte 4-7 Y Coordinate ± 0-900,000,000 cm Byte 8-11 Z Coordinate ± 0-900,000,000 cm

2.0 References

2.1 Applicable Documents

The following normative documents of the exact revision and date, form a part of this specification to the extent specified herein:

Table 5: Applicable Documents

Document	Section
AAR Standard	S-9101.V1.2 (Revised 2019): Locomotive Electronics and Train Consist System Architecture
AAR Manual of Standards and Recommend Practices Section K4	S-9354.V2.0 (Revised 2018): Edge Message Protocol
AAR Manual of Standards and Recommend Practices Section K4	S-9356.V2.0 (Revised 2018): Class D Messaging

2.2 Reference Documents

The following documents provide information which may be useful in implementing this interface, but do not contain interface requirements.

Table 6: Reference Documents

Document	Section
AAR Manual of Standards and Recommend Practices Section K4	S-9501: Positive Train Control Data Model Definition
AAR Manual of Standards and Recommend Practices Section K4	S-9503: Interoperable Electronic Train Management System® (I-ETMS) Subdivision File
AAR Manual of Standards and Recommend Practices Section K4	S-9357: Mutually Authenticated Key Exchange
AAR Manual of Standards and Recommend Practices Section K4	S-9360: Data Protection
Automated Train Operation System Requirements	N/A
Automated Train Operation Subsystem Requirements	ATO Executive
Automated Train Operation Subsystem Requirements	ITC-EMS Requirements for ATO
Automated Train Operation Subsystem Requirements	ITC-PTC Onboard Requirements for ATO

3.0 Interoperable ITC-ATOSS BO – ITC-PTC BO Interface Requirements

Messaging requirements and descriptions in this section define an interoperable interface between ITC-ATOSS BO and ITC-PTC BO. The messaging requirements and descriptions include protocol requirements, descriptions of the message structure, message definitions, message creation requirements, and message verification requirements.

To achieve an interoperable interface, all communication between ITC-ATOSS BO and ITC-PTC BO must comply with the AAR standards S-9354 (Edge Message Protocol) and S-9356 (Class D Messaging). AAR standard S-9355 (Class C Messaging) is not used in this interface.

3.1 Class D Interface Requirements

ATO messaging between ITC-ATOSS BO and ITC-PTC BO is conducted through a Class D link as defined in AAR Standard S-9356, Class D Messaging. The Class D configurable parameters necessary to achieve an interoperable interface are specified in this IRS.

a) *Interoperable communication between ITC-ATOSS BO and ITC-PTC BO shall use the Class D messaging service defined in AAR MSRP Section K4, S-9356.*

The following link attributes will be used for the Class D connection between ITC-ATOSS BO and ITC-PTC BO. Refer to S-9356 for more information on the definition and use of class D parameters. The IP addresses for each subsystem are defined in AAR standard S-9101 Appendix F. All other configurable Class D parameters are defined here.

Table 7: ITC-ATOSS BO to ITC-PTC BO Link Attributes

Attribute	ITC-ATOSS BO	ITC-PTC BO
TCP Role	Client	Server
Mode	Bidirectional	Bidirectional
Local Address	The IP address for ITC-ATOSS BO is defined in S-9101 Appendix F.	The IP address for ITC-PTC BO shall be as defined in S-9101 Appendix F.
Remote Address	The IP address for ITC-ATOSS BO is defined in S-9101 Appendix F.	The IP address for ITC-PTC BO shall be as defined in S-9101 Appendix F.
Local Port	N/A	TBC-IRS-P2-P3-CD-1
Remote Port	TBC-IRS-P2-P3-CD-1	N/A
Log Traffic	TBC-IRS-P2-P3-CD-2	TBC-IRS-P2-P3-CD-3
Keep-Alive Interval	TBC-IRS-P2-P3-CD-4	TBC-IRS-P2-P3-CD-4
Keep-Alive ACK Timeout	TBC-IRS-P2-P3-CD-5	N/A
Data ACK Enabled	TBC-IRS-P2-P3-CD-6	TBC-IRS-P2-P3-CD-6
Data ACK Timeout	TBC-IRS-P2-P3-CD-7	TBC-IRS-P2-P3-CD-7
Data NACK Retry Limit	TBC-IRS-P2-P3-CD-8	TBC-IRS-P2-P3-CD-8
ACK Timer Delay	TBC-IRS-P2-P3-CD-9	TBC-IRS-P2-P3-CD-9
Retransmit Delay	TBC-IRS-P2-P3-CD-10	TBC-IRS-P2-P3-CD-10
Connection Attempt Timeout	TBC-IRS-P2-P3-CD-11	N/A
Connection Delay	TBC-IRS-P2-P3-CD-12	N/A
Connection Retry Limit	TBC-IRS-P2-P3-CD-13	N/A
Reconnection Limit	TBC-IRS-P2-P3-CD-14	N/A
Shared Port	N/A	No
TLS Enabled	No	No
TLS Private Key	N/A	N/A
TLS Public Certificate	N/A	N/A
TLS Encryption Method	N/A	N/A
TLS Trusted Root Store	N/A	N/A
TLS CRL Source	N/A	N/A
TLS Local CRL	N/A	N/A

3.1.1 Class D Link Initialization

The Class D link is initialized during the train initialization procedure described in the ITC-ATOSS BO and ITC-PTC BO Subsystem Requirements documents. ITC-ATOSS BO serves as the client, and ITC-PTC BO as the server, in that the server waits for the client to initiate the TCP connection. Either application may reach the Class D link initialization phase first, and an arbitrary amount of time may pass before the other application is ready for Class D link initialization. The client must continue to retry establishing the link if the server does not respond, and the server must continue to wait for a link as long as one has not been established. The Class D parameters connection attempt timeout (TBC-IRS-P2-P3-CD-11), connection delay (TBC-IRS-P2-P3-CD-12), connection retry limit (TBC-IRS-P2-P3-CD-13), and reconnection limit (TBC-IRS-P2-P3-CD-14), allow the owning railroad to configure ITC-ATOSS BO to continue to retry class D link initialization for as long as desired.

a) *When establishing a Class D link with ITC-ATOSS BO, ITC-PTC BO shall serve as a Class D server to ITC-ATOSS BO.*

b) *When establishing a Class D link with ITC-PTC BO, ITC-ATOSS BO shall serve as a Class D client to ITC-PTC BO.*

c) *When establishing a Class D link with ITC-PTC BO, ITC-ATOSS BO shall use the Class D parameters specified in the ITC-ATOSS BO column of Table 7.*

d) *When establishing a Class D link with ITC-ATOSS BO, ITC-PTC BO shall use the Class D parameters specified in the ITC-PTC BO column of Table 7.*

e) *ITC-PTC BO shall accept a Class D connection from ITC-ATOSS BO in accordance with S-9356.*

   ITC-ATOSS BO shall initiate a Class D connection with ITC-PTC BO in accordance with S-9356.

3.2 EMP Requirements

The ITCM communication infrastructure supports messaging between ITC-ATOSS BO to ITC-PTC BO. To support ITCM-based delivery, messages sent between ITC-ATOSS BO and ITC-PTC BO comply with the EMP message format defined in AAR MSRP Section K4, S-9354.

The EMP message wrapper is used by both applications to facilitate message transmission, reception, decoding, and routing within the ITCM infrastructure. The EMP message format is provided in Table 8.

Table 8: EMP Message Structure

Field	Size	Description
EMP Header	Variable	The EMP header contains protocol information which is included with every message.
Message Body	Variable	The contents of the message.
Data Integrity Value (EMP Footer)	4 bytes	A data integrity check value computed around the EMP header and message data. May be a CRC, HMAC, or set to indicate no data integrity value.

a) *Interoperable messages between ITC-ATOSS BO and ITC-PTC BO shall comply with the EMP message structure defined in AAR MSRP Section K4, S-9354.*

3.2.1 EMP Header

The EMP header supports application interpretation of messages exchanged between applications. Table 9 shows the EMP header structure, including field size and order.

Table 9: EMP Header Fields

Field		Size (bytes)	Data Type	Description
Protocol Version		1	uint	EMP header version
Message Type (ID)		2	uint	Message type (ID) identification number of the message contained in the EMP message body.
Message Version		1	uint	Message version of the message contained in the EMP message body.
Flags (1 byte)	Bit 0: Time Stamp Format	1 bit	enum	EMP time stamp format bit. 0) Relative time 1) Absolute time
	Bit 1: Encryption	1 bit	enum	0) EMP message body is not encrypted 1) EMP message body is encrypted
	Bit 2: Compression	1 bit	enum	0) EMP message body is not compressed 1) EMP message body is compressed
	Bits 3-4: Data integrity	2 bits	enum	0) No data integrity supported 1) CRC calculated and stored in the EMP footer 2) HMAC calculated and stored in the EMP footer 3) Reserved
Data Length		3	uint	Size of EMP message body (excludes EMP header and EMP footer)
Message Number		4	uint	Application message sequence number
Message Time		4	uint	Time of message creation
Variable Header Size		1	uint	Total size of all message header fields following this field. Excludes the message body and footer.
Time To Live		2	uint	Message time to live; used in routing.
Quality of Service (2 bytes)	Class	3 bits	uint	EMP message class
	Priority	3 bits	uint	EMP message priority
	Network Preference	3 bits	uint	EMP network preference
	Special Handling	4 bits	uint	EMP special handling parameter
	Service Request	3 bits	uint	EMP service request
Source		Up to 64	string	Message source address
Destination		Up to 64	string	Message destination address

3.2.1.1 EMP Header Protocol Version Field

The receiving application uses the EMP header Protocol Version field to interpret the EMP header and footer according to the correct version of the EMP and S-9354.

a) *When an application generates a message, the application shall set the EMP header Protocol Version field to the EMP header version implemented by the application.*

3.2.1.2 EMP Header Message Type (ID) Field

The EMP header Message Type (ID) field provides the message type (ID) value associated with the specific message contained within the EMP message body. The receiving application uses the EMP header Message Type (ID) field to correctly identify each message received. The sending application sets the value of the EMP header Message Type (ID) field to the message type (ID) value provided in the description of the message being generated.

a) *When an application generates a message, the application shall set the EMP message Type (ID) field to the message type (ID) number defined for the specific message being generated.*

3.2.1.3 EMP Header Message Version Field

The receiving application uses the EMP message version, in conjunction with the EMP message type (ID), to identify the format and contents of the EMP message body. The sending application sets the value of the EMP header message version field to the message version defined in the IRS.

a) *When an application generates a message, the application shall set the EMP header Message Version Field to the message version number defined for the specific message being generated.*

3.2.1.4 EMP Header Flags Field

The EMP message header Flags field contains flags specifying the time stamp format, if encryption is used, if compression is used, and the data integrity settings. The remaining bits are reserved for future use. The use of the EMP message header flags is defined within the requirements for each message type (ID).

3.2.1.4.1 EMP Header Flags Field Bit 0: Time Stamp Format

The EMP header Flag field bit 0: Time Stamp Format provides the time of message generation. The EMP header Flag field bit 0: Time Stamp Format is set to 0 if the EMP header Message Time field contains the time since the last message of the same type was created by the sending application. The EMP header Flag bit 0: Time Stamp Format is set to 1 if the EMP header Message Time field contains the absolute time of message creation as specified in Section 3.2.1.7. The time stamp format is specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP Header Flag field bit 0: Time Stamp Format to the value defined for the specific message type (ID).*

3.2.1.4.2 EMP Header Flags Field Bit 1: Encryption

The EMP header flag bit 1: Encryption is set to 0 if the EMP message body is not encrypted and 1 if the EMP message body is encrypted.

a) *When an application generates a message, the application shall set the EMP header Flag bit 1: Encryption to the value defined for the specific message type (ID).*

3.2.1.4.3 EMP Header Flags Field Bit 2: Compression

The EMP header Flag bit 2: Compression is set to 0 if the body of the message is not compressed and 1 if the body of the message is compressed. The use of compression is specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP header Flag bit 2: Compression to the value defined by the specific message type (ID).*

3.2.1.4.4 EMP Header Flags Field Bits 3 and 4: Data Integrity

The EMP header Flag bits 3 and 4: Data Integrity are treated as a single 2-bit enumeration which use the enumeration values given in Table 10. The use of data integrity and the data integrity value is specified in the description of each message.

Table 10: EMP Header Flags field Bits 3 and 4 Enumeration Values

Value	Description
1	No data integrity supported
2	CRC calculated and stored in the EMP footer
3	HMAC calculated and stored in the EMP footer
4	Reserved

a) *When an application generates a message, the application shall set the EMP header Flag bits 3 and 4: Data Integrity to the value defined for the specific message type (ID).*

3.2.1.5 EMP Header Data Length Field

The EMP header Data Length field provides the length of the EMP message body. The length of the EMP header and EMP footer are not included in this value. Instructions for calculating the length of the EMP message body are provided in the description of each message.

a) *When an application generates a message, the application shall set the EMP header Data Length field to the length, in bytes, of the EMP message body.*

3.2.1.6 EMP Header Message Number Field

The EMP header message number is used to place messages within a sequence and to identify repeated messages. Generation and use of this field is described in Section 3.4.2.

3.2.1.7 EMP Header Message Time Field

The EMP header Message Time field contains the time the message was generated which allows the receiving application to identify and discard stale messages. If the time required to generate a message is greater than 1 second, the time of generation is considered to be the time at which generation of the message was completed. Relative time stamps and absolute time stamps are supported. A relative time stamp gives the time elapsed since the last message of the same type was generated. An absolute time stamp gives the absolute time of message generation, measured as seconds since midnight, January 1, 1970. An EMP header Message Time field value of 0 indicates a relative time and a 1 indicates absolute time.

Note: S-9354 does not clearly indicate the management of leap seconds by EMP. Unix/POSIX time, of which the EMP absolute time resembles (but does not duplicate), assumes an ideal day length of

86,400 seconds and ignores leap seconds. Other time standards, such as UTC, account for leap seconds. Improperly handling leap seconds could (currently) result in an error of about 30 s, and this error would increase with time. Assuming this section remains in the ATO IRSs, this issue will be resolved later in the ATO development process.

3.2.1.7.1 EMP Header Message Time Field: Absolute Time

a) *When an application generates a message and the message description specifies the use of an absolute time stamp, the application shall set the EMP header Message Time field to the UTC time of message creation as measured by the sending application's clock.*

b) *When an application generates a message and the message description specifies the use of an absolute time stamp, the application shall set the EMP header Message Time field to the number of seconds elapsed since midnight, January 1, 1970.*

3.2.1.7.2 EMP Header Message Time Field: Relative Time

a) *When an application generates a message and the message description specifies the use of a relative time stamp, the sending application shall set the EMP header message time field to the number of seconds since the last message of the same message type (ID) was generated by the sending application.*

3.2.1.8 EMP Header Variable Header Size Field

The EMP header Variable Header Size field provides the total size, in bytes, of the variable-size portion of the EMP message header which supports correct interpretation of the message by the receiving application. The variable-size portion of the EMP message header includes the EMP header fields Time to Live, Routing QoS, Source Address, and Destination Address. This includes the bytes used for the null termination of the address strings.

a) *When an application generates a message, the application shall set the EMP header Variable Header Size field to the sum of the sizes, in bytes, of the EMP header TTL field, Routing QoS field, Source Address field, and the Destination Address field.*

3.2.1.9 EMP Header Time to Live Field

The EMP header Time to Live field provides the maximum time in which a message may reside in the message delivery infrastructure. If a message is not delivered by the end of the time period specified in the EMP header Time to Live field, the message is discarded by the message delivery infrastructure and will not be delivered. The EMP header Time to Live field is distinct from the Class D time to live and persists through non-Class D delivery methods. The EMP header Time to Live is specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP Header Time to Live field to the value defined by the requirements for the specific message type (ID).*

3.2.1.10 EMP Header QoS Field

The EMP header QoS field defines a message priority for use by network routing and queuing services. The EMP QoS field consists of several sub fields all of which are specified in the description of each message.

a) *When an application generates a message, the application shall set the EMP Header message QoS field value to the QoS value defined by the requirements for the specific message type (ID).*

3.2.1.11 EMP Header Source Address Field

The EMP header Source Address field contains the EMP address for the application from which the message originated. For the purposes of ATO, this is also the address to which a reply should be sent.

a) *When an application generates a message, the application shall set the EMP header Source Address field to the EMP address of the application generating the message.*

b) *When an application generates a message, the application shall format the EMP header Source Address field in compliance with S-9379.*

c) *When an application generates a message, the application shall encode the EMP source address as a null-terminated ASCII string.*

3.2.1.12 EMP Header Destination Address Field

The EMP header Destination Address field contains the EMP address of the receiving application.

a) *When an application generates a message, the application shall set the EMP header Destination Address field to the EMP address of the application to which the message is being sent.*

b) *When an application generates a message, the application shall format the EMP header Destination Address Field in compliance with S-9379.*

c) *When an application generates a message, the application shall encode the EMP destination address as a null-terminated ASCII string.*

3.2.2 Message Body

The message body starts in the byte immediately following the EMP header. Message body content for each message type (ID) is defined in Section 3.3.1.1.2. Messages consist of static fields and records, as defined in Section 3.3.1.1.2. Records are repeated in a loop of 0, 1, or many instances. A message containing records has an associated record counter indicating the number of times each record is repeated. Fields may be of fixed or variable size, as specified in the message description. A field with a variable size is preceded by a fixed-size field specifying the size of the variable-size field. Requirements related to the management of records and variable-size fields are given on a message-by-message basis.

a) *When an application generates a message, the application shall start the message body in the byte immediately following the end of the EMP header.*

b) *When an application generates a message, the application shall include in the message body all static data fields specified in the message description for the specific message type (ID) being generated.*

c) *When an application generates a message, the application shall order the message fields in the order given in the message description for the specific message type (ID) being generated.*

d) *When an application generates a message, the application shall generate each fixed size field to be the size specified in the message description for the specific message type (ID) being generated.*

e) *When an application generates a message, the application shall encode each message field using the data type specified in the message description for the specific field being encoded.*

3.2.3 EMP Footer

The EMP footer contains a data 32-bit integrity field covering the entire EMP header and message body. This field may contain a CRC, an HMAC, or the value 0. The EMP footer is set to 0 if the message does not include a data integrity check. The use of CRC, HMAC, or no data integrity value, is specified on a message-by-message basis in the message definition.

a) *When an application generates a message, and the message description requires neither a CRC nor an HMAC, the sending application shall set the EMP footer to 0x00000000.*

b) *When an application generates a message, and the message description requires a CRC, the sending application shall set the EMP footer data integrity field to the value calculated per the CRC calculation procedure given in S-9354.*

c) *When an application generates a message, and the message description requires an HMAC value, the sending application shall set the EMP footer data integrity field to the calculated HMAC value.*

3.3 Message Definitions

All messages sent between ITC-ATOSS BO and ITC-PTC BO are defined in this section.

3.3.1 ITC-ATOSS BO to ITC-PTC BO Messages

This section documents all messages sent by ITC-ATOSS BO to ITC-PTC BO. The following message type (ID) assignments are currently made:

Table 11: ITC-ATOSS BO to ITC-PTC BO Messages

Message Type (ID)	Version	Description
P200	1	ITC-ATOSS BO to ITC-PTC BO Poll
P201	1	Locomotive System State ACK
P202	1	Onboard Violation Report ACK
P203	1	Onboard Violation Cleared ACK
P204	1	Locomotive Fault Summary Report ACK
P205	1	Emergency Brake Application Report ACK
P206	1	Train Handling Exception Report ACK
P207	1	Locomotive Fault Report ACK

3.3.1.1 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message, Version 1

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message provides ITC-PTC BO with a list of all ATO trains currently registered with ITC-ATOSS BO, and to acknowledge receipt of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message.

3.3.1.1.1 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message EMP Header Parameters

Message-specific EMP header values for the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message are specified in Table 12.

Table 12: ITC-ATOSS BO to ITC-PTC BO Poll (P200) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P200
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P200-1
QoS	Class	3 bits	uint	TBC-IRS-P200-2
	Priority	3 bits	uint	TBC-IRS-P200-3
	Network Preference	3 bits	uint	TBC-IRS-P200-4
	Special Handling	4 bits	uint	TBC-IRS-P200-5
	Service Request	3 bits	uint	TBC-IRS-P200-6

3.3.1.1.1.1 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message EMP Header Data Length Field

The EMP header Data Length field for an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message contains the length, in bytes, of the message body. The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message contains a record loop that is repeated a variable number of times. The loop is preceded by a counter indicating the number of times the record is repeated.

To calculate the value stored in the EMP data length field, the size of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message body must be calculated at run time for each ITC-ATOSS BO to ITC-PTC BO Poll (P200) message generated. The size of an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message is the sum of:

- 3 bytes for field IDs 1-2
- 5 bytes multiplied by the value of field ID 2 for fields ID 2.1 and 2.2
- The sum of the values of each instance of field ID 2.2 for field 2.3
- 11 bytes multiplied by the value of field ID 2 for field IDs 2.4 and 2.5
- 4 bytes for field ID 3

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.1.1.2 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message EMP Header Number Field

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message EMP header message number field is calculated according to the numbering process described in Section 3.4.23.2.1.6.

3.3.1.1.2 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Body

A summary of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message body is given in Table 13. Detailed descriptions and requirements follow.

Table 13: ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Body

ID	Field	Size, bytes	Data Type	Description
1	ACK Status	1	enum	ACK status. See Table 15.
2	Train Record Counter	2	uint	Number of trains being reported by ITC-ATOSS BO
<Start Train Record loop>				Repeat once for each train
2.1	Train ID SCAC	4	SCAC	SCAC of this train's identification number
2.2	Train ID Length	1	string	Length of Train ID field
2.3	Train ID	varies	string	Train identification number
2.4	Lead Locomotive ID	10	U	Locomotive ID of the lead locomotive
2.5	ITC-ATO Ex State	1	enum	Current state of ITC-ATO Ex
<End Train Record loop>				
3	Coordination Number	4	uint	Coordination number from the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message being acknowledged.

Range limitations, other than those inherent to the data types placed on the fields in Table 13, are provided in Table 14. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values. These ranges will be enforced by the receiving subsystem.

Table 14: ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)
2.1	Train ID SCAC	Capital letters, left-justified, space filled; must contain at least two letters
2.2	Train ID Length	0 to 30
2.4	ITC-ATO Ex State	0 to 17 (valid enumeration values)

3.3.1.1.3 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message body are given in this section.

3.3.1.1.3.1 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message ACK Status Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message ACK Status field indicates if the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 15: ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message ACK Status Field

Value	Description
0	ACK – ITC-PTC BO to ITC-ATOSS BO Poll (P300) message successfully received
1	NACK – message discarded

3.3.1.1.3.2 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Back Office SCAC Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Back Office SCAC field provides the SCAC of the ITC-ATOSS BO generating the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall set the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Back Office SCAC field to the SCAC of the ITC-ATOSS BO generating the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message.*

3.3.1.1.3.3 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train Record Counter Dynamic Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train Record Counter dynamic field provides the number of ATO trains ITC-ATOSS BO is reporting to ITC-PTC BO and is the number of times the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train record is repeated. Each Train record consists of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message dynamic fields Train ID SCAC, Train ID Length, Train ID, Lead Locomotive ID, and ITC-ATO Ex State.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall populate the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train Record Counter field with the total number of trains being reported to ITC-ATOSS BO.*

b) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall repeat the Train record once for each train being reported to ITC-ATOSS BO.*

3.3.1.1.3.4 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train ID SCAC Dynamic Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID SCAC dynamic field contains the SCAC of the railroad that assigned the associated train ID.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall populate each instance of ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID SCAC dynamic field with the SCAC of the railroad that assigned the corresponding train ID.*

3.3.1.1.3.5 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train ID Length Dynamic Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID Length field contains the length of the following ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field. The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID field may be up to 30 characters in length. If the train identification number is not available, the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID Length field will be populated with a value of 0 and the following ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field will not be present.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall populate the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID*

Length field with the length, in bytes, of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID.

b) *If ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message and the train identification number is unavailable, the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID Length field will be populated with a value of 0.*

3.3.1.1.3.6 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train ID Dynamic Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field contains the operating-RR assigned train ID. Train IDs are assigned per the business practices of the operating RR; the only standardization is that they must be no more than 30 ASCII characters. If the train ID is not available, the corresponding instance of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field will not be present.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall populate the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID field with the corresponding train ID.*

3.3.1.1.3.7 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Lead Locomotive ID Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Lead Locomotive ID field is populated with the ID of the lead locomotive of the train reporting the exception. This is a string containing locomotive unit data as described in Section 1.6. The ID of each lead locomotive is reported to ITC-ATOSS BO by each ATO train when the ATO train registers with ITC-ATOSS BO.

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall populate each instance of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Lead Locomotive ID field with the ID of the lead locomotive of the corresponding train.*

3.3.1.1.3.8 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message ITC-ATO Ex State Dynamic Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message ITC-ATO Ex State field reports the current operating state of the ITC-ATO Ex subsystem as defined in the ITC-ATO Ex Subsystem Requirements document. The valid values of this enumeration are listed in Table 16. All other values are unused.

Table 16: ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message ITC-ATO Ex State

Value	ATO Ex State
0	Power-Up
1	Failed
2	Non-Init
3	Initialization
4	Pre-Arm Setup
5	Unarmed Configured
6	Armed Automated Standby
7	Automated Active
8	Automated Exception
9	Attended Active

Value	ATO Ex State
10	Attended Exception
11	Manual Control
12	Manual Setup
13	Attended Setup
14	Attended Ready
15	ITM
16	Shadow
17	ATO Suspended

a) *When ITC-ATOSS BO generates an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-ATOSS BO shall set the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message ITC-ATO Ex State field to the current ITC-ATO Ex state using the enumeration values given in Table 16.*

3.3.1.1.3.9 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Coordination Number Field, Generation Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.1.1.4 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Field Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message fields are given in this section.

3.3.1.1.4.1 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message ACK Status Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.1.4.2 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train Record Counter Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train Record Counter field provides ITC-ATOSS BO with the number of ATO trains being reported to ITC-ATOSS BO and is used to assist in correctly unpacking the message by providing the number of times the train record loop is repeated.

a) *When ITC-PTC BO receives an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-PTC BO shall use the value contained in the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train Record Counter field as the number of ATO trains currently tracked by ITC-ATOSS BO.*

b) *When ITC-PTC BO receives an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, ITC-PTC BO shall extract the number of Train records indicated by the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train Record Counter field.*

3.3.1.1.4.3 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train ID SCAC Dynamic Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID SCAC dynamic field provides the SCAC of the railroad that assigned the associated train ID and is used as the SCAC portion of the train ID.

c) *When ITC-PTC BO receives an ITC-ATOSS BO Poll (P200) message ITC-PTC BO shall use the SCAC contained in each instance of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID SCAC dynamic field as the SCAC of the associated train ID.*

3.3.1.1.4.4 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train ID Length Dynamic Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID Length dynamic field helps ITC-ATOSS BO interpret the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message by providing ITC-ATOSS BO with the length of the following ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field.

a) *When ITC-PTC BO receives an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message ITC-PTC BO shall use the value contained in each instance of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field as the length, in bytes, of the following instance of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID field.*

3.3.1.1.4.5 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Train ID Dynamic Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field provides the train ID of the corresponding train.

a) *When ITC-PTC BO receives an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message ITC-PTC BO shall use each instance of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Train ID dynamic field as the train ID of the corresponding train.*

3.3.1.1.4.6 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Lead Locomotive ID Dynamic Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Lead Locomotive ID dynamic field provides the locomotive ID of the lead locomotive of the corresponding train. In the event that an ATO train is registered with the back office but does not yet have a train ID (e.g., during train initialization) this allows for positive identification of the ATO train being reported.

a) *When ITC-PTC BO receives an ITC-ATOSS to ITC-PTC BO Poll (P200) message ITC-PTC BO shall use the string contained in each instance of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Lead Locomotive ID dynamic field as the locomotive ID of the lead locomotive of the corresponding train.*

3.3.1.1.4.7 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message ITC-ATO Ex State Dynamic Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message ITC-ATO Ex State dynamic field provides the last reported state of the ITC-ATO Ex subsystem on the corresponding train.

a) *When ITC-PTC BO receives an ITC-ATOSS to ITC-PTC BO Poll (P200) message ITC-PTC BO shall, using the enumeration values given in Table 16, interpret each in each instance of the ITC-ATOSS to ITC-PTC BO Poll (P200) message ITC-ATO Ex State dynamic field as the state of the corresponding ATO train.*

3.3.1.1.4.8 ITC-ATOSS BO to ITC-PTC BO Poll (P200) Message Coordination Number Field, Use Requirements

The ITC-ATOSS BO to ITC-PTC BO Poll (P200) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.1.2 Locomotive System State ACK (P201) Message, Version 1

The Locomotive System State ACK (P201) message is sent by the ITC-ATOSS BO to the ITC-PTC BO to confirm receipt of the Locomotive System State (P301) message. This is done as part of the reliable messaging process described in Section 3.4.4.

3.3.1.2.1 Locomotive System State ACK (P201) Message EMP Header Parameters

Message-specific EMP header values for the Locomotive System State ACK (P201) message are specified in Table 17.

Table 17: Locomotive System State ACK (P201) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P201
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P201-1
QoS	Class	3 bits	uint	TBC-IRS-P201-2
	Priority	3 bits	uint	TBC-IRS-P201-3
	Network Preference	3 bits	uint	TBC-IRS-P201-4
	Special Handling	4 bits	uint	TBC-IRS-P201-5
	Service Request	3 bits	uint	TBC-IRS-P201-6

3.3.1.2.1.1 Locomotive System State ACK (P201) Message EMP Header Data Length Field

The EMP header Data Length field for a Locomotive System State ACK (P201) message contains the length, in bytes, of the message body. The Locomotive System State ACK (P201) message contains only static fields, so the message body is always the same size of 5 bytes.

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.2.1.2 Locomotive System State ACK (P201) Message EMP Header Number Field

The Locomotive System State ACK (P201) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.2.2 Locomotive System State ACK (P201) Message Body

A summary of the Locomotive System State ACK (P201) message body is given in Table 18. Detailed description and requirements follow.

Table 18: Locomotive System State ACK (P201) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	ACK Status	1	enum	ACK status. See Table 20.
2	Coordination Number	4	uint	Coordination number from the Locomotive System State (P301) message being acknowledged.

Range limitations other than those inherent to the data type are placed on the above fields are provided in Table 19. These ranges will be enforced by the receiving subsystem.

Table 19: Locomotive System State ACK (P201) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.2.3 Locomotive System State (P201) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in a Locomotive System State ACK (P201) message body are given in this section.

3.3.1.2.3.1 Locomotive System State ACK (P201) Message ACK Status Field, Generation Requirements

The Locomotive System State ACK (P201) message ACK Status field indicates if the Locomotive System State ACK (P201) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 20: Locomotive System State ACK (P201) Message ACK Status Field Enumeration

Value	Description
0	ACK – Locomotive System State (P301) message successfully received
1	NACK – Message discarded

3.3.1.2.3.2 Locomotive System State ACK (P201) Message Coordination Number Field, Generation Requirements

The Locomotive System State ACK (P201) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.1.2.4 Locomotive System State ACK (P201) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Locomotive System State ACK (P201) message fields are given in this section.

3.3.1.2.4.1 Locomotive System State ACK (P201) Message ACK Status Field, Use Requirements

The Locomotive System State ACK (P201) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.2.4.2 Locomotive System State ACK (P201) Message Coordination Number Field, Use Requirements

The Locomotive System State ACK (P201) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.1.3 Onboard Violation Report ACK (P202) Message, Version 1

The Onboard Violation Report ACK (P202) message is sent by the ITC-ATOSS BO to the ITC-PTC BO to confirm receipt of the Onboard Violation Report (P302) message.

3.3.1.3.1 Onboard Violation Report ACK (P202) Message EMP Header Parameters

Message-specific EMP header values for the Onboard Violation Report ACK (P202) message are specified in Table 21.

Table 21: Onboard Violation Report ACK (P202) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P202
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P202-1
QoS	Class	3 bits	uint	TBC-IRS-P202-2
	Priority	3 bits	uint	TBC-IRS-P202-3
	Network Preference	3 bits	uint	TBC-IRS-P202-4
	Special Handling	4 bits	uint	TBC-IRS-P202-5
	Service Request	3 bits	uint	TBC-IRS-P202-6

3.3.1.3.1.1 Onboard Violation Report ACK (P202) Message EMP Header Data Length Field

The EMP header Data Length field for an Onboard Violation Report (301) message contains the length, in bytes, of the message body. The Onboard Violation Report (301) message contains only static fields, so the message body is always the same size of 5 bytes.

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.3.1.2 Onboard Violation Report ACK (P202) Message EMP Header Number Field

The Onboard Violation Report ACK (P202) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.3.2 *Onboard Violation Report ACK (P202) Message Body*

A summary of the Onboard Violation Report ACK (P202) message body is given in Table 22. Detailed description and requirements follow.

Table 22: Onboard Violation Report ACK (P202) Message Body

ID	Field	Size, bytes	Data Type	Description
1.	ACK Status	1	enum	ACK status. See Table 24.
2.	Coordination Number	4	uint	Coordination number from the Onboard Violation Report (P302) message being acknowledged.

Range limitations other than those inherent to the data type are placed on the above fields are provided in Table 23. These ranges will be enforced by the receiving subsystem.

Table 23: Onboard Violation Report ACK (P202) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.3.3 *Onboard Violation Report ACK (P202) Message Field Generation Requirements*

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an Onboard Violation Report ACK (P202) message body are given in this section.

3.3.1.3.3.1 Onboard Violation Report ACK (P202) Message ACK Status Field, Generation Requirements

The Onboard Violation Report ACK (P202) message ACK Status field indicates if the Onboard Violation Report ACK (P202) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 24: Onboard Violation Report ACK (P202) Message ACK Status Field Enumeration

Value	Description
0	ACK – Onboard Violation Report (P302) message successfully received
1	NACK – Message discarded

3.3.1.3.3.2 Onboard Violation Report ACK (P202) Message Coordination Number Field, Generation Requirements

The Onboard Violation Report ACK (P202) message Coordination Number is generated according to the numbering process described in Section 3.4.2.

3.3.1.3.4 *Onboard Violation Report ACK (P202) Message Field Use Requirements*

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Onboard Violation Report ACK (P202) message fields are given in this section.

3.3.1.3.4.1 Onboard Violation Report ACK (P202) Message ACK Status Field, Use Requirements

The Onboard Violation Report ACK (P202) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.3.4.2 Onboard Violation Report ACK (P202) Message Coordination Number Field, Use Requirements

The Onboard Violation Report ACK (P202) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.1.4 Onboard Violation Cleared ACK (P203) Message, Version 1

The Onboard Violation Cleared ACK (P203) message is sent by the ITC-ATOSS BO to the ITC-PTC BO to confirm receipt of the Onboard Violation Cleared (P303) message.

3.3.1.4.1 Onboard Violation Cleared ACK (P203) Message EMP Header Parameters

Message-specific EMP header values for the Onboard Violation Cleared ACK (P203) message are specified in Table 25.

Table 25: Onboard Violation Cleared (P203) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P203
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P203-1
QoS	Class	3 bits	uint	TBC-IRS-P203-2
	Priority	3 bits	uint	TBC-IRS-P203-3
	Network Preference	3 bits	uint	TBC-IRS-P203-4
	Special Handling	4 bits	uint	TBC-IRS-P203-5
	Service Request	3 bits	uint	TBC-IRS-P203-6

3.3.1.4.1.1 Onboard Violation Cleared ACK (P203) Message EMP Header Data Length Field

The EMP header Data Length field for an Onboard Violation Cleared ACK (P203) message contains the length, in bytes, of the message body. The Onboard Violation Cleared ACK (P203) message contains only static fields, so the message body is always the same size of 5 bytes.

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.4.1.2 Onboard Violation Cleared ACK (P203) Message EMP Header Number Field

The Onboard Violation Cleared ACK (P203) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.4.2 Onboard Violation Cleared ACK (P203) Message Body

A summary of the Onboard Violation Cleared ACK (P203) message body is given in Table 26. Detailed description and requirements follow.

Table 26: Onboard Violation Cleared ACK (P203) Message Body

ID	Field	Size (bytes)	Data Type	Description
1.	ACK Status	1	enum	ACK status. See Table 28.
2.	Coordination Number	4	uint	Coordination number from the Onboard Violation Cleared (P303) message being acknowledged.

Range limitations other than those inherent to the data type are placed on the above fields are provided in Table 27. These ranges will be enforced by the receiving subsystem.

Table 27: Onboard Violation Cleared ACK (P203) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.4.3 Onboard Violation Cleared ACK (P203) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an Onboard Violation Cleared ACK (P203) message body are given in this section.

3.3.1.4.3.1 Onboard Violation Cleared ACK (P203) Message ACK Status Field, Generation Requirements

The Onboard Violation Cleared ACK (P203) message ACK Status field indicates if the Onboard Violation Cleared ACK (P203) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 28: Onboard Violation Cleared ACK (P203) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – Onboard Violation Cleared (P303) message successfully received
1	NACK – Message discarded

3.3.1.4.3.2 Onboard Violation Cleared ACK (P203) Message Coordination Number Field, Generation Requirements

The Onboard Violation Cleared ACK (P203) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.1.4.4 Onboard Violation Cleared ACK (P203) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Onboard Violation Cleared ACK (P203) message fields are given in this section.

3.3.1.4.4.1 Onboard Violation Cleared ACK (P203) Message ACK Status Field, Use Requirements

The Onboard Violation Cleared ACK (P203) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.4.4.2 Onboard Violation Cleared ACK (P203) Message Coordination Number Field, Use Requirements

The Onboard Violation Cleared ACK (P203) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.1.5 Locomotive Fault Summary Report ACK (P204) Message, Version 1

The Locomotive Fault Summary Report ACK (P204) message is sent by the ITC-ATOSS BO to the ITC-PTC BO to confirm receipt of the Locomotive Fault Summary Report (P304) message.

3.3.1.5.1 Locomotive Fault Summary Report ACK (P204) Message EMP Header Parameters

Message-specific EMP header values for the Locomotive Fault Summary Report ACK (P204) message are specified in Table 29.

Table 29: Locomotive Fault Summary Report ACK (P204) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P204
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P204-1
QoS	Class	3 bits	uint	TBC-IRS-P204-2
	Priority	3 bits	uint	TBC-IRS-P204-3
	Network Preference	3 bits	uint	TBC-IRS-P204-4
	Special Handling	4 bits	uint	TBC-IRS-P204-5
	Service Request	3 bits	uint	TBC-IRS-P204-6

3.3.1.5.1.1 Locomotive Fault Summary Report ACK (P204) Message EMP Header Data Length Field

The EMP header Data Length field for a Locomotive Fault Summary Report ACK (P204) message contains the length, in bytes, of the message body. The Locomotive Fault Summary Report ACK (P204) message contains only static fields, so the message body is always the same size of 5 bytes.

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.5.1.2 Locomotive Fault Summary Report ACK (P204) Message EMP Header Number Field

The Locomotive Fault Summary Report ACK (P204) Message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.5.2 Locomotive Fault Summary Report ACK (P204) Message Body

A summary of the Locomotive Fault Summary Report ACK (P204) message body is given in Table 30. Detailed description and requirements follow.

Table 30: Locomotive Fault Summary Report ACK (P204) Message Body

ID	Field	Size (bytes)	Data Type	Description
1.	ACK Status	1	enum	ACK status. See Table 32.
2.	Coordination Number	4	uint	Coordination number from the Locomotive Fault Summary Report (P304) message being acknowledged.

Range limitations other than those inherent to the data type are placed on the above fields are provided in Table 31. These ranges will be enforced by the receiving subsystem.

Table 31: Locomotive Fault Summary Report ACK (P204) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.5.3 Locomotive Fault Summary Report ACK (P204) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in a Locomotive Fault Summary Report ACK (P204) message body are given in this section.

3.3.1.5.3.1 Locomotive Fault Summary Report ACK (P204) Message ACK Status Field, Generation Requirements

The Locomotive Fault Summary Report ACK (P204) message ACK Status field indicates if the Locomotive Fault Summary Report ACK (P204) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 32: Locomotive Fault Summary Report ACK (P204) Message ACK Status Field Enumeration

Value	Description
0	ACK – Locomotive Fault Summary Report (P304) message successfully received
1	NACK – Message discarded

3.3.1.5.3.2 Locomotive Fault Summary Report ACK (P204) Message Coordination Number Field, Generation Requirements

The Locomotive Fault Summary Report ACK (P204) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.1.5.4 Locomotive Fault Summary Report ACK (P204) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Locomotive Fault Summary Report ACK (P204) message fields are given in this section.

3.3.1.5.4.1 Locomotive Fault Summary Report ACK (P204) Message ACK Status Field, Use Requirements

The Locomotive Fault Summary Report ACK (P204) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.5.4.2 Locomotive Fault Summary Report ACK (P204) Message Coordination Number Field, Use Requirements

The Locomotive Fault Summary Report ACK (P204) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.1.6 Emergency Brake Application Report ACK (P205) Message, Version 1

The Emergency Brake Application Report ACK (P205) message is sent by the ITC-ATOSS BO to the ITC-PTC BO to confirm receipt of the Emergency Brake Application Report (P305) message.

3.3.1.6.1 Emergency Brake Application Report ACK (P205) Message EMP Header Parameters

Message-specific EMP header values for the Emergency Brake Application Report ACK (P205) message are specified in Table 33.

Table 33: Emergency Brake Application Report ACK (P205) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P205
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS- P205-1
QoS	Class	3 bits	uint	TBC-IRS- P205-2
	Priority	3 bits	uint	TBC-IRS- P205-3
	Network Preference	3 bits	uint	TBC-IRS- P205-4
	Special Handling	4 bits	uint	TBC-IRS- P205-5
	Service Request	3 bits	uint	TBC-IRS- P205-6

3.3.1.6.1.1 Emergency Brake Application Report ACK (P205) Message EMP Header Data Length Field

The EMP header Data Length field for an Emergency Brake Application Report ACK (P205) message contains the length, in bytes, of the message body. The Emergency Brake Application Report ACK (P205) message contains only static fields, so the message body is always the same size of 5 bytes.

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.6.1.2 Emergency Brake Application Report ACK (P205) Message EMP Header Number Field

The Emergency Brake Application Report ACK (P205) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.6.2 Emergency Brake Application Report ACK (P205) Message Body

A summary of the Emergency Brake Application Report ACK (P205) message body is given in Table 34. Detailed description and requirements follow.

Table 34: Emergency Brake Application Report ACK (P205) Message Body

ID	Field	Size (bytes)	Data Type	Description
1.	ACK Status	1	enum	ACK status. See Table 36.
2.	Coordination Number	4	uint	Coordination number from the Emergency Brake Application Report (P305) message being acknowledged.

Range limitations other than those inherent to the data type are placed on the above fields are provided in Table 35. These ranges will be enforced by the receiving subsystem.

Table 35: Emergency Brake Application Report ACK (P205) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.6.3 Emergency Brake Application Report ACK (P205) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in an Emergency Brake Application Report ACK (P205) message body are given in this section.

3.3.1.6.3.1 Emergency Brake Application Report ACK (P205) Message ACK Status Field, Generation Requirements

The Emergency Brake Application Report ACK (P205) message ACK Status field indicates if the Emergency Brake Application Report ACK (P205) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 36: Emergency Brake Application Report ACK (P205) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – Brake Application Report (P305) message successfully received
1	NACK – Message discarded

3.3.1.6.3.2 Emergency Brake Application Report ACK (P205) Message Coordination Number Field, Generation Requirements

The Emergency Brake Application Report ACK (P205) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.1.6.4 Emergency Brake Application Report ACK (P205) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Emergency Brake Application Report ACK (P205) message fields are given in this section.

3.3.1.6.4.1 Emergency Brake Application Report ACK (P205) Message ACK Status Field, Use Requirements

The Emergency Brake Application Report ACK (P205) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.6.4.2 Emergency Brake Application Report ACK (P205) Message Coordination Number Field, Use Requirements

The Emergency Brake Application Report ACK (P205) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.1.7 Train Handling Exception Report ACK (P206) Message, Version 1

The Train Handling Exception Report ACK (P206) message is sent by the ITC-ATOSS BO to the ITC-PTC BO to confirm receipt of the Train Handling Exception Report (P306) message.

3.3.1.7.1 Train Handling Exception Report ACK (P206) Message EMP Header Parameters

Message-specific EMP header values for the Train Handling Exception Report ACK (P206) message are specified in Table 37.

Table 37: Train Handling Exception Report ACK (P206) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P206
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS- P206-1
QoS	Class	3 bits	uint	TBC-IRS- P206-2
	Priority	3 bits	uint	TBC-IRS- P206-3
	Network Preference	3 bits	uint	TBC-IRS- P206-4
	Special Handling	4 bits	uint	TBC-IRS- P206-5

3.3.1.7.1.1 Train Handling Exception Report ACK (P206) Message EMP Header Data Length Field

The EMP header Data Length field for a Train Handling Exception Report ACK (P206) message contains the length, in bytes, of the message body. The Train Handling Exception Report ACK (P206) message contains only static fields, so the message body is always the same size of 5 bytes.

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.7.1.2 Train Handling Exception Report ACK (P206) Message EMP Header Number Field

The Train Handling Exception Report ACK (P206) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.7.2 Train Handling Exception Report ACK (P206) Message Body

A summary of the Train Handling Exception Report ACK (P206) message body is given in Table 38. Detailed description and requirements follow.

Table 38: Train Handling Application Report ACK (P206) Message Body

ID	Field	Size (bytes)	Data Type	Description
1.	ACK Status	1	enum	ACK status. See Table 40.
2.	Coordination Number	4	uint	Coordination number from the Train Handling Exception Report ACK (P206) message being acknowledged.

Range limitations other than those inherent to the data type are placed on the above fields are provided in Table 39. These ranges will be enforced by the receiving subsystem.

Table 39: Train Handling Exception Report ACK (P206) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.7.3 Train Handling Exception Report ACK (P206) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in a Train Handling Exception Report ACK (P206) message body are given in this section.

3.3.1.7.3.1 Train Handling Exception Report ACK (P206) Message ACK Status Field, Generation Requirements

The Train Handling Exception Report ACK (P206) message ACK Status field indicates if the Train Handling Exception Report ACK (P206) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 40: Train Handling Exception Report ACK (P206) Message ACK Status Field Enumeration Values

Value	Description
0	ACK – Train Handling Exception Report ACK (P206) message successfully received
1	NACK – Message discarded

3.3.1.7.3.2 Train Handling Exception Report ACK (P206) Message Coordination Number Field, Generation Requirements

The Train Handling Exception Report ACK (P206) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.1.7.4 Train Handling Exception Report ACK (P206) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Train Handling Exception Report ACK (P206) message fields are given in this section.

3.3.1.7.4.1 Train Handling Exception Report ACK (P206) Message ACK Status Field, Use Requirements

The Train Handling Exception Report ACK (P206) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.7.4.2 Train Handling Exception Report ACK (P206) Message Coordination Number Field, Use Requirements

The Train Handling Exception Report ACK (P206) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.1.8 Locomotive Fault Report ACK (P207) Message, Version 1

The Locomotive Fault Report ACK (P207) message is sent by the ITC-ATOSS BO to the ITC-PTC BO to confirm receipt of the Locomotive Fault Report (P307) message.

3.3.1.8.1 Locomotive Fault Report ACK (P207) Message EMP Header Parameters

Message-specific EMP header values for the Locomotive Fault Report ACK (P207) message are specified in Table 41.

Table 41: Locomotive Fault Report ACK (P207) Message EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P207
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS- P207-1
QoS	Class	3 bits	uint	TBC-IRS- P207-2
	Priority	3 bits	uint	TBC-IRS- P207-3
	Network Preference	3 bits	uint	TBC-IRS- P207-4
	Special Handling	4 bits	uint	TBC-IRS- P207-5
	Service Request	3 bits	uint	TBC-IRS- P207-6

3.3.1.8.1.1 Locomotive Fault Report ACK (P207) Message EMP Header Data Length Field

The EMP header Data Length field for a Locomotive Fault Report ACK (P207) message contains the length, in bytes, of the message body. The Locomotive Fault Report ACK (P207) message contains only static fields, so the message body is always the same size of 5 bytes.

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.1.8.1.2 Locomotive Fault Report ACK (P207) Message EMP Header Number Field

The Locomotive Fault Report ACK (P207) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.1.8.2 Locomotive Fault Report ACK (P207) Message Body

A summary of the Locomotive Fault Report ACK (P207) message body is given in Table 42. Detailed description and requirements follow.

Table 42: Locomotive Fault Report ACK (P207) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	ACK Status	1	enum	ACK status. See Table 44.
2	Coordination Number	4	uint	Coordination number from the Locomotive Fault Report (P307) message being acknowledged.

Range limitations other than those inherent to the data type are placed on the above fields are provided in Table 43. These ranges will be enforced by the receiving subsystem.

Table 43: Locomotive Fault Report ACK (P207) Message Field Ranges

ID	Field	Range
1	ACK Status	0 to 1 (valid enumeration values)

3.3.1.8.3 Locomotive Fault Report ACK (P207) Message Field Generation Requirements

Requirements placed on ITC-ATOSS BO in regard to populating the fields in a Locomotive Fault Report ACK (P207) message body are given in this section.

3.3.1.8.3.1 Locomotive Fault Report ACK (P207) Message ACK Status Field, Generation Requirements

The Locomotive Fault Report ACK (P207) message ACK Status field indicates if the Locomotive Fault Report ACK (P207) message being sent is an ACK or NACK according to the reliable messaging process described in Section 3.4.4.

Table 44: Locomotive Fault Report ACK (P207) Message ACK Status Field Enumeration

Value	Description
0	ACK – Locomotive Fault Report (P307) message successfully received
1	NACK – Message discarded

3.3.1.8.3.2 Locomotive Fault Report ACK (P207) Message Coordination Number Field, Generation Requirements

The Locomotive Fault Report ACK (P207) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.1.8.4 Locomotive Fault Report ACK (P207) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the Locomotive Fault Report ACK (P207) message fields are given in this section.

3.3.1.8.4.1 Locomotive Fault Report ACK (P207) Message ACK Status Field, Use Requirements

The Locomotive Fault Report ACK (P207) message ACK Status field is used to support the reliable messaging process described in Section 3.4.4.

3.3.1.8.4.2 Locomotive Fault Report ACK (P207) Message Coordination Number Field, Use Requirements

The Locomotive Fault Report ACK (P207) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.2 ITC-PTC BO to ITC-ATOSS BO Messages

This section documents all messages sent by ITC-PTC BO to ITC-ATOSS BO. The following message type (ID) assignments are currently made:

Table 45: ITC-ATOSS BO to ITC-PTC BO Messages

Message Type (ID)	Version	Description
P300	1	ITC-PTC BO to ITC-ATOSS BO Poll
P301	1	Locomotive System State
P302	1	Onboard Violation Report
P303	1	Onboard Violation Cleared
P304	1	Locomotive Fault Summary Report
P305	1	Emergency Brake Application Report
P306	1	Train Handling Exception Report
P307	1	Locomotive Fault Report

3.3.2.1 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message, Version1

ITC-PTC BO periodically sends the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message to ITC-ATOSS BO to provide a list of all trains currently registered with ITC-PTC BO. ITC-ATOSS BO replies with the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message, which serves as an ACK and provides a list of ATO trains currently registered with ITC-ATOSS BO.

3.3.2.1.1 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message EMP Header Parameters

Message-specific EMP header values for the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message are specified in Table 46.

Table 46: ITC-PTC BO to ITC-ATOSS BO Poll (P300) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P300
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P300-1
QoS	Class	3 bits	uint	TBC-IRS-P300-2
	Priority	3 bits	uint	TBC-IRS-P300-3
	Network Preference	3 bits	uint	TBC-IRS-P300-4
	Special Handling	4 bits	uint	TBC-IRS-P300-5
	Service Request	3 bits	uint	TBC-IRS-P300-6

3.3.2.1.1.1 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message EMP Header Data Length Field

The EMP header Data Length field for an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message contains the length, in bytes, of the message body. The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message contains a record loop, which is preceded by a counter indicating the number of times the record is repeated.

In order to calculate the value stored in the EMP data length field, the size of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message body must be calculated at run time for each ITC-PTC BO to ITC-ATOSS BO Poll (P300) message generated. The size of an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message is the sum of:

- 2 bytes for field ID 1
- 15 bytes multiplied by the value of field ID 1 for fields ID 1.1-1.3
- The sum of the values of each instance of field ID 1.3 for the variable-length field ID 1.4
- 8 bytes times the value of field ID 1 for field IDs 1.5 and 1.6
- 4 bytes for field ID 2

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.1.1.2 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message EMP Header Number Field

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message EMP header message number field is calculated according to the process described in Section 3.4.2.

3.3.2.1.2 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Body

A summary of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message body is given in Table 47. Detailed descriptions and requirements follow.

Table 47: ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Body

ID	Field	Size, bytes	Data Type	Description
1	Train Record Counter	2	uint	Number of trains
<start Train Record loop>				repeat once for each train
1.1	Lead Locomotive ID	10	U	Identification number of the lead locomotive
1.2	Train ID SCAC	4	SCAC	SCAC of the railroad which assigned the Train ID
1.3	Train ID Length	1	string	Length of Train ID
1.4	Train ID	varies	string	Train identification number
1.5	ITC-PTC OB State	1	enum	Current ITC-PTC OB state. See Table 50.
1.6	Locomotive State Time	7	time	UTC time locomotive state was sampled
<end Train Record loop>				
2	Coordination Number	4	uint	Unique ITC-PTC BO-assigned message coordination number for use in the resulting ITC-ATOSS BO to ITC-PTC BO Poll (P200) message.

Range limitations, other than those inherent to the data types placed on the fields in Table 47, are provided in Table 48. Ranges placed on enumerated types refer to the numerical value of the enumeration and restrict the field to the valid enumeration values. These ranges will be enforced by the receiving subsystem.

Table 48: ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Field Ranges

ID	Field	Range
1.2	Train ID SCAC	Capital letters, left-justified, space filled; must contain at least two letters
1.3	Train ID Length	0 to 30
1.5	ITC-PTC OB State	0 to 9 (Valid enumeration values)

3.3.2.1.3 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Reliable Messaging Properties

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 49.

Table 49: ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	ITC-ATOSS BO to ITC-PTC BO Poll (P200) message
Number of Retries	TBC-IRS-P300-7
Retry Interval	TBC-IRS-P300-8

3.3.2.1.4 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Field Generation Requirements

Requirements placed on ITC-PTC BO in regard to populating the fields in an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message body are given in this section.

3.3.2.1.4.1 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train Record Counter Dynamic Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train Record Counter dynamic field provides the number of trains currently registered with ITC-PTC BO.

a) *When ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-PTC BO shall populate the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train Record Counter field with the total number of trains currently registered with ITC-PTC BO.*

3.3.2.1.4.2 ITC-ATOSS BO to ITC-PTC BO Poll (P300) Message Lead Locomotive ID Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Lead Locomotive ID field is populated with the identification number of the lead locomotive of the train. This is a string containing locomotive unit data as described in Section 1.6.

a) *When ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-PTC BO shall populate each instance of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Lead Locomotive ID field with the identification number of the lead locomotive of the corresponding train.*

3.3.2.1.4.3 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train ID SCAC Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID SCAC field contains the SCAC of the railroad that assigned the Train ID given in the Locomotive System State Report (P301) message Train ID field.

a) *When ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-PTC BO shall populate the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID SCAC field with the SCAC of the railroad that assigned the Train ID.*

3.3.2.1.4.4 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train ID Length Dynamic Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID Length field contains the length of the following ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID field. The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID field may be up to 30 characters in length. If the train identification number is not available, the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID Length field will be populated with a value of 0 and the following ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID field will not be present.

a) *When ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-PTC BO shall populate the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID*

Length field with the length, in bytes, of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID.

b) If ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message and the train identification number is unavailable, the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID Length field will be populated with a value of 0.

3.3.2.1.4.5 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train ID Dynamic Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID dynamic field contains the operating-RR assigned train identification number. Train IDs are assigned per the business practices of the operating RR; the only standardization is that they must be no more than 30 ASCII characters. If the train identification number is not available, the corresponding instance of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID field will not be present.

a) When ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-PTC BO shall populate the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID field with the corresponding train identification number.

3.3.2.1.4.6 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message ITC-PTC OB State Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-PTC OB State field reports the current operating state of the ITC-PTC OB subsystem as defined by the ITC-PTC OB subsystem requirements. The valid values of this enumeration, 0 to 9, are listed in Table 50. All other values are unused.

Table 50: ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message ITC-PTC OB State Field Enumeration Values

Value	Description
0.	Self-Test
1.	Cut-Out
2.	Initializing
3.	Disengaged
4.	Active
5.	ATO Passive
6.	ATO Active
7.	Attended Active
8.	Failed
9.	Restricted

a) When ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-PTC BO shall set the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-PTC OB Status field to the current ITC-PTC OB state using the enumeration values given in Table 50.

3.3.2.1.4.7 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Locomotive State Time Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Locomotive State Time field contains the time that the locomotive state was sampled. The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Locomotive State Time field is stored as a 7-byte unsigned integer in the format

YYYYMMDDHHMMSS. YYYY is the year and is 2 bytes in size. MM, DD, HH, MM, SS are the month, day, hour, minute, and second, respectively; each are 1 byte in size.

a) *When ITC-PTC BO generates an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-PTC BO shall populate the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Locomotive State Time field with the time at which the locomotive state was sampled.*

3.3.2.1.4.8 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Coordination Number Field, Generation Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.2.1.5 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Field Use Requirements

Requirements placed on ITC-ATOSS BO regarding the verification and use of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message fields are given in this section.

3.3.2.1.5.1 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train Record Counter Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train Record Counter field provides ITC-PTC BO with the number of ATO trains being reported to ITC-PTC BO and is used to assist in correctly unpacking the message by providing the number of times the train record loop is repeated.

a) *When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-ATOSS BO shall use the value contained in the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train Record Counter field as the number of ATO trains currently tracked by ITC-PTC BO.*

b) *When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-ATOSS BO shall extract the number of ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train records indicated by the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train Record Counter field.*

3.3.2.1.5.2 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Lead Locomotive ID Dynamic Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Lead Locomotive ID dynamic field provides the identification number of the lead locomotive of the train described in the corresponding ITC-PTC to ITC-ATOSS BO Poll (P300) message Train ID record.

a) *When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-ATOSS BO shall use each instance of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Lead Locomotive ID field as the identification number of the lead locomotive of the corresponding train.*

3.3.2.1.5.3 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train ID SCAC Dynamic Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID SCAC dynamic field provides the SCAC of the railroad that assigned the train ID given in the corresponding ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID dynamic field.

a) *When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-ATOSS BO ITC-ATOSS BO shall use the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID SCAC as an indication of the SCAC of the railroad that assigned the train ID given in the corresponding ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID dynamic field.*

3.3.2.1.5.4 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train ID Length Dynamic Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID Length dynamic field helps ITC-ATOSS BO interpret the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message by providing ITC-ATOSS BO with the length of the following ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID dynamic field.

a) *When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message, ITC-ATOSS BO shall use the value contained in the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID Length dynamic field as the length, in bytes, of the following instance of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID dynamic field.*

3.3.2.1.5.5 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Train ID Dynamic Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID dynamic field provides the identification number of the corresponding train. The train ID is a variable-length alpha-numeric string, and each railroad assigns their own train ID to each train according to their business practices. This string does not include a null termination.

a) *When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-ATOSS BO shall use each instance of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Train ID dynamic field as the identification number of the corresponding train.*

3.3.2.1.5.6 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message ITC-PTC OB State Dynamic Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-PTC OB State field reports the current operating state of the ITC-PTC OB subsystem on the corresponding train.

a) *When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-ATOSS BO shall, using the enumeration values given in Table 50, interpret each instance of the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-PTC OB state dynamic field as the state of the ITC-PTC OB subsystem on the corresponding train.*

3.3.2.1.5.7 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Locomotive State Time Dynamic Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message State Time dynamic field provides the time that the corresponding locomotive state was sampled.

a) When ITC-ATOSS BO receives an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message ITC-ATOSS BO shall use the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Locomotive State Time dynamic field as the time at which the corresponding locomotive state was sampled.

3.3.2.1.5.8 ITC-PTC BO to ITC-ATOSS BO Poll (P300) Message Coordination Number Field, Use Requirements

The ITC-PTC BO to ITC-ATOSS BO Poll (P300) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.2.2 Locomotive System State (P301) Message, Version 1

The Locomotive System State (P301) message is sent by the ITC-PTC BO to the ITC-ATOSS BO to inform ATOSS BO of a change in locomotive state. ITC-PTC BO receives the original Locomotive System State (2010) message from ITC-PTC OB.

3.3.2.2.1 Locomotive System State (P301) Message EMP Header Parameters

Message-specific EMP header values for the Locomotive System State (P301) message are specified in Table 51.

Table 51: Locomotive System State (P301) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P301
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P301-1
QoS	Class	3 bits	uint	TBC-IRS-P301-2
	Priority	3 bits	uint	TBC-IRS-P301-3
	Network Preference	3 bits	uint	TBC-IRS-P301-4
	Special Handling	4 bits	uint	TBC-IRS-P301-5
	Service Request	3 bits	uint	TBC-IRS-P301-6

3.3.2.2.1.1 Locomotive System State (P301) Message EMP Header Data Length Field

The EMP header Data Length field for a Locomotive System State (P301) message contains the length, in bytes, of the message body.

In order to calculate the value stored in the EMP data length field, the size of the Locomotive System State (P301) message body must be calculated at run time for each Locomotive System State (P301) message generated. The size of a Locomotive System State (P301) message is the sum of:

- 5 bytes for field IDs 1 and 2
- The value of field 2 for the IRS Version contained in field 3
- 12 bytes for fields IDs 4-9
- The value of field 9 for the Clearance Number in field 10
- 1 byte for field ID 11
- The value of field 11 for the Train ID in field 12
- 7 bytes for field IDs 13-15
- The value of field 15 for the Head End Milepost Prefix in field 16
- 1 byte for field ID 17
- The value of field 17 for the Head End Milepost Suffix in field 18
- 1 byte for field ID 19
- The value of field 19 for the Head End Track Name in field 20
- 11 bytes for field IDs 21-24
- The value of field 24 for the Rear End Milepost Prefix in field 25
- 1 byte for field ID 26
- The value of field 26 for the Rear End Milepost Suffix in field 27
- 1 byte for field ID 28
- The value of field 28 for the Rear End Track Name in field 29
- 22 bytes for field IDs 30-3

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.2.1.2 Locomotive System State (P301) Message EMP Header Number Field

The Locomotive System State (P301) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.2.2 *Locomotive System State (P301) Message Body*

A summary of the Locomotive System State (P301) message body is given in Table 52. Detailed description and requirements follow.

Table 52: Locomotive System State (P301) Message Body

ID	Field	Size (bytes)	Data Type	Description
1.	Railroad SCAC	4	SCAC	SCAC of the railroad BOS to which ITC-PTC OB sent the Locomotive System State (02010) message
2.	IRS Version Length	1	uint	Length of the IRS Version field
3.	IRS Version	varies	string	ITC-PTC Office-locomotive segment IRS version.
4.	Reason for Sending	1	enum	Reason the Locomotive System State (02010) message was sent. See Table 55.
5.	Locomotive State Time	7	uint	UTC time that the locomotive state was sampled.
6.	Locomotive State Summary	1	enum	Summary of the state of the locomotive onboard system. See Table 56.
7.	Previous Locomotive State	1	enum	Locomotive state prior to sample. See Table 57.
8.	Current Locomotive State	1	enum	Locomotive state at sample time. See Table 58.
9.	Clearance Number Length	1	uint	String length of the Clearance Number field
10.	Clearance Number	varies	string	Clearance number
11.	Train ID Length	1	uint	Length of Train ID field
12.	Train ID	varies	string	Identification number of the train
13.	Fault Code	2	uint	Unique code number for the fault that caused the state to change to Failed, when applicable. If the current locomotive state is not Failed, this field is populated with zero.
14.	Head End Milepost	4	MP	Head end milepost. See Section 1.6 for information on converting the MP data type to a milepost number.
15.	Head End Milepost Prefix Length	1	uint	Length of Head End Milepost Prefix field
16.	Head End Milepost Prefix	varies	string	Head end milepost prefix
17.	Head End Milepost Suffix Length	1	uint	Length of Head End Milepost Suffix field
18.	Head End Milepost Suffix	varies	string	Head end milepost suffix
19.	Head End Track Name Length	1	uint	Length of Head End Track Name field
20.	Head End Track Name	varies	string	Head end track name
21.	Head End Railroad SCAC	4	string	Railroad SCAC of the railroad that operates the head end subdivision/district, left justified, space filled
22.	Head End PTC Subdivision/District ID	2	uint	PTC subdivision/district in which the HOT is located
23.	Rear End Milepost	4	MP	Rear end milepost. See Section 1.6 for information on converting the MP data type to a milepost number.
24.	Rear End Milepost Prefix Length	1	uint	Length of Rear End Milepost Prefix field
25.	Rear End Milepost Prefix	varies	string	Rear end milepost prefix
26.	Rear End Milepost Suffix Length	1	uint	Length of Rear End Milepost Suffix field

ID	Field	Size (bytes)	Data Type	Description
27.	Rear End Milepost Suffix	varies	string	Rear end milepost suffix
28.	Rear End Track Name Length	1	uint	Length of Rear End Track Name field
29.	Rear End Track Name	varies	string	Rear end track name
30.	Rear End Railroad SCAC	4	uint	Railroad SCAC of the railroad that operates the rear end subdivision/district, left justified, space filled
31.	Rear End PTC Subdivision/District ID	2	uint	Current PTC subdivision/district ID of the rear end
32.	Head End Current Position	12	ECEF	ECEF Position (LSB = 1 centimeter, see Section 1.6 for more information).
33.	Coordination Number	4	uint	ITC-PTC BO-assigned coordination number for use in the resulting Locomotive System State ACK (P201) message.

Range limitations, other than those inherent to the data, are provided in Table 53. These ranges will be enforced by the receiving system.

Table 53: Locomotive System State (P301) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
2	IRS Version Length	1 to 20
4	Reason for Sending	0-31 (valid enumeration values)
6	Locomotive State Summary	0-2 (valid enumeration values)
7	Previous Locomotive State	0-7 (valid enumeration values)
8	Current Locomotive State	0-7 (valid enumeration values)
9	Clearance Number Length	0-8 characters
11	Train ID Length	0-30 characters
15	Head End Milepost Prefix Length	0-5 characters
17	Head End Milepost Suffix Length	0-5 characters
19	Head End Track Name Length	0-32 characters
21	Head End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
22	Head End PTC Subdivision/District ID	0 to 9999
24	Rear End Milepost Prefix Length	0-5 characters
26	Rear End Milepost Suffix Length	0-5 characters
28	Rear End Track Name Length	0-32 characters
30	Rear End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
31	Rear End PTC Subdivision/District ID	0 to 9999

3.3.2.2.3 Locomotive System State (P301) Message Reliable Messaging Properties

The Locomotive System State (P301) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 54.

Table 54: Locomotive System State (P301) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Locomotive System State ACK (P201)
Number of Retries	TBC-IRS-P301-7
Retry Interval	TBC-IRS-P301-8

3.3.2.2.4 Locomotive System State (P301) Message Field Generation Requirements

Requirements placed on ITC-PTC BO in regard to populating the fields in a Locomotive System State (P301) message body are given in this section.

3.3.2.2.4.1 Locomotive System State (P301) Message Railroad SCAC Field, Generation Requirements

The Locomotive System State (P301) message Railroad SCAC field contains the SCAC that was originally reported to ITC-PTC BO from ITC-PTC OB using the Locomotive System State (02010) message Railroad SCAC field. The Locomotive System State (P301) message Railroad SCAC field is used for forwarding the Locomotive System State (02010) message Railroad SCAC field from ITC-PTC BO to ITC-ATOSS BO.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Railroad SCAC field with the SCAC that ITC-PTC BO received in the ITC-PTC OB Locomotive System State (02010) message Railroad SCAC field of the message being forwarded.*

3.3.2.2.4.2 Locomotive System State (P301) Message IRS Version Length Field, Generation Requirements

The Locomotive System State (P301) message IRS Version Length field contains the length, in bytes, of the Locomotive System State (P301) message IRS Version field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message IRS Version Length field with the length, in bytes, of the Locomotive System State (P301) message IRS Version field.*

3.3.2.2.4.3 Locomotive System State (P301) Message IRS Version Field, Generation Requirements

The Locomotive System State (P301) message IRS Version field contains the version of the IRS that is in use between ITC-PTC OB and ITC-PTC BO. The ITC-ATOSS BO to ITC-PTC BO IRS version is recorded in the Locomotive System State (P301) message EMP header. The Locomotive System State (P301) message IRS Version field must have a string length between 1 and 20 characters.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message IRS Version field with the version of the IRS in use between ITC-PTC OB and ITC-PTC BO.*

b) *When ITC-PTC BO populates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message IRS Version field with between 1 and 20 printable ASCII characters.*

3.3.2.2.4.4 Locomotive System State (P301) Message Reason for Sending Field, Generation Requirements

The Locomotive System State (P301) message Reason for Sending field indicates why the Locomotive System State (02010) message was sent from ITC-PTC OB to ITC-PTC BO. The enumeration values are given in Table 55.

Some of the enumeration values are used only in non-ATO operations and are not used when the train is in an ATO-active state. The interface does not prohibit transmitting non-ATO enumeration values from ITC-PTC BO to ITC-ATOSS BO, so any of the enumeration field values listed in Table 55 are potentially valid.

Table 55: Locomotive System State (P301) Message Reason for Sending Enumeration Field Values

Value	Description
0	Not Used
1	Crew initiated change – cut out
2	Crew initiated change - logoff
3	Reserved
4	Office commanded change
5	Sent in response to the 01003 message
6	Periodic report to railroad operating at least one subdivision/district on the train subdivision/district list
7	Periodic report to railroad operating ancillary subdivision(s)/district(s) only
8	Conditions for Active state satisfied
9	Not on PTC track
10	Locomotive position unknown
11	Direction of movement unknown
12	Crew begin initialization
13	Crew exit initialization
14	Crew exit initialization – request timed out
15	Crew exit initialization – system configuration incompatible
16	Crew exit initialization – software download
17	Crew exit initialization – verification failure
18	Crew exit initialization – no train ID
19	Crew exit initialization – system configuration invalid
20	Software installation timeout
21	Successful completion of installation
22	Unsuccessful departure test
23	Air brake system cut out
24	Non-synchronized subdivision/district
25	Request for configuration timed out
26	Invalid configuration
27	Crew enter Restricted state
28	Crew exit Restricted state
29	System failure

Value	Description
30	System failure cleared
31	Crew cut in
32	Enter ATO
33	Exit ATO
34	ATO state change

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Reason for Sending field with an enumeration value from Table 55, indicating the reason that the Locomotive System State (02010) message was sent by ITC-PTC OB to ITC-PTC BO.*

3.3.2.2.4.5 Locomotive System State (P301) Message Locomotive State Time Field, Generation Requirements

The Locomotive System State (P301) message Locomotive State Time field contains the time that the Locomotive State was sampled. The Locomotive System State (P301) message Locomotive State Time field is stored as a 7-byte binary-coded decimal number in the format YYYYMMDDHHMMSS. YYYY is the year and is 2 bytes in size. MM, DD, HH, MM, SS are the month, day, hour, minute, and second, respectively; each are 1 byte in size.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Locomotive State Time field with the time at which the Locomotive State was sampled.*

b) *When ITC-PTC BO generates a Locomotive System State (P301) message, the Locomotive System State (P301) message Locomotive State Time field shall be a 7-byte uint representing time in the format YYYYMMDDHHMMSS.*

3.3.2.2.4.6 Locomotive System State (P301) Message Locomotive State Summary Field, Generation Requirements

The Locomotive System State (P301) message Locomotive State Summary field provides a summary of the current locomotive state at the time indicated by the Locomotive System State (P301) message Locomotive State Time field. The enumeration values are given in Table 56.

Table 56: Locomotive System State (P301) Message Locomotive State Summary Field Enumeration Values

Value	Description
0	Not Used
1	Controlling
2	Non-controlling

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message with the locomotive state, as provided to ITC-PTC BO by ITC-PTC OB, using the enumeration values given in Table 56.*

3.3.2.2.4.7 Locomotive System State (P301) Message Previous Locomotive State Field, Generation Requirements

The Locomotive System State (P301) message Previous Locomotive State field indicates the locomotive state that was recorded before the time indicated by the Locomotive System State (P301) message Locomotive State Time field. When the Locomotive System State (P301) message is sent for a reason not involving a state change, this will be the same as the current locomotive state. The enumeration values are given in the message body description.

Table 57: Locomotive System State (P301) Message Previous Locomotive State Field Enumeration Values

Value	Description
0	Not Used
1	Reserved
2	Initializing
3	Disengaged
4	Cut Out
5	Active
6	Restricted
7	Failed
8	ATO Disengaged
9	Shadow Active
10	Attended Active
11	ATO Active

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Previous Locomotive State field with the previous locomotive state using the enumeration values given in Table 57.*

3.3.2.2.4.8 Locomotive System State (P301) Message Current Locomotive State Field, Generation Requirements

The Locomotive System State (P301) message Current Locomotive State field indicates the locomotive state recorded at the time indicated by the Locomotive System State (P301) message Locomotive State Time field. The enumeration values are given in Table 58.

Table 58: Locomotive System State (P301) Message Current Locomotive State Field Enumeration Values

Value	Description
0	Not Used
1	Reserved
2	Initializing
3	Disengaged
4	Cut Out
5	Active
6	Restricted
7	Failed

Value	Description
8	ATO Disengaged
9	Shadow Active
10	Attended Active
11	ATO Active

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Current Locomotive State field with the state of the locomotive at the time indicated in the Locomotive System State (P301) message Locomotive State field using the enumeration values in Table 58.*

3.3.2.2.4.9 Locomotive System State (P301) Message Clearance Number Length Field, Generation Requirements

The Locomotive System State (P301) message Clearance Number Length field contains the length of the Locomotive System State (P301) message Clearance Number field. If the Locomotive System State (P301) message Clearance Number is not available when the message is created, the Locomotive System State (P301) message Clearance Number Length field is set to 0 and no Locomotive System State (P301) message Clearance Number field is present.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message and the clearance number is available, ITC-PTC BO shall populate the Locomotive System State (P301) message Clearance Number Length field with the length of the Locomotive System State (P301) message Clearance Number.*

b) *When ITC-PTC BO generates a Locomotive System State (P301) message and the clearance number is unavailable ITC-PTC BO shall set the Locomotive System State (P301) message Clearance Number Length field to 0.*

3.3.2.2.4.10 Locomotive System State (P301) Message Clearance Number Field, Generation Requirements

The Locomotive System State (P301) message Clearance Number field contains the clearance number. Locomotive System State (P301) message Clearance Number field may not exceed eight characters in length. If the clearance number is not available, the Locomotive System State (P301) message Clearance Number field will not exist.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message and the clearance number is available, ITC-PTC BO shall populate the Locomotive System State (P301) message Clearance Number field with the clearance number.*

b) *If ITC-PTC BO generates a Locomotive System State (P301) message and the Clearance number is unavailable ITC-PTC BO shall not include a Locomotive System State (P301) message Clearance Number field will.*

3.3.2.2.4.11 Locomotive System State (P301) Message Train ID Length Field, Generation Requirements

The Locomotive System State (P301) message Train ID Length field contains length of the Locomotive System State (P301) message Train ID field. The Locomotive System State (P301) message Train ID field may be up to 30 characters in length. If the Train ID is not available, the Locomotive System State (P301) message Train ID Length field will be populated with 0 and the Locomotive System State (P301) message Train ID field will not exist.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message and the train ID is available, ITC-PTC BO shall populate the Locomotive System State (P301) message Train ID Length field with the length of the Locomotive System State (P301) message Train ID.*

b) *If ITC-PTC BO generates a Locomotive System State (P301) message and the Train ID is unavailable ITC-PTC BO shall populate the Locomotive System State (P301) message Train ID Length field with a value of 0.*

3.3.2.2.4.12 Locomotive System State (P301) Message Train ID Field, Generation Requirements

The Locomotive System State (P301) message Train ID field contains a string data type which indicates the train's identification number. If the train ID is not available, the Locomotive System State (P301) message Train ID field will not be included.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message and the train ID is available, ITC-PTC BO shall populate the Locomotive System State (P301) message Train ID field with a string indicating the train's identification number.*

b) *If ITC-PTC BO generates a Locomotive System State (P301) message and the train ID is not available ITC-PTC BO shall not include a Locomotive System State (P301) message Train ID field.*

3.3.2.2.4.13 Locomotive System State (P301) Message Fault Code Field, Generation Requirements

The Locomotive System State (P301) message Fault Code field contains a unique code that identifies the fault that caused the locomotive state to change to a failed locomotive state, if applicable. If the Locomotive System State (P301) message Current Locomotive State field is not "Failed," this field is populated with 0.

a) *If ITC-PTC BO generates a Locomotive System State (P301) message and a fault code is available ITC-PTC BO shall populate the Locomotive System State (P301) message Fault Code field with the fault code indicating the cause of the locomotive state change.*

b) *When ITC-PTC BO generates a Locomotive System State (P301) message and a fault code is unavailable ITC-PTC OB shall populate the Locomotive System State (P301) message Current Locomotive State with 0.*

3.3.2.2.4.14 Locomotive System State (P301) Message Head End Milepost Field, Generation Requirements

The Locomotive System State (P301) message Head End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides the location of the HOT, accurate to 1/1000 of a mile.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Milepost field with the location of the HOT.*

3.3.2.2.4.15 Locomotive System State (P301) Message Head End Milepost Prefix Length Field, Generation Requirements

The Locomotive System State (P301) message Head End Milepost Prefix Length field is populated with the length of the Locomotive System State (P301) message Head End Milepost Prefix field. When the associated track does not have a milepost prefix the Locomotive System State (P301) message Head End Milepost Prefix Length field is populated with 0 and no Locomotive System State (P301) message Head End Milepost Prefix field is present.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Milepost Prefix Length field with the length of the Locomotive System State (P301) message Head End Milepost Prefix.*

3.3.2.2.4.16 Locomotive System State (P301) Message Head End Milepost Prefix Field, Generation Requirements

The Locomotive System State (P301) message Head End Milepost Prefix field is populated with a string that contains the milepost prefix of the location of the HOT. The Locomotive System State (P301) message Head End Milepost Prefix field cannot exceed five characters.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Milepost Prefix field with the head end milepost prefix.*

3.3.2.2.4.17 Locomotive System State (P301) Message Head End Milepost Suffix Length Field, Generation Requirements

The Locomotive System State (P301) message Head End Milepost Suffix Length field is populated with the length of the Locomotive System State (P301) message Head End Milepost Suffix. When the associated track does not have a milepost suffix the Locomotive System State (P301) message Head End Milepost Suffix Length field is populated with 0 and no Locomotive System State (P301) message Head End Milepost Suffix field is present.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Milepost Suffix Length field with the length of the Locomotive System State (P301) message Head End Milepost Suffix.*

3.3.2.2.4.18 Locomotive System State (P301) Message Head End Milepost Suffix Field, Generation Requirements

The Locomotive System State (P301) message Head End Milepost Suffix field is populated with a string that contains the head end milepost suffix. The Locomotive System State (P301) message Head End Milepost Suffix field cannot exceed five characters.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Milepost Suffix field with the head end milepost suffix.*

3.3.2.2.4.19 Locomotive System State (P301) Message Head End Track Name Length Field, Generation Requirements

The Locomotive System State (P301) message Head End Track Name Length field is populated with the length of the Locomotive System State (P301) message Head End Track Name field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Track Name Length field with the length of the Locomotive System State (P301) message Head End Track Name.*

3.3.2.2.4.20 Locomotive System State (P301) Message Head End Track Name Field, Generation Requirements

The Locomotive System State (P301) message Head End Track Name field is populated with a string that contains the name of the track where the HOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Track Name field with the name of the track where the head end was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.4.21 Locomotive System State (P301) Message Head End Railroad SCAC Field, Generation Requirements

The Locomotive System State (P301) message Head End Railroad SCAC field is populated with the SCAC of the operating railroad of the track where the HOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Railroad SCAC field with the SCAC of the track where the head end was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.4.22 Locomotive System State (P301) Message Head End PTC Subdivision/District ID Field, Generation Requirements

The Locomotive System State (P301) message Head End PTC Subdivision/District ID field is populated with the PTC subdivision/district ID of where the HOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End PTC Subdivision/District ID field with the PTC subdivision/district ID of where the head end was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.4.23 Locomotive System State (P301) Message Rear End Milepost Field, Generation Requirements

The Locomotive System State (P301) message Rear End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides the location of the EOT at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Milepost field with an MP data type that, when multiplied by 0.0001, represents the location of the EOT.*

3.3.2.2.4.24 Locomotive System State (P301) Message Rear End Milepost Prefix Length Field, Generation Requirements

The Locomotive System State (P301) message Rear End Milepost Prefix Length field is populated with the length of the Locomotive System State (P301) message Rear End Milepost Prefix. When the associated track does not have a milepost prefix the Locomotive System State (P301) message Rear End Milepost Prefix Length field is populated with 0 and no Locomotive System State (P301) message Rear End Milepost Prefix field is present.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Milepost Prefix Length field with the length of the Locomotive System State (P301) message Rear End Milepost Prefix.*

3.3.2.2.4.25 Locomotive System State (P301) Message Rear End Milepost Prefix Field, Generation Requirements

The Locomotive System State (P301) message Rear End Milepost Prefix field is populated with a string that contains the rear end milepost prefix.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Milepost Prefix field with the rear end milepost prefix.*

3.3.2.2.4.26 Locomotive System State (P301) Message Rear End Milepost Suffix Length Field, Generation Requirements

The Locomotive System State (P301) message Rear End Milepost Suffix Length field is populated with the length of the Locomotive System State (P301) message Rear End Milepost Suffix. When the associated track does not have a milepost suffix the Locomotive System State (P301) message Rear End Milepost Suffix Length field is populated with 0 and no Locomotive System State (P301) message Rear End Milepost Suffix field is present.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Milepost Suffix Length field with the length of the Locomotive System State (P301) message Rear End Milepost Suffix.*

3.3.2.2.4.27 Locomotive System State (P301) Message Rear End Milepost Suffix Field, Generation Requirements

The Locomotive System State (P301) message Rear End Milepost Suffix field is populated with a string that contains the rear end milepost suffix. The Locomotive System State (P301) message Rear End Milepost Suffix field cannot exceed five characters.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Milepost Suffix field with the rear end milepost suffix.*

3.3.2.2.4.28 Locomotive System State (P301) Message Rear End Track Name Length Field, Generation Requirements

The Locomotive System State (P301) message Rear End Track Name Length field is populated with the length of the Locomotive System State (P301) message Rear End Track Name.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Track Name Length field with the length of the Locomotive System State (P301) message Rear End Track Name.*

3.3.2.2.4.29 Locomotive System State (P301) Message Rear End Track Name Field, Generation Requirements

The Locomotive System State (P301) message Rear End Track Name field is populated with a string that contains the name of the track where the EOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Track Name field with the name of the track where the EOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.4.30 Locomotive System State (P301) Message Rear End Railroad SCAC Field, Generation Requirements

The Locomotive System State (P301) message Rear End Railroad SCAC field is populated with a SCAC data type that contains the operating railroad's SCAC where the EOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End Railroad SCAC field with the railroad SCAC of the track where the rear end was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.4.31 Locomotive System State (P301) Message Rear End PTC Subdivision/District ID Field, Generation Requirements

The Locomotive System State (P301) message Rear End PTC Subdivision/District ID field is populated with the PTC subdivision/district ID of where the EOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Rear End PTC Subdivision/District ID field with the PTC subdivision/district of where the EOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.4.32 Locomotive System State (P301) Message Head End Current Position Field, Generation Requirements

The Locomotive System State (P301) message Head End Current Position field is populated with the Earth-Centered, Earth Fixed coordinates of where the HOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

The first four bits of the Locomotive System State (P301) message Head End Current Position field identify the ECEF X coordinate of the HOT. The following four bits identify the ECEF Y coordinate of the HOT, and the last four bits identify the ECEF Z coordinate of the HOT.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Current Position field with the Earth-Centered, Earth Fixed coordinates that give the position of the HOT at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.4.33 Locomotive System State (P301) Message Coordination Number Field, Generation Requirements

The Locomotive System State (P301) message Coordination Number is generated according to the numbering process described in Section 3.4.2.

3.3.2.2.5 Locomotive System State (P301) Message Field Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the Locomotive System State (P301) message fields are given in this section.

3.3.2.2.5.1 Locomotive System State (P301) Message Railroad SCAC Field, Use Requirements

The Locomotive System State (P301) message Railroad SCAC field provides the SCAC of the BOS to which the Locomotive System State (02084) message was sent.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Railroad SCAC field as an indication of the SCAC of the ITC-PTC BOS to which the ITC-PTC OB sent the Locomotive System State (02084) message.*

3.3.2.2.5.2 Locomotive System State (P301) Message IRS Version Length Field, Use Requirements

The Locomotive System State (P301) message IRS Version Length field provides the length, in bytes, of the Locomotive System State (P301) message IRS Version field.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message IRS Version Length field as the length, in bytes, of the Locomotive System State (P301) message IRS Version field.*

3.3.2.2.5.3 Locomotive System State (P301) Message IRS Version Field, Use Requirements

The Locomotive System State (P301) message IRS Version field provides the IRS version currently implemented by ITC-PTC OB. This field is used during the interface version negotiation process to communicate the selected IRS version. This field is included because it is in the Locomotive System State (02084) message being forwarded to ITC-ATOSS BO and is not used by ITC-ATOSS BO.

3.3.2.2.5.4 Locomotive System State (P301) Message Reason for Sending Field, Use Requirements

The Locomotive System State (P301) message Reason for Sending field provides ITC-ATOSS BO with the reason the ITC-PTC OB sent the Locomotive State Report (P301) message to ITC-PTC BOS.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall, using the enumeration values in Table 55, use the Locomotive System State (P301) message Reason for Sending field to identify the reason that the Locomotive System State (P301) message was sent.*

3.3.2.2.5.5 Locomotive System State (P301) Message Locomotive State Time Field, Use Requirements

The Locomotive System State (P301) message Locomotive State Time field is used to indicate the time that the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Locomotive State Time field as the time the locomotive state was sampled.*

3.3.2.2.5.6 Locomotive System State (P301) Message Locomotive State Summary Field, Use Requirements

The Locomotive System State (P301) message Locomotive State Summary field is used to summarize the current locomotive state at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall, using the enumeration values in Table 56, use the Locomotive System State (P301) message Locomotive State Summary field as the locomotive state summary of the corresponding locomotive.*

3.3.2.2.5.7 Locomotive System State (P301) Message Previous Locomotive State Field, Use Requirements

The Locomotive System State (P301) message Previous Locomotive State field provides ITC-PTC BO with the locomotive operating state that was recorded before the time shown in the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall, using the enumeration values in Table 57, use the Locomotive System State (P301) message Previous Locomotive State field as the previously recorded locomotive operating state of the corresponding locomotive.*

3.3.2.2.5.8 Locomotive System State (P301) Message Current Locomotive State Field, Use Requirements

The Locomotive System State (P301) message Current Locomotive State field is used to indicate the current state the locomotive that sent the Locomotive System State (P301) message.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall, using the enumeration values in Table 58, use the Locomotive System State (P301) message Current Locomotive State field as the state of the corresponding locomotive at the time shown in the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.5.9 Locomotive System State (P301) Message Clearance Number Length Field, Use Requirements

The Locomotive System State (P301) message Clearance Number Length field provides the length, in bytes, of the Locomotive System State (P301) message Clearance Number field.

a) *ITC-PTC BO shall use the Locomotive System State (P301) message Clearance Number Length field as the length, in bytes, of the Locomotive System State (P301) message Clearance Number.*

3.3.2.2.5.10 Locomotive System State (P301) Message Clearance Number Field, Use Requirements

The Locomotive System State (P301) message Clearance Number field provides the clearance number.

a) *ITC-PTC BO shall use the Locomotive System State (P301) message Clearance Number field as the clearance number.*

3.3.2.2.5.11 Locomotive System State (P301) Message Train ID Length Field, Use Requirements

The Locomotive System State (P301) message Train ID Length field provides the length, in bytes, of the Locomotive System State (P301) message Train ID field.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Train ID Length field as the length, in bytes, of the Locomotive System State (P301) message Train ID.*

3.3.2.2.5.12 Locomotive System State (P301) Message Train ID Field, Use Requirements

The Locomotive System State (P301) message Train ID field provides the identification number of the corresponding train.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Train ID field as the identification number of the corresponding train.*

3.3.2.2.5.13 Locomotive System State (P301) Message Fault Code Field, Use Requirements

The Locomotive System State (P301) message Fault Code field is used to indicate the fault, if any, that caused the locomotive state to change to a failed state. It is populated with 0 if there is not any applicable fault code.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Fault Code field as the fault code that caused the locomotive state to change to "Failed."*

3.3.2.2.5.14 Locomotive System State (P301) Message Head End Milepost Field, Use Requirements

The Locomotive System State (P301) message Head End Milepost field provides the milepost location of the HOT at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Milepost field as the milepost location of the HOT at the time the locomotive state was sampled.*

3.3.2.2.5.15 Locomotive System State (P301) Message Head End Milepost Prefix Length Field, Use Requirements

The Locomotive System State (P301) message Head End Milepost Prefix Length field provides the length of the Locomotive System State (P301) message Head End Milepost Prefix field. If there is not a milepost prefix the Locomotive System State (P301) message Head End Milepost Prefix Length field will be 0 and the Locomotive System State (P301) message Head End Milepost Prefix field will not be present.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Milepost Prefix Length field as the length, in bytes, of the Locomotive System State (P301) message Head End Milepost Prefix field.*

3.3.2.2.5.16 Locomotive System State (P301) Message Head End Milepost Prefix Field, Use Requirements

The Locomotive System State (P301) message Head End Milepost Prefix field provides the milepost prefix, if any, of the milepost location of the HOT at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Milepost Prefix field as the milepost prefix of the milepost location of the HOT at the time the locomotive state was sampled.*

3.3.2.2.5.17 Locomotive System State (P301) Message Head End Milepost Suffix Length Field, Use Requirements

The Locomotive System State (P301) message Head End Milepost Suffix Length field provides the length, in bytes, of the Locomotive System State (P301) message Head End Milepost Suffix field. If there is not a milepost suffix the Locomotive System State (P301) message Head End Milepost Suffix Length field will be 0 and the Locomotive System State (P301) message Head End Milepost Suffix field will not be present.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Milepost Suffix Length field as the length, in bytes, of the Locomotive System State (P301) message Head End Milepost Suffix.*

3.3.2.2.5.18 Locomotive System State (P301) Message Head End Milepost Suffix Field, Use Requirements

The Locomotive System State (P301) message Head End Milepost Suffix field provides the milepost suffix, if any, of the milepost location of the HOT at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Milepost Suffix field as the milepost suffix of the milepost location of the HOT at the time the locomotive state was sampled.*

3.3.2.2.5.19 Locomotive System State (P301) Message Head End Track Name Length Field, Use Requirements

The Locomotive System State (P301) message Head End Track Name Length field provides the length, in bytes, of the Locomotive System State (P301) message Head End Track Name field.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Track Name Length field as the length, in bytes, of the Locomotive System State (P301) message Head End Track Name.*

3.3.2.2.5.20 Locomotive System State (P301) Message Head End Track Name Field, Use Requirements

The Locomotive System State (P301) message Head End Track Name field provides the name of the track where the HOT was located at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Track Name field to identify the name of the track where the HOT was located at the time the locomotive state was sampled.*

3.3.2.2.5.21 Locomotive System State (P301) Message Head End Railroad SCAC Field, Use Requirements

The Locomotive System State (P301) message Head End Railroad SCAC field provides the operating railroad's SCAC where the HOT was located at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Railroad SCAC field to identify the SCAC of the track on which the HOT was located at the time the locomotive state was sampled.*

3.3.2.2.5.22 Locomotive System State (P301) Message Head End PTC Subdivision/District ID Field, Use Requirements

The Locomotive System State (P301) message Head End PTC Subdivision/District ID field is used to identify the specific subdivision/district in which the HOT was located at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End PTC Subdivision/District ID field to identify the subdivision/district in which the HOT was located at the time the locomotive state was sampled.*

3.3.2.2.5.23 Locomotive System State (P301) Message Rear End Milepost Field, Use Requirements

The Locomotive System State (P301) message Rear End Milepost field provides the milepost location of the EOT at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Milepost field as the milepost location of the EOT at the time the locomotive state was sampled.*

3.3.2.2.5.24 Locomotive System State (P301) Message Rear End Milepost Prefix Length Field, Use Requirements

The Locomotive System State (P301) message Rear End Milepost Prefix Length field provides the length, in bytes, of the Locomotive System State (P301) message Rear End Milepost Prefix field. If there is not a milepost prefix the Locomotive System State (P301) message Rear End Milepost Prefix Length field will be 0 and the Locomotive System State (P301) message Rear End Milepost Prefix field will not be present.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Milepost Prefix Length field as the length, in bytes, of the Locomotive System State (P301) message Rear End Milepost Prefix.*

3.3.2.2.5.25 Locomotive System State (P301) Message Rear End Milepost Prefix Field, Use Requirements

The Locomotive System State (P301) message Rear End Milepost Prefix field provides the prefix of the milepost location of the EOT at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Milepost Prefix field as the milepost prefix of the milepost location of the EOT at the time the locomotive state was sampled.*

3.3.2.2.5.26 Locomotive System State (P301) Message Rear End Milepost Suffix Length Field, Use Requirements

The Locomotive System State (P301) message Rear End Milepost Suffix Length field provides the length, in bytes, of the Locomotive System State (P301) message Rear End Milepost Suffix field. If there is not a milepost suffix the Locomotive System State (P301) message Rear End Milepost Suffix Length field will be 0 and the Locomotive System State (P301) message Rear End Milepost Suffix field will not be present.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Milepost Suffix Length field as the length, in bytes, of the Locomotive System State (P301) message Rear End Milepost Suffix.*

3.3.2.2.5.27 Locomotive System State (P301) Message Rear End Milepost Suffix Field, Use Requirements

The Locomotive System State (P301) message Rear End Milepost Suffix field provides the milepost suffix of the milepost location of the EOT at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Milepost Suffix field as the milepost suffix of the milepost location of the EOT at the time the locomotive state was sampled.*

3.3.2.2.5.28 Locomotive System State (P301) Message Rear End Track Name Length Field, Use Requirements

The Locomotive System State (P301) message Rear End Track Name Length field provides the length, in bytes, of the Locomotive System State (P301) message Rear End Track Name field.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Track Name Length field as the length, in bytes, of the Locomotive System State (P301) message Rear End Track Name.*

3.3.2.2.5.29 Locomotive System State (P301) Message Rear End Track Name Field, Use Requirements

The Locomotive System State (P301) message Rear End Track Name field provides the name of the track where the EOT was located at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Track Name field to identify the name of the track where the EOT was located at the time the locomotive state was sampled.*

3.3.2.2.5.30 Locomotive System State (P301) Message Rear End Railroad SCAC Field, Use Requirements

The Locomotive System State (P301) message Rear End Railroad SCAC field provides the SCAC of the track on which the EOT was located at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End Railroad SCAC field to identify the SCAC of the track segment on which the EOT was located at the time the locomotive state was sampled.*

3.3.2.2.5.31 Locomotive System State (P301) Message Rear End PTC Subdivision/District ID Field, Use Requirements

The Locomotive System State (P301) message Rear End PTC Subdivision/District ID field provides the specific subdivision/district in which the EOT was located at the time the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Rear End PTC Subdivision/District ID field to identify the subdivision/district in which the EOT was located at the time the locomotive state was sampled.*

3.3.2.2.5.32 Locomotive System State (P301) Message Head End Current Position Field, Use Requirements

The Locomotive System State (P301) message Head End Current Position field provides the ECEF coordinates of where the HOT was located at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.

a) *When ITC-ATOSS BO receives a Locomotive System State (P301) message ITC-ATOSS BO shall use the Locomotive System State (P301) message Head End Current Position field as the ECEF position of the HOT at the time indicated by the Locomotive System State (P301) message Locomotive State Time field.*

3.3.2.2.5.33 Locomotive System State (P301) Message Coordination Number Field, Use Requirements

The Locomotive System State (P301) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.2.3 Onboard Violation Report (P302) Message, Version 1

The Onboard Violation Report (P302) message is sent by the ITC-PTC BO to the ITC-ATOSS BO to inform ATOSS BO of a PTC violation. ITC-PTC BO receives the original Onboard Violation Report (02070) message from ITC-PTC OB. The Onboard Violation Report (P302) message is sent when the violation occurs and periodically while the violation exists.

3.3.2.3.1 Onboard Violation Report (P302) Message EMP Header Parameters

Message-specific EMP header values for the Onboard Violation Report (P302) message are specified in Table 59.

Table 59: Onboard Violation Report (P302) EMP Header Parameters

Field		Size (Bytes)	Data Type	Value
Message Type		2	uint	P302
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P302-1
QoS	Class	3 bits	uint	TBC-IRS-P302-2
	Priority	3 bits	uint	TBC-IRS-P302-3
	Network Preference	3 bits	uint	TBC-IRS-P302-4
	Special Handling	4 bits	uint	TBC-IRS-P302-5
	Service Request	3 bits	uint	TBC-IRS-P302-6

3.3.2.3.1.1 Onboard Violation Report (P302) Message EMP Header Data Length Field

The EMP header Data Length field for an Onboard Violation Report (301) message contains the length, in bytes, of the message body. In order to calculate the value stored in the EMP message header Data Length field, the size of the Onboard Violation Report (P302) message body must be calculated at run time for each Onboard Violation Report (P302) message generated. The size of an Onboard Violation Report (P302) message is the sum of:

- 16 bytes for field IDs 1-4
- The value of field 4 for the Head End Milepost Prefix in field 5
- 1 byte for field ID 6
- The value of field 6 for the Head End Milepost Suffix in field 7
- 1 byte for field ID 8
- The value of field 8 for the Head End Track Name in field 9
- 11 bytes for field IDs 10-13
- The value of field 13 for the Rear End Milepost Prefix in field 14
- 1 byte for field ID 15
- The value of field 15 for the Rear End Milepost Suffix in field 16
- 1 byte for field ID 17
- The value of field 17 for the Rear End Track Name in field 18
- 20 bytes for field IDs 19-24
- The value of field 24 for the Violating Train ID in field 25
- 9 bytes for field IDs 26-28
- The value of field 28 for the Point of Violation Milepost Prefix in field 29
- 1 byte for field ID 30
- The value of field 30 for the Point of Violation Milepost Suffix in field 31
- 1 byte for field ID 32
- The value of field 32 for the Point of Violation Track Name in field 33
- 6 bytes for field IDs 34 and 35

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.3.1.2 Onboard Violation Report (P302) Message EMP Header Number Field

The Onboard Violation Report (P302) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.3.2 *Onboard Violation Report (P302) Message Body*

A summary of the Onboard Violation Report (P302) message body is given in Table 60. Detailed description and requirements follow.

Table 60: Onboard Violation Report (P302) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	Railroad SCAC	4	SCAC	SCAC of ITC-PTC BO
2	Violation Start Time	7	uint	UTC timestamp in YYYYMMDDHHMMSS format. The Violation Start Time is the time when the violation is first detected.
3	Head End Milepost	4	MP	Current HOT location
4	Head End Milepost Prefix Length	1	uint	Head end milepost prefix length
5	Head End Milepost Prefix	varies	string	Head end milepost prefix
6	Head End Milepost Suffix Length	1	uint	Head end milepost suffix length
7	Head End Milepost Suffix	varies	string	Head end milepost suffix
8	Head End Track Name Length	1	uint	Head end track name length
9	Head End Track Name	varies	string	Head end track name
10	Head End Railroad SCAC	4	string	Railroad SCAC of HOT location
11	Head End PTC Subdivision/District ID	2	uint	Current PTC subdivision/district ID HOT
12	Rear End Milepost	4	MP	Current EOT location
13	Rear End Milepost Prefix Length	1	uint	Rear end milepost prefix length
14	Rear End Milepost Prefix	varies	string	Rear end milepost prefix
15	Rear End Milepost Suffix Length	1	uint	Rear end milepost suffix length
16	Rear End Milepost Suffix	varies	string	Rear end milepost suffix
17	Rear End Track Name Length	1	uint	Rear end track name
18	Rear End Track Name	varies	string	Rear end track name
19	Rear End Railroad SCAC	4	string	Railroad SCAC of EOT location
20	Rear End PTC Subdivision/District ID	2	uint	Current PTC subdivision/district ID of the EOT
21	Current Position Uncertainty	2	uint	Current position uncertainty of the locomotive in feet
22	Direction of Travel	1	enum	The direction of travel for the lead locomotive. See Table 63.
23	Locomotive ID	10	U	Locomotive ID of the lead locomotive in the violating train
24	Violating Train ID Length	1	uint	Train ID length
25	Violating Train ID	varies	string	Train identification number of the violating train
26	Locomotive Speed	4	float	Current speed of the lead locomotive
27	Point of Violation Milepost	4	MP	Location violation first occurred

ID	Field	Size (bytes)	Data Type	Description
28	Point of Violation Milepost Prefix Length	1	uint	Point of violation milepost prefix
29	Point of Violation Milepost Prefix	varies	string	Point of violation milepost prefix
30	Point of Violation Milepost Suffix Length	1	uint	Point of violation milepost suffix length
31	Point of Violation Milepost Suffix	varies	string	Point of violation milepost suffix
32	Point of Violation Track Name Length	1	uint	Point of violation track name length
33	Point of Violation Track Name	varies	string	Point of violation track name
34	Point of Violation PTC Subdivision/District ID	2	uint	Point of Violation PTC subdivision/district
35	Coordination Number	4	uint	ITC-PTC BO-assigned coordination number for use in the resulting Onboard Violation Report ACK (P202) message.

Range limitations, other than those inherent to the data, are provided in Table 53. These ranges will be enforced by the receiving system.

Table 61: Onboard Violation Report (P302) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left justified, space filled; must contain at least 2 letters
4	Head End Milepost Prefix Length	0-5 characters
6	Head End Milepost Suffix Length	0-5 characters
8	Head End Track Name Length	0-32 characters
10	Head End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
11	Head End PTC Subdivision/District ID	0 to 9999
11	Rear End Milepost Prefix Length	0-5 characters
15	Rear End Milepost Suffix Length	0-5 characters
17	Rear End Track Name Length	0-32 characters
19	Rear End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
20	Rear End PTC Subdivision/District ID	0 to 9999
24	Train ID Length	0-30 characters

3.3.2.3.3 Onboard Violation Report (P302) Message Reliable Messaging Properties

The Onboard Violation Report (P302) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 62.

Table 62: Onboard Violation Report (P302) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Onboard Violation Report ACK (P202) message
Number of Retries	TBC-IRS-P302-7
Retry Interval	TBC-IRS-P302-8

3.3.2.3.4 Onboard Violation Report (P302) Message Field Generation Requirements

Requirements placed on ITC-PTC BO in regard to populating the fields in an Onboard Violation Report (P302) message body are given in this section.

3.3.2.3.4.1 Onboard Violation Report (P302) Message Railroad SCAC Field, Generation Requirements

The Onboard Violation Report (P302) message Railroad SCAC field contains the railroad SCAC for the ITC-PTC BO to which the ITC-PTC OB sent the original Onboard Violation Report (02070) message of which is being forwarded.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Railroad SCAC field with the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Onboard Violation Report (02070) message.*

3.3.2.3.4.2 Onboard Violation Report (P302) Message Violation Start Time Field, Generation Requirements

The Onboard Violation Report (P302) message Violation Start Time field contains the time at which the violation occurred. The Onboard Violation Report (P302) message Violation Start Time field is stored as a 7-byte unsigned integer in the format YYYYMMDDHHMMSS where YYYY is 2 bytes in size and MM, DD, HH, MM, SS are each 1 byte in size. In binary coded decimal, the 4 Ys represent the 4 digits of the year, the first two Ms the two digits of the month, the two Ds the two digits of the day, the two Hs the two digits of the hour, the second two Ms the two digits of the minutes, and the two Ss the two digits of the seconds.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P300) message Violation Start Time field with the time at which the violation occurred formatted as 7 unsigned binary-coded decimal bytes in the order YYYYMMDDHHMMSS.*

3.3.2.3.4.3 Onboard Violation Report (P302) Message Head End Milepost Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides milepost location, accurate to 1/1000 of a mile, of the HOT at the time the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Milepost field with the location of the HOT at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.4 Onboard Violation Report (P302) Message Head End Milepost Prefix Length Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Milepost Prefix Length field is populated with the length, in bytes, of the Onboard Violation Report (P302) message Head End Milepost Prefix. If there is no milepost prefix the Onboard Violation Report (P302) message Head End Milepost Prefix Length field is set to 0 and there is no Onboard Violation Report (P302) message Head End Milepost Prefix field present.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Milepost Prefix Length field with the length, in bytes, of the Onboard Violation Report (P302) message Head End Milepost Prefix.*

3.3.2.3.4.5 Onboard Violation Report (P302) Message Head End Milepost Prefix Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Milepost Prefix field is populated with the milepost prefix for the location of the HOT. The Onboard Violation Report (P302) message Head End Milepost Prefix field cannot exceed five characters.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Milepost Prefix field with the milepost prefix of the location of the HOT at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.6 Onboard Violation Report (P302) Message Head End Milepost Suffix Length Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Milepost Suffix Length field is populated with the length, in bytes, of the Onboard Violation Report (P302) message Head End Milepost Suffix. If there is no milepost suffix the Onboard Violation Report (P302) message Head End Milepost Suffix Length field is set to 0 and there is no Onboard Violation Report (P302) message Head End Milepost Suffix field present.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Milepost Suffix Length field with the length, in bytes, of the Onboard Violation Report (P302) message Head End Milepost Suffix.*

3.3.2.3.4.7 Onboard Violation Report (P302) Message Head End Milepost Suffix Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Milepost Suffix field is populated with the milepost suffix for the location of the HOT. The Onboard Violation Report (P302) message Head End Milepost Suffix field cannot exceed five characters.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Milepost Suffix field with the milepost suffix of the location of the HOT at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.8 Onboard Violation Report (P302) Message Head End Track Name Length Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Track Name Length field is populated with the length, in bytes, of the Onboard Violation Report (P302) message Head End Track Name.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Milepost Track Name Length field with the length of the Onboard Violation Report (P302) message Head End Track Name.*

3.3.2.3.4.9 Onboard Violation Report (P302) Message Head End Track Name Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Track Name field is populated with the name of the track on which the HOT located when the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Track Name field with the name of the track on which the HOT was located when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.10 Onboard Violation Report (P302) Message Head End Railroad SCAC Field, Generation Requirements

The Onboard Violation Report (P302) message Head End Railroad SCAC field is populated with the SCAC of the track on which the HOT was located when the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End Railroad SCAC field with the SCAC of the track on which the HOT was located when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.11 Onboard Violation Report (P302) Message Head End PTC Subdivision/District ID Field, Generation Requirements

The Onboard Violation Report (P302) message Head End PTC Subdivision/District ID field contains the PTC subdivision/district ID in which the HOT was located when the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Head End PTC Subdivision/District ID field with the PTC subdivision/district ID of the track on which the HOT was located when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.12 Onboard Violation Report (P302) Message Rear End Milepost Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides the location of the EOT at the time the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End Milepost field with the location of the EOT at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.13 Onboard Violation Report (P302) Message Rear End Milepost Prefix Length Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Milepost Prefix Length field is populated the length of the Onboard Violation Report (P302) message Rear End Milepost Prefix. If there is no milepost prefix the Onboard Violation Report (P302) message Rear End Milepost Prefix Length field is set to 0 and there is no Onboard Violation Report (P302) message Rear End Milepost Prefix field present.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End Milepost Prefix Length field with the length of the Onboard Violation Report (P302) message Rear End Milepost Prefix.*

3.3.2.3.4.14 Onboard Violation Report (P302) Message Rear End Milepost Prefix Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Milepost Prefix field is populated with the milepost prefix for the location of the EOT. The Onboard Violation Report (P302) message Rear End Milepost Prefix field cannot exceed five characters.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End Milepost Prefix field with the milepost prefix of the location of the EOT at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.15 Onboard Violation Report (P302) Message Rear End Milepost Suffix Length Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Milepost Suffix Length field is populated with the length, in bytes, of the Onboard Violation Report (P302) message Rear End Milepost Suffix. If there is no milepost suffix the Onboard Violation Report (P302) message Rear End Milepost Suffix Length field is set to 0 and there is no Onboard Violation Report (P302) message Rear End Milepost Suffix field present.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End Milepost Suffix Length field with the length of the Onboard Violation Report (P302) message Rear End Milepost Suffix.*

3.3.2.3.4.16 Onboard Violation Report (P302) Message Rear End Milepost Suffix Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Milepost Suffix field is populated with the milepost suffix for the location of the EOT. The Onboard Violation Report (P302) message Rear End Milepost Suffix field cannot exceed five characters.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End Milepost Suffix field with the milepost suffix of the location of the EOT at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.17 Onboard Violation Report (P302) Message Rear End Track Name Length Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Track Name Length field is populated with the length of the Onboard Violation Report (P302) message Rear End Track Name.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End Track Name field with the length of the Onboard Violation Report (P302) message Rear End Track Name.*

3.3.2.3.4.18 Onboard Violation Report (P302) Message Rear End Track Name Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Track Name field is populated with a string that contains the name of the track on which the EOT was located when the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End Track Name field with the name of the track on which the EOT was located when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.19 Onboard Violation Report (P302) Message Rear End Railroad SCAC Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End Railroad SCAC field is populated with the SCAC of the track on which the EOT was located when the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End SCAC field with the SCAC of the track on which the EOT was located when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.20 Onboard Violation Report (P302) Message Rear End PTC Subdivision/District ID Field, Generation Requirements

The Onboard Violation Report (P302) message Rear End PTC Subdivision/District ID field is populated with the PTC subdivision/district ID in which the EOT was located when the original Onboard Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Rear End PTC Subdivision/District ID field the PTC subdivision/district ID of the subdivision/district in which the EOT was located when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.21 Onboard Violation Report (P302) Message Current Position Uncertainty Field, Generation Requirements

The Onboard Violation Report (P302) message Current Position Uncertainty field contains the position uncertainty, measured in feet, of the provided HOT location. The actual location of the HOT when the original Onboard Violation Report (02070) message was generated is no further from the provided HOT location than the position uncertainty.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Current Position Uncertainty field with the position uncertainty, measured in feet.*

3.3.2.3.4.22 Onboard Violation Report (P302) Message Direction of Travel Field, Generation Requirements

The Onboard Violation Report (P302) message Direction of Travel field is populated with an enumeration containing the direction the train was moving when the original Onboard Violation Report (02070) message was generated. The enumeration values are given in Table 63.

Table 63: Onboard Violation Report (P302) Message Direction of Travel Field Enumeration Values

Value	Description
0	Unknown
1	Increasing Mileposts
2	Decreasing Mileposts

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Direction of Travel field with the direction the train was moving when the original Onboard Violation Report (02070) message was generated using the enumeration values given in Table 63.*

3.3.2.3.4.23 Onboard Violation Report (P302) Message Locomotive ID Field, Generation Requirements

The Onboard Violation Report (P302) message Locomotive ID field is populated with the ID of the lead locomotive of the train that generated the original Onboard Violation Report (02070) message.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Locomotive ID field with the ID of the*

lead locomotive of the train that generated the original Onboard Violation Report (02070) message.

3.3.2.3.4.24 Onboard Violation Report (P302) Message Violating Train ID Length Field, Generation Requirements

The Onboard Violation Report (P302) message Violating Train ID Length field is populated with the length, in bytes, of the train ID of the train that issued the original Onboard Violation Report (02070) message.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Violating Train ID Length field with the length of the Onboard Violation Report (P302) message Violating Train ID field.*

3.3.2.3.4.25 Onboard Violation Report (P302) Message Violating Train ID Field, Generation Requirements

The Onboard Violation Report (P302) message Violating Train ID field is populated with the train ID of the train that issued the original Onboard Violation Report (02070) message.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Violating Train ID field with the train ID of the train that issued the original Violation Report (02070) message.*

3.3.2.3.4.26 Onboard Violation Report (P302) Message Locomotive Speed Field, Generation Requirements

The Onboard Violation Report (P302) message Locomotive Speed field provides the speed of the lead locomotive of the train that issued the original Violation Report (02070) message at the time the original Violation Report (02070) message was generated.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Locomotive Speed field with the speed of the locomotive when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.27 Onboard Violation Report (P302) Message Point of Violation Milepost Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides milepost location, accurate to 1/1000 of a mile, of the HOT at the time the reported violation first occurred.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation Milepost field with the location of the HOT at the time the reported violation first occurred.*

3.3.2.3.4.28 Onboard Violation Report (P302) Message Point of Violation Milepost Prefix Length Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Prefix Length field is populated with the length, in bytes, of the Onboard Violation Report (P302) message Point of Violation Milepost Prefix. If there is no milepost prefix the Onboard Violation Report (P302) message Point of

Violation Milepost Prefix Length field is set to 0 and there is no Onboard Violation Report (P302) message Point of Violation Milepost Prefix field present.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation Milepost Prefix Length field with the length, in bytes, of the Onboard Violation Report (P302) message Point of Violation Milepost Prefix field.*

3.3.2.3.4.29 Onboard Violation Report (P302) Message Point of Violation Milepost Prefix Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Prefix field is populated with the milepost prefix for the location of the HOT at the time the reported violation first occurred. The Onboard Violation Report (P302) message Point of Violation Milepost Prefix field cannot exceed five characters.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation Milepost Prefix field with the milepost prefix of the location of the HOT at the time the reported violation first occurred.*

3.3.2.3.4.30 Onboard Violation Report (P302) Message Point of Violation Milepost Suffix Length Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Suffix Length field is populated with the length, in bytes, of the Onboard Violation Report (P302) message Point of Violation Milepost Suffix. If there is no milepost suffix the Onboard Violation Report (P302) message Point of Violation Milepost Suffix Length field is set to 0 and there is no Onboard Violation Report (P302) message Point of Violation Milepost Suffix field present.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation Milepost Suffix Length field with the length, in bytes, of the Onboard Violation Report (P302) message Point of Violation Milepost Suffix field.*

3.3.2.3.4.31 Onboard Violation Report (P302) Message Point of Violation Milepost Suffix Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Suffix field is populated with the milepost suffix for the location of the HOT at the time the reported violation first occurred. The Onboard Violation Report (P302) message Point of Violation Milepost Suffix field cannot exceed five characters.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation Milepost Suffix field with the milepost suffix of the location of the HOT at the time the reported violation first occurred.*

3.3.2.3.4.32 Onboard Violation Report (P302) Message Point of Violation Track Name Length Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation Track Name Length field is populated with the length, in bytes, of the Onboard Violation Report (P302) message Point of Violation Track Name field.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation Milepost Track Name Length field with the length of the Onboard Violation Report (P302) message Point of Violation Track Name field.*

3.3.2.3.4.33 Onboard Violation Report (P302) Message Point of Violation Track Name Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation Track Name field is populated with the name of the track on which the HOT located at the time the reported violation first occurred.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation Track Name field with the name of the track on which the HOT was located when the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.4.34 Onboard Violation Report (P302) Message Point of Violation PTC Subdivision/District ID Field, Generation Requirements

The Onboard Violation Report (P302) message Point of Violation PTC Subdivision/District ID field contains the PTC subdivision/district ID in which the HOT at the time the reported violation first occurred.

a) *When ITC-PTC BO generates an Onboard Violation Report (P302) message, ITC-PTC BO shall populate the Onboard Violation Report (P302) message Point of Violation PTC Subdivision/District ID field with the PTC subdivision/district ID of the track on which the HOT was located at the time the reported violation first occurred.*

3.3.2.3.4.35 Onboard Violation Report (P302) Message Coordination Number Field, Generation Requirements

The Onboard Violation Report (P302) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.2.3.5 Onboard Violation Report (P302) Message Field Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the Onboard Violation Report (P302) message fields are given in this section.

3.3.2.3.5.1 Onboard Violation Report (P302) Message Railroad SCAC Field, Use Requirements

The Onboard Violation Report (P302) message Railroad SCAC field provides the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Onboard Violation Report (02070) message.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Railroad SCAC field as an indication of the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Onboard Violation Report (02070) message.*

3.3.2.3.5.2 Onboard Violation Report (P302) Message Violation Start Time Field, Use Requirements

The Onboard Violation Report (P302) message Violation Start Time field provides the time the PTC violation first occurred.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Violation Start Time field as the time the PTC violation first occurred.*

3.3.2.3.5.3 Onboard Violation Report (P302) Message Head End Milepost Field, Use Requirements

The Onboard Violation Report (P302) message Head End Milepost field provides the milepost location of the HOT at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Milepost field as the milepost location of the HOT at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.4 Onboard Violation Report (P302) Message Head End Milepost Prefix Length Field, Use Requirements

The Onboard Violation Report (P302) message Head End Milepost Prefix Length field provides the length, in bytes, of the Onboard Violation Report (P302) message Head End Milepost Prefix field. If there is no milepost prefix the Onboard Violation Report (P302) message Head End Milepost Prefix Length field is set to 0 and there is no Onboard Violation Report (P302) message Head End Milepost Prefix field present.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Milepost Prefix Length field as the length, in bytes, of the Onboard Violation Report (P302) message Head End Milepost Prefix field.*

3.3.2.3.5.5 Onboard Violation Report (P302) Message Head End Milepost Prefix Field, Use Requirements

The Onboard Violation Report (P302) message Head End Milepost Prefix field provides the milepost prefix of the location of the HOT at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Milepost Prefix field as the prefix of the milepost location of the HOT at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.6 Onboard Violation Report (P302) Message Head End Milepost Suffix Length Field, Use Requirements

The Onboard Violation Report (P302) message Head End Milepost Suffix Length field provides the length of the Onboard Violation Report (P302) message Head End Milepost Suffix field. If there is no milepost suffix the Onboard Violation Report (P302) message Head End Milepost Suffix Length field is set to 0 and there is no Onboard Violation Report (P302) message Head End Milepost Suffix field present.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Milepost Suffix Length field as the length of the Onboard Violation Report (P302) message Head End Milepost Suffix.*

3.3.2.3.5.7 Onboard Violation Report (P302) Message Head End Milepost Suffix Field, Use Requirements

The Onboard Violation Report (P302) message Head End Milepost Suffix field provides the suffix of the milepost location of the HOT at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Milepost Prefix field as the Suffix of the milepost location of the HOT at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.8 Onboard Violation Report (P302) Message Head End Track Name Length Field, Use Requirements

The Onboard Violation Report (P302) message Head End Track Name Length field provides length of the Onboard Violation Report (P302) message Head End Track Name field.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Track Name Length field as the length of the Onboard Violation Report (P302) message Head End Track Name field.*

3.3.2.3.5.9 Onboard Violation Report (P302) Message Head End Track Name Field, Use Requirements

The Onboard Violation Report (P302) message Head End Track Name field provides the name of the track on which the HOT was located at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Track Name field to as the name of the track on which the HOT was located at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.10 Onboard Violation Report (P302) Message Head End Railroad SCAC Field, Use Requirements

The Onboard Violation Report (P302) message Head End Railroad SCAC field provides the SCAC of the track on which the HOT was located at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End Railroad SCAC as an indication of the SCAC of the track on which the HOT located at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.11 Onboard Violation Report (P302) Message Head End PTC Subdivision/District ID Field, Use Requirements

The Onboard Violation Report (P302) message Head End PTC Subdivision/District ID field provides the specific subdivision/district in which the HOT was located at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Head End PTC Subdivision/District ID field to identify the subdivision/district in which the HOT was located at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.12 Onboard Violation Report (P302) Message Rear End Milepost Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Milepost field provides the milepost location of the EOT at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Milepost field as the milepost location of the EOT at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.13 Onboard Violation Report (P302) Message Rear End Milepost Prefix Length Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Milepost Prefix Length field provides the length, in bytes, of the Onboard Violation Report (P302) message Rear End Milepost Prefix field. If there is no milepost prefix the Onboard Violation Report (P302) message Rear End Milepost Prefix Length field is set to 0 and there is no Onboard Violation Report (P302) message Rear End Milepost Prefix field present.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Milepost Prefix Length field as the length, in bytes, of the Onboard Violation Report (P302) message Rear End Milepost Prefix field.*

3.3.2.3.5.14 Onboard Violation Report (P302) Message Rear End Milepost Prefix Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Milepost Prefix field provides the milepost prefix of the location of the EOT at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Milepost Prefix field as the prefix of the milepost location of the EOT at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.15 Onboard Violation Report (P302) Message Rear End Milepost Suffix Length Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Milepost Suffix Length field provides the length of the Onboard Violation Report (P302) message Rear End Milepost Suffix field. If there is no milepost suffix the Onboard Violation Report (P302) message Rear End Milepost Suffix Length field is set to 0 and there is no Onboard Violation Report (P302) message Rear End Milepost Suffix field present.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Milepost Suffix Length field as the length of the Onboard Violation Report (P302) message Rear End Milepost Suffix.*

3.3.2.3.5.16 Onboard Violation Report (P302) Message Rear End Milepost Suffix Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Milepost Suffix field provides the suffix of the milepost location of the EOT at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Milepost Prefix field as the Suffix of the milepost location of the EOT at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.17 Onboard Violation Report (P302) Message Rear End Track Name Length Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Track Name Length field provides length of the Onboard Violation Report (P302) message Rear End Track Name field.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Track Name Length field as the length of the Onboard Violation Report (P302) message Rear End Track Name field.*

3.3.2.3.5.18 Onboard Violation Report (P302) Message Rear End Track Name Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Track Name field provides the name of the track on which the EOT was located at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Track Name field to as the name of the track on which the EOT was located at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.19 Onboard Violation Report (P302) Message Rear End Railroad SCAC Field, Use Requirements

The Onboard Violation Report (P302) message Rear End Railroad SCAC field provides the SCAC of the track on which the EOT was located at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End Railroad SCAC as an indication of the SCAC of the track on which the EOT located at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.20 Onboard Violation Report (P302) Message Rear End PTC Subdivision/District ID Field, Use Requirements

The Onboard Violation Report (P302) message Rear End PTC Subdivision/District ID field provides the specific subdivision/district in which the EOT was located at the time the original Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Rear End PTC Subdivision/District ID field to identify the subdivision/district in which the EOT was located at the time the original Violation Report (02070) message was generated.*

3.3.2.3.5.21 Onboard Violation Report (P302) Message Current Position Uncertainty Field, Use Requirements

The Onboard Violation Report (P302) message Current Position Uncertainty field contains the position uncertainty, measured in feet, of the provided HOT location. The actual location of the HOT when the original Onboard Violation Report (02070) message was generated is no further from the provided HOT location than the position uncertainty.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Current Position Uncertainty field as the position uncertainty, in feet, of the location of the HOT at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.5.22 Onboard Violation Report (P302) Message Direction of Travel Field, Use Requirements

The Onboard Violation Report (P302) message Direction of Travel field is populated with an enumeration containing the direction the train was moving when the original Onboard Violation Report (02070) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report (P302) message ITC-PTC BO, using the enumeration values in Table 63, use the Onboard Violation Report (P302) message*

Direction of Travel field as the direction the train was traveling at the time the original Violation Report (02070) message was generated.

3.3.2.3.5.23 Onboard Violation Report (P302) Message Locomotive ID Field, Use Requirements

The Onboard Violation Report (P302) message Locomotive ID field provides the identification number of the lead locomotive of the train at the time the violation occurred.

a) *When ITC-ATOSS BO receives an Onboard Violation Report (P302) message ITC-PTC BO shall use the Onboard Violation Report (P302) message Locomotive ID field as the identification number of the lead locomotive of the train at the time the violation occurred.*

3.3.2.3.5.24 Onboard Violation Report (P302) Message Violating Train ID Length Field, Use Requirements

The Onboard Violation Report (P302) message Violating Train ID Length field provides the length of the Onboard Violation Report (P302) message Violating Train ID field.

a) *When ITC-ATOSS BO receives an Onboard Violation Report (P302) message ITC-PTC BO shall use the Onboard Violation Report (P302) message Violating Train ID Length field as the length of the Onboard Violation Report (P302) message Violating Train ID field.*

3.3.2.3.5.25 Onboard Violation Report (P302) Message Violating Train ID Field, Use Requirements

The Onboard Violation Report (P302) message Violating Train ID field provides the train ID of the train reporting the PTC violation.

a) *When ITC-ATOSS BO receives an Onboard Violation Report (P302) message ITC-PTC BO shall use the Onboard Violation Report (P302) message Violating Train ID field to as the train ID of the train reporting the PTC violation.*

3.3.2.3.5.26 Onboard Violation Report (P302) Message Locomotive Speed Field, Use Requirements

The Onboard Violation Report (P302) message Locomotive Speed field provides the ITC-ATOSS back office with the speed of the train at the time the original Violation Report (P302) message was generated.

a) *When ITC-ATOSS BO receives an Onboard Violation Report (P302) message ITC-PTC BO shall use the Onboard Violation Report (P302) message Locomotive Speed field as the speed of the lead locomotive of the train reporting the PTC violation at the time the original Onboard Violation Report (02070) message was generated.*

3.3.2.3.5.27 Onboard Violation Report (P302) Message Point of Violation Milepost Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost field provides the milepost location of the HOT at the time the PTC violation first occurred.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation Milepost field as the milepost location of the HOT at the time the PTC violation first occurred.*

3.3.2.3.5.28 Onboard Violation Report (P302) Message Point of Violation Milepost Prefix Length Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Prefix Length field provides the length, in bytes, of the Onboard Violation Report (P302) message Point of Violation Milepost Prefix field. If there is no milepost prefix the Onboard Violation Report (P302) message Point of Violation Milepost Prefix Length field is set to 0 and there is no Onboard Violation Report (P302) message Point of Violation Milepost Prefix field present.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation Milepost Prefix Length field as the length, in bytes, of the Onboard Violation Report (P302) message Point of Violation Milepost Prefix field.*

3.3.2.3.5.29 Onboard Violation Report (P302) Message Point of Violation Milepost Prefix Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Prefix field provides the milepost prefix of the location of the HOT at the time the PTC violation first occurred.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation Milepost Prefix field as the prefix of the milepost location of the HOT at the time the PTC violation first occurred*

3.3.2.3.5.30 Onboard Violation Report (P302) Message Point of Violation Milepost Suffix Length Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Suffix Length field provides the length of the Onboard Violation Report (P302) message Point of Violation Milepost Suffix field. If there is no milepost suffix the Onboard Violation Report (P302) message Point of Violation Milepost Suffix Length field is set to 0 and there is no Onboard Violation Report (P302) message Point of Violation Milepost Suffix field present.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation Milepost Suffix Length field as the length of the Onboard Violation Report (P302) message Point of Violation Milepost Suffix.*

3.3.2.3.5.31 Onboard Violation Report (P302) Message Point of Violation Milepost Suffix Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation Milepost Suffix field provides the suffix of the milepost location of the HOT at the time the PTC violation first occurred.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation Milepost Prefix field as the Suffix of the milepost location of the HOT at the time the PTC violation first occurred*

3.3.2.3.5.32 Onboard Violation Report (P302) Message Point of Violation Track Name Length Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation Track Name Length field provides length of the Onboard Violation Report (P302) message Point of Violation Track Name field.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation Track Name Length field as the length of the Onboard Violation Report (P302) message Point of Violation Track Name field.*

3.3.2.3.5.33 Onboard Violation Report (P302) Message Point of Violation Track Name Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation Track Name field provides the name of the track on which the HOT was located at the time the PTC violation first occurred.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation Track Name field to as the name of the track on which the HOT was located at the time the PTC violation first occurred*

3.3.2.3.5.34 Onboard Violation Report (P302) Message Point of Violation PTC Subdivision/District ID Field, Use Requirements

The Onboard Violation Report (P302) message Point of Violation PTC Subdivision/District ID field provides the specific subdivision/district in which the HOT was located at the time the PTC violation first occurred.

a) *When ITC-ATOSS BO receives an Onboard Violation Report message ITC-ATOSS BO shall use the Onboard Violation Report (P302) message Point of Violation PTC Subdivision/District ID field to identify the subdivision/district in which the HOT was located at the time the PTC violation first occurred.*

3.3.2.3.5.35 Onboard Violation Report (P302) Message Coordination Number Field, Use Requirements

The Onboard Violation Report (P302) message Coordination Number is used according to the process described in Section 3.4.3.

3.3.2.4 Onboard Violation Cleared (P303) Message, Version 1

The Onboard Violation Cleared (P303) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO receives the original Onboard Violation Cleared (02072) message from ITC-PTC OB, then the Onboard Violation Cleared (P303) message is forwarded to ITC-ATOSS BO. The Onboard Violation Cleared (P303) message is sent from the locomotive to the back office to report when the train is no longer violating its PTC authority.

3.3.2.4.1 Onboard Violation Cleared (P303) Message EMP Header Parameters

Message-specific EMP header values for the Onboard Violation Cleared (P303) message are specified in Table 64.

Table 64: Onboard Violation Cleared (P303) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P303
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P303-1
QoS	Class	3 bits	uint	TBC-IRS-P303-2
	Priority	3 bits	uint	TBC-IRS-P303-3
	Network Preference	3 bits	uint	TBC-IRS-P303-4
	Special Handling	4 bits	uint	TBC-IRS-P303-5
	Service Request	3 bits	uint	TBC-IRS-P303-6

3.3.2.4.1.1 Onboard Violation Cleared (P303) Message EMP Header Data Length Field

The EMP header Data Length field for an Onboard Violation Cleared (P303) message contains the length, in bytes, of the message body. The Onboard Violation Cleared (P303) message contains only static fields, so the message body is always the same size of 35 bytes. Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.4.1.2 Onboard Violation Cleared (P303) Message EMP Header Number Field

The Onboard Violation Cleared (P303) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.4.2 Onboard Violation Cleared (P303) Message Body

A summary of the Onboard Violation Cleared (P303) message body is given in Table 65. Detailed description and requirements follow.

Table 65: Onboard Violation Cleared (P303) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	Railroad SCAC	4	SCAC	Railroad SCAC of ITC-PTC BO
2	Reason for Sending	1	enum	Reason for sending. See Table 68.
3	Point of Violation PTC Subdivision/District ID	2	uint	PTC subdivision/district where the point of violation was previously reported
4	Violation Cleared Time	7	uint	UTC timestamp in YYYYMMDDHHMMSS format
5	Violation Start Time	7	uint	UTC timestamp in YYYYMMDDHHMMSS format
6	Locomotive ID	10	U	Identification number of the lead locomotive previously violating train.
7	Coordination Number	4	uint	ITC-PTC BO-assigned coordination number for use in the resulting Onboard Violation Cleared ACK (P203) message.

Range limitations, other than those inherent to the data, are provided in Table 67. These ranges will be enforced by the receiving system.

Table 66: Onboard Violation Cleared (P303) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left justified, space filled; must contain at least 2 letters
2	Reason for Sending	0-3 (valid enumeration values)
3	Point of Violation PTC Subdivision/District ID	0 to 9999

3.3.2.4.3 Onboard Violation Cleared (P303) Message Reliable Messaging Properties

The Onboard Violation Cleared (P303) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 69.

Table 67: Onboard Violation Cleared (P303) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Onboard Violation Cleared ACK (P203)
Number of Retries	TBC-IRS-P303-7
Retry Interval	TBC-IRS-P303-8

3.3.2.4.4 Onboard Violation Cleared (P303) Message Field Generation Requirements

Requirements placed on ITC-PTC BO in regard to populating the fields in an Onboard Violation Cleared (P303) message body are given in this section.

3.3.2.4.4.1 Onboard Violation Cleared (P303) Message Railroad SCAC Field, Generation Requirements

The Onboard Violation Cleared (P303) message Railroad SCAC field contains the railroad SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Onboard Violation Cleared (02072) message.

a) When ITC-PTC BO generates an Onboard Violation Cleared (P303) message, ITC-PTC BO shall populate the Onboard Violation Cleared (P303) message Railroad SCAC field with the SCAC of the BOS to which the ITC-PTC OB sent the original Onboard Violation Cleared (02072) message.

3.3.2.4.4.2 Onboard Violation Cleared (P303) Message Reason for Sending Field, Generation Requirements

The Onboard Violation Cleared (P303) message Reason for Sending field indicates why the Onboard Violation Cleared (02072) message was sent from ITC-PTC OB to ITC-PTC BO. The enumeration values are given in Table 68.

Table 68: Onboard Violation Cleared (P303) Reason for Sending Enumeration Field Values

Value	Description
0	Not used
1	Train has authority for current location
2	Onboard system state change
3	Onboard system does not know current location

a) *When ITC-PTC BO generates an Onboard Violation Cleared (P303) message, ITC-PTC BO shall, using the enumeration values from Table 68, populate the Onboard Violation Cleared (P303) message Reason for Sending field with the reason the original Onboard Violation Cleared (02072) message was sent.*

3.3.2.4.4.3 Onboard Violation Cleared (P303) Message Point of Violation PTC Subdivision/District ID Field, Generation Requirements

The Onboard Violation Cleared (P303) message Point of Violation PTC Subdivision/District ID field is populated with the PTC subdivision/district where the violation was first reported.

a) *When ITC-PTC BO generates an Onboard Violation Cleared (P303) message, ITC-PTC BO shall populate the Onboard Violation Cleared (P303) message Point of Violation PTC Subdivision/District ID field with the PTC subdivision/district ID where the violation was first reported.*

3.3.2.4.4.4 Onboard Violation Cleared (P303) Message Violation Cleared Time Field, Generation Requirements

The Onboard Violation Cleared (P303) message Violation Cleared Time field is populated with a UTC timestamp providing the time at which the reporting train stopped violating its authority. The Onboard Violation Cleared (P303) message Violation Cleared Time field is stored as a 7-byte binary-coded decimal number in the format YYYYMMDDHHMMSS. YYYY is the year and is 2 bytes in size. MM, DD, HH, MM, SS are the month, day, hour, minute, and second, respectively; each are 1 byte in size.

a) *When ITC-PTC BO generates an Onboard Violation Cleared (P303) message, ITC-PTC BO shall populate the Onboard Violation Cleared (P303) message Violation Cleared Time field with a UTC timestamp in the format YYYYMMDDHHMMSS containing the time at which the reporting train stopped violating its authority.*

3.3.2.4.4.5 Onboard Violation Cleared (P303) Message Violation Start Time Field, Generation Requirements

The Onboard Violation Cleared (P303) message Violation Start Time field is populated with UTC timestamp containing the time at which the specified locomotive began violating its authority. The Onboard Violation Cleared (P303) message Violation Start Time field is stored as a 7-byte binary-coded decimal number in the format YYYYMMDDHHMMSS. YYYY is the year and is 2 bytes in size. MM, DD, HH, MM, SS are the month, day, hour, minute, and second, respectively; each are 1 byte in size.

a) *When ITC-PTC BO generates an Onboard Violation Cleared (P303) message, ITC-PTC BO shall populate the Onboard Violation Cleared (P303) message Violation Start Time field with a UTC timestamp in the format YYYYMMDDHHMMSS containing the time at which the reporting locomotive began violating its authority.*

3.3.2.4.4.6 Onboard Violation Cleared (P303) Message Locomotive ID Field, Generation Requirements

The Onboard Violation Cleared (P303) message Locomotive ID field is populated with the violating locomotive's ID.

a) *When ITC-PTC BO generates an Onboard Violation Cleared (P303) message, ITC-PTC BO shall populate the Onboard Violation Cleared (P303) message Locomotive ID field with the violating locomotive's ID.*

3.3.2.4.4.7 Onboard Violation Cleared (P303) Message Coordination Number Field, Generation Requirements

The Onboard Violation Cleared (P303) message Coordination Number is generated according to the numbering process described in Section 3.4.2.

3.3.2.4.5 Onboard Violation Cleared (P303) Message Field Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the Onboard Violation Cleared (P303) message fields are given in this section.

3.3.2.4.5.1 Onboard Violation Cleared (P303) Message Railroad SCAC Field, Use Requirements

The Onboard Violation Cleared (P303) message Railroad SCAC field provides the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Onboard Violation Cleared (02072) message.

a) *When ITC-ATOSS BO receives an Onboard Violation Cleared (P303) message ITC-ATOSS BO shall use the Onboard Violation Cleared (P303) message Railroad SCAC field as an indication of the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Onboard Violation Cleared (02072) message.*

3.3.2.4.5.2 Onboard Violation Cleared (P303) Message Reason for Sending Field, Use Requirements

The Onboard Violation Cleared (P303) message Reason for Sending field provides ITC-ATOSS BO with the reason the ITC-PTC BO sent the original Onboard Violation Cleared (P303) message.

a) *When ITC-ATOSS BO receives an Onboard Violation Cleared (P303) message ITC-ATOSS BO shall, using the enumeration values in Table 68, use the Onboard Violation Cleared (P303) message Reason for Sending field to identify the reason that the original Onboard Violation Cleared (02072) message was sent.*

3.3.2.4.5.3 Onboard Violation Cleared (P303) Message Point of Violation PTC Subdivision/District ID Field, Use Requirements

The Onboard Violation Cleared (P303) message Point of Violation PTC Subdivision/District ID field is used to identify the subdivision/district where the onboard violation was first reported.

a) *When ITC-ATOSS BO receives an Onboard Violation Cleared (P303) message ITC-ATOSS BO shall use the Onboard Violation Cleared (P303) message Point of Violation PTC Subdivision/District ID field to identify the subdivision/district where the onboard violation was first reported.*

3.3.2.4.5.4 Onboard Violation Cleared (P303) Message Violation Cleared Time Field, Use Requirements

The Onboard Violation Cleared (P303) message Violation Cleared Time field is used as the time at which the reporting locomotive stopped violating its authority. The Onboard Violation Cleared (P303)

message Violation Cleared Time field is stored as a 7-byte binary-coded decimal number in the format YYYYMMDDHHMMSS. YYYY is the year and is 2 bytes in size. MM, DD, HH, MM, SS are the month, day, hour, minute, and second, respectively; each are 1 byte in size.

a) *When ITC-ATOSS BO receives an Onboard Violation Cleared (P303) message ITC-ATOSS BO shall use the Onboard Violation Cleared (P303) message Violation Cleared Time field to indicate when the specified locomotive stopped violating its authority.*

3.3.2.4.5.5 Onboard Violation Cleared (P303) Message Violation Start Time Field, Use Requirements

The Onboard Violation Cleared (P303) message Violation Start Time field is used as the time at which the specified locomotive began violating its authority. The Onboard Violation Cleared (P303) message Violation Start Time field is stored as a 7-byte binary-coded decimal number in the format YYYYMMDDHHMMSS. YYYY is the year and is 2 bytes in size. MM, DD, HH, MM, SS are the month, day, hour, minute, and second, respectively; each are 1 byte in size.

a) *When ITC-ATOSS BO receives an Onboard Violation Cleared (P303) message ITC-ATOSS BO shall use the Onboard Violation Cleared (P303) message Violation Start Time field to as the time at which the violation first occurred.*

3.3.2.4.5.6 Onboard Violation Cleared (P303) Message Locomotive ID Field, Use Requirements

The Onboard Violation Cleared (P303) message Locomotive ID field is used to identify the ID of the lead locomotive of the violating train.

a) *When ITC-ATOSS BO receives an Onboard Violation Cleared (P303) message ITC-ATOSS BO shall use the Onboard Violation Cleared (P303) message Locomotive ID field to as the violating locomotive's ID.*

3.3.2.4.5.7 Onboard Violation Cleared (P303) Message Coordination Number Field, Use Requirements

The Onboard Violation Cleared (P303) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.2.5 Locomotive Fault Summary Report (P304) Message, Version 1

The Locomotive Fault Summary Report (P304) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO receives the original Locomotive Fault Summary Report (02081) message from ITC-PTC OB and forwards it as the Locomotive Fault Summary Report (P304) to inform ITC-ATOSS BO of any active fault/failure.

3.3.2.5.1 Locomotive Fault Summary Report (P304) Message EMP Header Parameters

Message-specific EMP header values for the Locomotive Fault Summary Report (P304) message are specified in Table 69.

Table 69: Locomotive Fault Summary Report (P304) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P304
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS-P304-1
QoS	Class	3 bits	uint	TBC-IRS-P304-2
	Priority	3 bits	uint	TBC-IRS-P304-3
	Network Preference	3 bits	uint	TBC-IRS-P304-4
	Special Handling	4 bits	uint	TBC-IRS-P304-5
	Service Request	3 bits	uint	TBC-IRS-P304-6

3.3.2.5.1.1 Locomotive Fault Summary Report (P304) Message EMP Header Data Length Field

The EMP header Data Length field for a Locomotive Fault Summary Report (P304) message contains the length, in bytes, of the message body. The Locomotive Fault Summary Report (P304) message contains one record loop nested inside of another. An entire instance of the inner loop, with unique data, is repeated inside each repetition of the outer loop.

In order to calculate the value stored in the EMP data length field, the size of the Locomotive Fault Summary Report (P304) message body must be calculated at run time for each Locomotive Fault Summary Report (P304) message generated. The size of a Locomotive Fault Summary Report (P304) message is the sum of:

- 5 bytes for field IDs 1 and 2
- The value of field ID 2 for the variable-length field 3
- 10 bytes for field IDs 4-7
- 2 bytes multiplied by the value of field ID 7 for field IDs 7.1 and 7.2
- 3 bytes multiplied by the sum of all instances of field ID 7.2 for field ID 7.2.1 and 7.2.2
- The sum of the values of each instance of field ID 7.2.2 for field 7.2.3
- 7 bytes multiplied by the sum of all instances of field ID 7.2 for field ID 7.2.4
- 13 bytes for field IDs 8-11

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.5.1.2 Locomotive Fault Summary Report (P304) Message EMP Header Number Field

The Locomotive Fault Summary Report (P304) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.5.2 Locomotive Fault Summary Report (P304) Message Body

The Locomotive Fault Summary Report (P304) message is sent from ITC-PTC BO to ITC-ATOSS BO to report any active fault/failure.

The fields indicated in this message will be populated in the same order as they are listed in the Vendor Component Data Dictionary. The faults will be listed according to the order that they were detected, with the most recent being listed first. The Locomotive Fault Summary Report (P304) message is limited to 255 faults, which are allocated on a first come, first serve basis. Once the Locomotive Fault Summary Report (P304) message reaches the 255-fault limit, each additional component will populate the "Number of Active Faults" field with a zero. If there are no active faults to report for a component the "Number of Active Faults" is populated with a zero.

Table 70: Locomotive Fault Summary Report (P304) Message Body

ID	Field	Size, bytes	Data Type	Description
1.	Railroad SCAC	4	SCAC	Railroad SCAC of the ITC-PTC BO receiving the original Locomotive Fault Summary Report (2081) message
2.	IRS Version Length	1	uint	Length of the IRS Version name
3.	IRS Version	varies	string	Office-locomotive segment IRS version
4.	Reason for Sending	1	enum	Reason for sending the Locomotive Fault Summary Report (P304) Message. See Table 73
5.	Vendor Code	4	string	Vendor code, left justified, space filled
6.	System Code	4	string	System code, left justified, space filled
7.	Number of Components	1	uint	Number of components included in this message
<Start Component record loop>				Repeat once for each component
7.1	Component	1	uint	Numeric code for component, provided in Vendor Component Data Directory
7.2	Number of Active Faults	1	uint	Number of faults included in this message for this component
<Start Active Fault Code record loop>				Repeat once for each active fault
7.2.1	Fault Code	2	uint	Unique code number for the fault, provided in Vendor Component Data Dictionary
7.2.2	Length of Fault Name Text	1	uint	String length of fault description
7.2.3	Fault Name Text	varies	string	Description of fault, provided in Vendor Component Data Dictionary
7.2.4	Time Fault Detected	7	uint	UTC time when fault became active
<End Active Fault Code record loop>				
<End Component record loop>				
8.	Locomotive State Time	7	uint	UTC time locomotive state was sampled
9.	Locomotive State Summary	1	enum	Locomotive state summary. See Table 74

Range limitations, other than those inherent to the data, are provided in Table 53. These ranges will be enforced by the receiving system.

Table 71: Locomotive Fault Summary Report (P304) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
2	IRS Version Length	1 to 20
4	Reason for Sending	1, 2 (valid enumeration values)
6	Locomotive State Summary	1, 2 (valid enumeration values)
7	Locomotive State	1 to 7 (valid enumeration values)
7.2.2	Length of Fault Name Text	0 to 64

3.3.2.5.3 Locomotive Fault Summary Report (P304) Message Reliable Messaging Properties

The Locomotive Fault Summary Report (P304) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 80.

Table 72: Locomotive Fault Summary Report (P304) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Locomotive Fault Summary ACK (P204)
Number of Retries	TBC-IRS-P304-7
Retry Interval	TBC-IRS-P304-8

3.3.2.5.4 Locomotive Fault Summary Report (P304) Message Generation Requirements

Requirements placed on ITC-PTC BO in regard to populating the fields in a Locomotive Fault Summary Report (P304) message body are given in this section.

3.3.2.5.4.1 Locomotive Fault Summary Report (P304) Message Railroad SCAC Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Railroad SCAC field contains the railroad SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Locomotive Fault Summary Report (02081) message was sent.

a) When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message Railroad SCAC field with the SCAC of the BOS to which the ITC-PTC OB sent the original Locomotive Fault Summary Report (02081) message.

3.3.2.5.4.2 Locomotive Fault Summary Report (P304) Message IRS Version Length Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message IRS Version Length field contains the length of the Locomotive Fault Summary Report (P304) message IRS Version field.

a) *When ITC-PTC BO generates a Locomotive System State (P301) message, ITC-PTC BO shall populate the Locomotive System State (P301) message IRS Version Length field with the length of the Locomotive System State (P301) message IRS Version field.*

3.3.2.5.4.3 Locomotive Fault Summary Report (P304) Message IRS Version Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message IRS Version field contains the version of the IRS that is in use between ITC-PTC OB and ITC-PTC BO. The ITC-ATOSS BO to ITC-PTC BO IRS version is recorded in the Locomotive Fault Summary Report (P304) message EMP header. The Locomotive Fault Summary Report (P304) message IRS Version field must have a string length between 1 and 20 characters.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message IRS Version field with the version of the IRS in use between ITC-PTC OB and ITC-PTC BO.*

3.3.2.5.4.4 Locomotive Fault Summary Report (P304) Message Reason for Sending Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Reason for Sending field indicates why the Locomotive Fault Summary Report (P304) message was sent. Enumeration values are given in Table 73.

Table 73: Locomotive Fault Summary Report (P304) Reason for Sending Enumeration Field Values

Value	Description
0	Not Used
1	Unsolicited
2	Solicited by a 01081 message

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message Reason for Sending field with the reason the message was sent using the enumeration values given in Table 73.*

3.3.2.5.4.5 Locomotive Fault Summary Report (P304) Message Vendor Code Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Vendor Code field contains the unique identifier for the supplier of the component involved in the locomotive fault. This four-character string is not null terminated.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message Vendor Code field with the identification code of the supplier of the component involved in the locomotive fault.*

3.3.2.5.4.6 Locomotive Fault Summary Report (P304) Message System Code Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message System Code field contains the unique identifier of the onboard system involved in the locomotive fault. This four-character string is not null terminated.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message System Code field with the identification code of the onboard system involved in the locomotive fault.*

3.3.2.5.4.7 Locomotive Fault Summary Report (P304) Message Number of Components Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Number of Components field provides the number of components reported within the component record loop, up to the field-size-imposed limit of 255. A Locomotive Fault Summary Report (P304) message Component record is repeated once for each component indicated in the Locomotive Fault Summary Report (P304) message Number of Components field. Each instance of the Locomotive Fault Summary Report (P304) message Component record contains the Locomotive Fault Summary Report message dynamic fields Component, Number of Active Faults, and a complete Locomotive Fault Summary Report (P304) message Active Fault record loop.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message Number of Components field with the total number of components being reported.*

b) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC OB shall repeat the Locomotive Fault Summary Report (P304) message Component record once for each component being reported.*

3.3.2.5.4.8 Locomotive Fault Summary Report (P304) Message Component Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Component dynamic field provides the numeric code assigned to the corresponding component being reported on as provided in the Vendor Component Data Dictionary.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Summary Report (P304) message Component field with the numeric code assigned to the corresponding component being reported on as provided in the Vendor Component Data Dictionary.*

3.3.2.5.4.9 Locomotive Fault Summary Report (P304) Message Number of Active Faults Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Number of Active Faults dynamic field gives the number of faults for the corresponding component in the corresponding Locomotive Fault Summary Report (P304) message Component dynamic field. The Locomotive Fault Summary Report (P304) message Active Faults record loop is repeated once for each active fault. Each instance of the Locomotive Fault Summary Report (P304) message Active Fault record contains the Locomotive Fault Summary Report (P304) message dynamic fields Fault Code, Length of Fault Name, Fault Name Text, and Time Fault Detected.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Summary Report (P304) message*

Number of Active Faults dynamic field with the number of active faults in the corresponding component.

b) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall repeat the Locomotive Fault Summary Report (P304) message Active Fault record once for each active fault in the corresponding component.*

3.3.2.5.4.10 Locomotive Fault Summary Report (P304) Message Fault Code Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Fault Code dynamic field provides the unique code number for the corresponding fault as provided in the Vendor Component Data Dictionary.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Summary Report (P304) message Fault Code field with the code number for the fault as provided in the Vendor Component Data Dictionary.*

3.3.2.5.4.11 Locomotive Fault Summary Report (P304) Message Length of Fault Name Text Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Length of Fault Name Text dynamic field gives the length, in bytes, of the following Locomotive Fault Summary Report (P304) message Fault Name field. If there is no fault description for the corresponding fault the Locomotive Fault Summary Report (P304) message Length of Fault Name dynamic field will be set to 0 and there will not be a corresponding Locomotive Fault Summary Report (P304) message Fault Name dynamic field.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P303) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Summary Report (P304) message Length of Fault Name Text field with the length, in bytes, of the following Locomotive Fault Summary Report (P304) message Fault Name Text field.*

3.3.2.5.4.12 Locomotive Fault Summary Report (P304) Message Fault Name Text Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Fault Name Text dynamic field provides a description of the corresponding fault as provided in the Vendor Component Data Dictionary.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Summary Report (P304) message Fault Name Text field with a description of the corresponding fault for the component shown in the Locomotive Fault Summary Report (P304) message Component field.*

3.3.2.5.4.13 Locomotive Fault Summary Report (P304) Message Time Fault Detected Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Time Fault Detected fields contains a UTC timestamp providing the time at which the corresponding fault was first detected. The Locomotive Fault Summary Report (P304) message Locomotive Time Fault Detected dynamic field is

stored as a 7-byte unsigned integer in the format YYYYMMDDHHMMSS where YYYY is 2 bytes in size and MM, DD, HH, MM, SS are each 1 byte in size. In binary coded decimal, the 4 Ys represent the 4 digits of the year, the first two Ms the two digits of the month, the two Ds the two digits of the day, the two Hs the two digits of the hour, the second two Ms the two digits of the minutes, and the two Ss the two digits of the seconds.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Summary Report (P304) message Time Fault Detected field with the time at which the corresponding fault was first detected.*

3.3.2.5.4.14 Locomotive Fault Summary Report (P304) Message Locomotive State Time Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Locomotive State Time field contains a UTC timestamp providing the time at which the original Locomotive Fault Summary Report (02081) message was generated. The Locomotive Fault Summary Report (P304) message Locomotive State Time field is stored as a 7-byte unsigned integer in the format YYYYMMDDHHMMSS where YYYY is 2 bytes in size and MM, DD, HH, MM, SS are each 1 byte in size. In binary coded decimal, the 4 Ys represent the 4 digits of the year, the first two Ms the two digits of the month, the two Ds the two digits of the day, the two Hs the two digits of the hour, the second two Ms the two digits of the minutes, and the two Ss the two digits of the seconds.

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message Locomotive State Time field with the time at which the locomotive state was sampled.*

3.3.2.5.4.15 Locomotive Fault Summary Report (P304) Message Locomotive State Summary Dynamic Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Locomotive State Summary field provides a summary of the current locomotive state for the corresponding locomotive at the time indicated by the Locomotive Fault Summary Report (P304) message Locomotive State Time field. The enumeration values are given in Table 74.

Table 74: Locomotive Fault Summary Report (P304) Locomotive State Summary Enumeration Field Values

Value	Description
0	Not Used
1	Controlling
2	Non-Controlling

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message Locomotive State Summary field with an enumeration value from Table 74 indicating the corresponding locomotive's state at the time indicated by the Locomotive Fault Summary Report (P304) message Locomotive State Time field.*

3.3.2.5.4.16 Locomotive Fault Summary Report (P304) Message Locomotive State Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Locomotive State field contains an enumeration providing the locomotive state at the time indicated by the Locomotive Fault Summary Report (P304) Message Locomotive State Time field. Enumeration values are given in Table 75.

Table 75: Locomotive Fault Summary Report (P304) Locomotive State Enumeration Field Values

Value	Description
0	Not Used
1	Self-Test
2	Initializing
3	Disengaged
4	Cut Out
5	Active
6	Restricted
7	Failed

a) *When ITC-PTC BO generates a Locomotive Fault Summary Report (P304) message, ITC-PTC BO shall populate the Locomotive Fault Summary Report (P304) message Locomotive State field with an enumeration value from Table 75 indicating the locomotive state at the time shown in the Locomotive Fault Summary Report (P304) message Locomotive State Time field.*

3.3.2.5.4.17 Locomotive Fault Summary Report (P304) Message Coordination Number Field, Generation Requirements

The Locomotive Fault Summary Report (P304) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.2.5.5 Locomotive Fault Summary Report (P304) Message Field Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the Locomotive Fault Summary Report (P304) message fields are given in this section.

3.3.2.5.5.1 Locomotive Fault Summary Report (P304) Message Railroad SCAC Field, Use Requirements

The Locomotive Fault Summary Report (P304) message Railroad SCAC field provides the SCAC for the BOS to which the ITC-PTC OB sent the Locomotive Fault Summary Report (02081) message.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message Railroad SCAC field as an indication of the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the Locomotive Fault Summary Report (02081) message.*

3.3.2.5.5.2 Locomotive Fault Summary Report (P304) Message IRS Version Length Field, Use Requirements

The Locomotive Fault Summary Report (P304) message IRS Version Length field provides ITC-PTC BO with the length, in bytes, of the Locomotive Fault Summary Report (P304) message IRS Version field.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message IRS Version Length field as the length, in bytes, of the Locomotive Fault Summary Report (P304) message IRS Version field.*

3.3.2.5.5.3 Locomotive Fault Summary Report (P304) Message IRS Version Field, Use Requirements

The Locomotive Fault Summary Report (P304) message IRS Version field provides the IRS version currently implemented by the ITC-PTC OB of which generated the original Locomotive Fault Summary Report (02081) message. This field is used during the interface version negotiation process to communicate the selected IRS version.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message IRS Version field as an indication of the ITC-PTC OB to ITC-PTC BO IRS version in use by the locomotive that generated the original Locomotive Fault Summary Report (P304) message.*

3.3.2.5.5.4 Locomotive Fault Summary Report (P304) Message Reason for Sending Field, Use Requirements

The Locomotive Fault Summary Report (P304) message Reason for Sending field provides ITC-ATOSS BO with the reason the ITC-PTC BO sent the Locomotive Fault Summary Report (P304) message.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall, using the enumeration values in Table 81, use the Locomotive Fault Summary Report (P304) message Reason for Sending field to identify the reason that the Locomotive Fault Summary Report (P304) message was sent.*

3.3.2.5.5.5 Locomotive Fault Summary Report (P304) Message Vendor Code Field, Use Requirements

The Locomotive Fault Summary Report (P304) message Vendor Code field is used to identify the supplier of the component involved in the locomotive fault.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message Vendor Code field as the identification code of the supplier of the component involved in the locomotive fault.*

3.3.2.5.5.6 Locomotive Fault Summary Report (P304) Message System Code Field, Use Requirements

The Locomotive Fault Summary Report (P304) message System Code field is used to identify the onboard system involved in the locomotive fault.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message System Code field as the identification code of the onboard system involved in the locomotive fault.*

3.3.2.5.5.7 Locomotive Fault Summary Report (P304) Message Number of Components Field, Use Requirements

The Locomotive Fault Summary Report (P304) message Number of Components provides the number of components about which faults are being reported and is used to determine how many times the Locomotive Fault Summary Report (P304) message Component record loop was repeated.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message Number of Components field as the number of components about which fault information is being received.*

b) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall extract a Locomotive Fault Summary Report (P304) message Component record for each component indicated by the Locomotive Fault Summary Report (P304) message Number of Components field.*

3.3.2.5.5.8 Locomotive Fault Summary Report (P304) Message Component Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Component dynamic field provides the numeric code assigned to the component being reported on as provided in the Vendor Component Data Dictionary.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use each instance the Locomotive Fault Summary Report (P304) message Component field to as the numeric code of the component being reported on.*

3.3.2.5.5.9 Locomotive Fault Summary Report (P304) Message Number of Active Faults Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Number of Active Faults dynamic field is used to determine how many active faults are associated with the corresponding component, and how many Locomotive Fault Summary Report (P304) message Active Fault records are included in the corresponding instance of the Locomotive Fault Summary Report (P304) message Component record.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use each instance of the Locomotive Fault Summary Report (P304) message Number of Active Faults field as the number of fault codes being reported for the corresponding component.*

b) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall, for each Locomotive Fault Summary Report (P304) message Number of Active Faults dynamic field, extract the indicated number of Locomotive Fault Summary Report (P304) Active Fault records.*

3.3.2.5.5.10 Locomotive Fault Summary Report (P304) Message Fault Code Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Fault Code dynamic field is used to identify the reported locomotive fault.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use each instance of the Locomotive Fault Summary Report (P304) message Fault Code dynamic field as the fault code of the corresponding fault.*

3.3.2.5.5.11 Locomotive Fault Summary Report (P304) Message Length of Fault Name Text Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Length of Fault Name Dynamic field provides the length of the corresponding Locomotive Fault Summary Report (P304) message Fault Name Text field.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use each instance of the Locomotive Fault Summary Report (P304) message Length of Fault Name Text field as the length of the corresponding Locomotive Fault Summary Report (P304) message Fault Name Text dynamic field.*

3.3.2.5.5.12 Locomotive Fault Summary Report (P304) Message Fault Name Text Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Fault Name Text dynamic field provides a description of the corresponding fault.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use each instance of the Locomotive Fault Summary Report (P304) message Fault Name Text dynamic field as a description of the corresponding fault.*

3.3.2.5.5.13 Locomotive Fault Summary Report (P304) Message Time Fault Detected Field, Use Requirements

Each instance of the Locomotive Fault Summary Report (P304) message Time Fault Detected field provides the time that the corresponding fault became active.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use each instance of the Locomotive Fault Summary Report (P304) message Time Fault Detected dynamic field as the time the corresponding fault became active.*

3.3.2.5.5.14 Locomotive Fault Summary Report (P304) Message Locomotive State Time Field, Use Requirements

The Locomotive Fault Summary Report (P304) message Locomotive State Time field provides the time that the locomotive state was sampled.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message Locomotive State Time field as the time the corresponding locomotive's state was sampled.*

3.3.2.5.5.15 Locomotive Fault Summary Report (P304) Message Locomotive State Summary Field, Use Requirements

The Locomotive Fault Summary Report (P304) message Locomotive State Summary field is used to summarize the current locomotive state at the time indicated by the Locomotive Fault Summary Report (P304) message Locomotive State Time field.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message Locomotive State Summary field as an indication of the locomotive state.*

3.3.2.5.5.16 Locomotive Fault Summary Report (P304) Message Locomotive State Field, Use Requirements

The Locomotive Fault Summary Report (P304) Locomotive State field provides the self-test state of the corresponding locomotive at the time the original Locomotive Fault Summary (02081) message was generated.

a) *When ITC-ATOSS BO receives a Locomotive Fault Summary Report (P304) message ITC-PTC BO shall use the Locomotive Fault Summary Report (P304) message Locomotive State field as an indication of the self-test state of the locomotive at the time shown in the Locomotive Fault Summary Report (P304) message Locomotive State Time field.*

3.3.2.5.5.17 Locomotive Fault Summary Report (P304) Message Coordination Number Field, Use Requirements

The Locomotive Fault Summary Report (P304) message Coordination Number is used according to the process described in Section 3.4.3.

3.3.2.6 Emergency Brake Application Report (P305) Message, Version 1

The Emergency Brake Application Report (P305) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO receives the original Emergency Brake Application Report (02084) message from ITC-PTC OB and forwards it to ITC-ATOSS BO to inform ITC-ATOSS BO of the situation. The Emergency Brake Application Report (02084) message is sent from the locomotive to the back office whenever the train comes to a stop after an emergency brake application occurs.

3.3.2.6.1 *Emergency Brake Application Report (P305) Message EMP Header Parameters*

Message-specific EMP header values for the Emergency Brake Application Report (P305) message are specified in Table 76.

Table 76: Emergency Brake Application Report (P305) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P305
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS- P305-1
QoS	Class	3 bits	uint	TBC-IRS- P305-2
	Priority	3 bits	uint	TBC-IRS- P305-3
	Network Preference	3 bits	uint	TBC-IRS- P305-4
	Special Handling	4 bits	uint	TBC-IRS- P305-5
	Service Request	3 bits	uint	TBC-IRS- P305-6

3.3.2.6.1.1 Emergency Brake Application Report (P305) Message EMP Header Data Length Field

The EMP header Data Length field for an Emergency Brake Application Report (P305) message contains the length, in bytes, of the message body. The size of an Emergency Brake Application Report (P305) message is the sum of:

- 5 bytes for field IDs 1 and 2
- The value of field 2 for field ID 3
- 12 bytes for field IDs 4-6
- The value of field 6 for field ID 7
- 1 byte for field ID 8
- The value of field 8 for field ID 9
- 1 byte for field ID 10
- The value of field 10 for field ID 11
- 11 bytes for field IDs 12-15
- The value of field 15 for field ID 16
- 1 byte for field ID 17
- The value of field 17 for field ID 18
- 1 byte for field ID 19
- The value of field 19 for field ID 20
- 28 bytes for field IDs 21-28

- The value of field 28 for field ID 29
- 1 byte for field ID 30
- The value of field 30 for field ID 31
- 1 byte for field ID 32
- The value of field 32 for field ID 33
- 11 bytes for field IDs 34-37
- The value of field 37 for field ID 38
- 1 byte for field ID 39
- The value of field 39 for field ID 40
- 1 byte for field ID 41
- The value of field 41 for field ID 42
- 25 bytes for field IDs 43-48

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.6.1.2 Emergency Brake Application Report (P305) Message EMP Header Number Field

The Emergency Brake Application Report (P305) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.6.2 Emergency Brake Application Report (P305) Message Body

The Emergency Brake Application Report (02084) message is sent from the locomotive to the back office whenever the train comes to a stop after an emergency brake application occurs. If the onboard system has not located the train on mapped track, all of the track location fields, position uncertainty fields and the "Direction of Travel" field will be populated with zeros.

Table 77: Emergency Brake Application Report (P305) Message Body

ID	Field	Size (bytes)	Data Type	Description
1.	Railroad SCAC	4	SCAC	Railroad SCAC of the ITC-PTC BO to which the emergency brake application was reported
2.	Train ID Length	1	uint	Length of Train ID field
3.	Train ID	varies	string	Train identification number
4.	Start Emergency Braking Time	7	uint	Time when the emergency brake application started
5.	Start Emergency Braking Head End Milepost	4	MP	HOT location at start of emergency brake application
6.	Start Emergency Braking Head End Milepost Prefix Length	1	uint	Length of Start Emergency Head End Milepost Prefix field
7.	Start Emergency Braking Head End Milepost Prefix	varies	string	Start emergency braking head end milepost prefix
8.	Start Emergency Braking Head End Milepost Suffix Length	1	uint	Length of Start Emergency Braking Head End Milepost Suffix field
9.	Start Emergency Braking Head End Milepost Suffix	varies	string	Start emergency braking head end milepost suffix

ID	Field	Size (bytes)	Data Type	Description
10.	Start Emergency Braking Head End Track Name Length	1	uint	Length of Start Emergency Braking Head End Track Name field
11.	Start Emergency Braking Head End Track Name	varies	string	Start emergency braking head end track name
12.	Start Emergency Braking Head End Railroad SCAC	4	string	SCAC of track HOT occupied when emergency braking began
13.	Start Emergency Braking Head End PTC Subdivision/District ID	2	uint	PTC subdivision/district in which HOT was located when emergency braking began
14.	Start Emergency Braking Rear End Milepost	4	MP	EOT location at start of emergency brake application
15.	Start Emergency Braking Rear End Milepost Prefix Length	1	uint	Length of Start Emergency Braking Rear End Milepost Prefix field
16.	Start Emergency Braking Rear End Milepost Prefix	varies	string	Start emergency braking rear end milepost prefix
17.	Start Emergency Braking Rear End Milepost Suffix Length	1	uint	Length of Start Emergency Braking Rear End Milepost Suffix field
18.	Start Emergency Braking Rear End Milepost Suffix	varies	string	Start emergency braking rear end milepost suffix
19.	Start Emergency Braking Rear End Track Name Length	1	uint	Length of Start Emergency Braking Rear End Track Name field
20.	Start Emergency Braking Rear End Track Name	varies	string	Start emergency braking rear end track name
21.	Start Emergency Braking Rear End Railroad SCAC	4	string	SCAC of track EOT occupied when emergency braking began
22.	Start Emergency Braking Rear End PTC Subdivision/District ID	2	uint	PTC subdivision/district in which EOT was located when emergency braking began
23.	Start Emergency Braking Position Uncertainty	2	uint	Position uncertainty of the provided HOT start emergency braking location
24.	Direction of Travel at Start of Emergency Braking	1	enum	The direction of travel at the start of emergency braking. See Table 80.
25.	Train Speed at Start of Emergency Braking	2	uint	Speed when emergency brake application started, in mph (LSB = 0.1 mph)
26.	Start Emergency Braking Head End Position	12	ECEF	ECEF position (LSB = 1 centimeter) of HOT when emergency braking began
27.	Stop Emergency Braking Head End Milepost	4	MP	HOT location at completion of emergency brake application
28.	Stop Emergency Head End Milepost Prefix Length	1	uint	Length of Stop Emergency Braking Head End Milepost Prefix field
29.	Stop Emergency Braking Head End Milepost Prefix	varies	string	Stop emergency braking head end milepost prefix

ID	Field	Size (bytes)	Data Type	Description
30.	Stop Emergency Braking Head End Milepost Suffix Length	1	uint	Length of Stop Emergency Braking Head End Milepost Suffix field
31.	Stop Emergency Braking Head End Milepost Suffix	varies	string	Stop emergency braking head end milepost suffix
32.	Stop Emergency Braking Head End Track Name Length	1	uint	Length of Stop Emergency Braking Head End Track Name field
33.	Stop Emergency Braking Head End Track Name	varies	string	Stop emergency braking head end track name
34.	Stop Emergency Braking Head End Railroad SCAC	4	string	SCAC of track HOT occupied at completion of emergency braking
35.	Stop Emergency Braking Head End PTC Subdivision/District ID	2	uint	PTC subdivision/district identification number of the head end when emergency braking ends
36.	Stop Emergency Braking Rear End Milepost	4	MP	EOT location at completion of emergency brake application
37.	Stop Emergency Braking Rear End Milepost Prefix Length	1	uint	Length of Stop Emergency Braking Rear End Milepost Prefix field
38.	Stop Emergency Braking Rear End Milepost Prefix	varies	string	Stop emergency braking rear end milepost prefix
39.	Stop Emergency Braking Rear End Milepost Suffix Length	1	uint	Length of Stop Emergency Braking Rear End Milepost Suffix field
40.	Stop Emergency Braking Rear End Suffix	varies	string	Stop emergency braking rear end milepost suffix
41.	Stop Emergency Braking Rear End Track Name Length	1	uint	Length of Stop Emergency Braking Rear End Track Name field
42.	Stop Emergency Braking Rear End Track Name	varies	string	Stop emergency braking rear end track name
43.	Stop Emergency Braking Rear End Railroad SCAC	4	string	SCAC of track EOT occupied at completion of emergency braking
44.	Stop Emergency Braking Rear End PTC Subdivision/District ID	2	uint	PTC subdivision/district in which EOT was located at completion of emergency braking
45.	Stop Emergency Braking Position Uncertainty	2	uint	Position uncertainty of the provided HOT stop emergency braking location
46.	Stop Emergency Braking Head End Position	12	ECEF	ECEF position (LSB = 1 centimeter)
47.	Application Type	1	enum	Brake application type. See Table 81.
48.	Coordination Number	4	uint	ITC-PTC BO-assigned coordination number for use in the resulting Emergency Brake Application Report ACK (P205) message.

Range limitations, other than those inherent to the data, are provided in Table 78. These ranges will be enforced by the receiving system.

Table 78: Emergency Brake Application Report (P305) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
2	Train ID Length	0 to 30
6	Start Emergency Braking Head End Milepost Prefix Length	0-5 characters
8	Start Emergency Braking Head End Milepost Suffix Length	0-5 characters
10	Start Emergency Braking Head End Track Name Length	0-32 characters
12	Start Emergency Braking Head End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
13	Start Emergency Braking Head End PTC Subdivision/District ID	0 to 9999
15	Start Emergency Braking Rear End Milepost Prefix Length	0-5 characters
17	Start Emergency Braking Rear End Milepost Suffix Length	0-5 characters
19	Start Emergency Braking Rear End Track Name Length	0-32 characters
21	Start Emergency Braking Rear End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
22	Start Emergency Braking Rear End PTC Subdivision/District ID	0 to 9999
24	Direction of Travel at Start of Emergency Braking	0 to 2 (Valid enumeration values)
28	Stop Emergency Braking Head End Milepost Prefix Length	0-5 characters
30	Stop Emergency Braking Head End Milepost Suffix Length	0-5 characters
32	Stop Emergency Braking Head End Track Name Length	0-32 characters
34	Stop Emergency Braking Head End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
35	Stop Emergency Braking Head End PTC Subdivision/District ID	0 to 9999
37	Stop Emergency Braking Rear End Milepost Prefix Length	0-5 characters
39	Stop Emergency Braking Rear End Milepost Suffix Length	0-5 characters
41	Stop Emergency Braking Rear End Track Name Length	0-32 characters
43	Stop Emergency Braking Rear End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
44	Stop Emergency Braking Rear End PTC Subdivision/District ID	0 to 9999
47	Application Type	0 to 4 (Valid enumeration values)

3.3.2.6.3 *Emergency Brake Application Report (P305) Message Reliable Messaging Properties*

The Emergency Brake Application Report (P305) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 79.

Table 79: Emergency Brake Application Report (P305) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Emergency Brake Application Report ACK (P205) message
Number of Retries	TBC-IRS-P305-7
Retry Interval	TBC-IRS-P305-8

3.3.2.6.4 *Emergency Brake Application Report (P305) Message Field Generation Requirements*

Requirements placed on ITC-PTC BO in regard to populating the fields in an Emergency Brake Application Report (P305) message body are given in this section.

The Emergency Brake Application Report (P305) message fields are populated with information from ITC-PTC OB as provided in the Emergency Brake Application Report (02084) message. The Emergency Brake Application Report (P305) message is a copy of the Emergency Brake Application Report (02084) message.

3.3.2.6.4.1 Emergency Brake Application Report (P305) Message Railroad SCAC Field, Generation Requirements

The Emergency Brake Application Report (P305) message Railroad SCAC field contains the railroad SCAC for the ITC-PTC BO to which the ITC-PTC OB sent the original Emergency Brake Application Report (02084) message.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Railroad SCAC field with the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the Emergency Brake Application Report (02084) message.*

3.3.2.6.4.2 Emergency Brake Application Report (P305) Message Train ID Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Train ID Length field contains the length of the Emergency Brake Application Report (P305) message Train ID field. The Emergency Brake Application Report (P305) message Train ID Length field may contain up to 30 characters.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Train ID Length field with the length of the Emergency Brake Application Report (P305) message Train ID.*

3.3.2.6.4.3 Emergency Brake Application Report (P305) Message Train ID Field, Generation Requirements

The Emergency Brake Application Report (P305) message Train ID field contains the train ID number assigned by the railroad to which the Emergency Brake Application Report was sent.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Train ID field with the train ID assigned by the railroad to which the Emergency Brake Application Report (P305) message is being sent.*

3.3.2.6.4.4 Emergency Brake Application Report (P305) Message Start Emergency Braking Time Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Time field shows the UTC time that the emergency brake application started. The Locomotive System State (P301) message Locomotive State Time field is stored as a 7-byte binary-coded decimal number in the format YYYYMMDDHHMMSS. YYYY is the year and is 2 bytes in size. MM, DD, HH, MM, SS are the month, day, hour, minute, and second, respectively; each are 1 byte in size.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Time field with the UTC time that the emergency brake application started.*

3.3.2.6.4.5 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides the location of the HOT when the emergency brake application started, accurate to 1/1000 of a mile.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost field with the milepost location of the HOT when the emergency brake application started.*

3.3.2.6.4.6 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Prefix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix Length field contains the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix. The Emergency Brake Application Report (P305) message Start Emergency. When the associated track does not have a milepost prefix the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start*

Emergency Braking Head End Milepost Prefix Length field with the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix.

3.3.2.6.4.7 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Prefix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix field contains the milepost prefix of the HOT location when the emergency brake application started. The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix field cannot exceed 5 characters.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix field with the milepost prefix of the HOT location at the time the emergency brake application started.*

3.3.2.6.4.8 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Suffix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix Length field contains the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix. When the associated track does not have a milepost suffix the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix Length field with the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix.*

3.3.2.6.4.9 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Suffix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field contains the milepost suffix of the HOT location when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field with the milepost suffix of the HOT when the emergency brake application started.*

3.3.2.6.4.10 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Track Name Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name Length field contains the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name Length field with the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name.*

3.3.2.6.4.11 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Track Name Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name field contains the name of the track where the HOT was located when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name field with the name of the track where the HOT was located when the emergency brake application started.*

3.3.2.6.4.12 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Railroad SCAC Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Railroad SCAC field contains the SCAC of the subdivision/district on which the HOT was located when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Railroad SCAC field with the railroad SCAC of the subdivision/district on which the HOT was located when the emergency brake application started.*

3.3.2.6.4.13 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End PTC Subdivision/District ID Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End PTC Subdivision/District ID field contains the subdivision/district ID of the subdivision/district in which the HOT was located when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End PTC Subdivision/District ID field with the identification number of the subdivision/district in which the HOT was located when the emergency brake application started.*

3.3.2.6.4.14 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides the location of the EOT when the emergency brake application started, accurate to 1/1000 of a mile.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Locomotive System State (P301) message Head End Milepost field with the milepost location of the EOT at the time the emergency brake application started.*

3.3.2.6.4.15 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Prefix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix Length field contains the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix. When the associated track does not have a milepost prefix the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix Length field with the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix.*

3.3.2.6.4.16 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Prefix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix field contains the milepost prefix of the EOT location when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix field with the milepost prefix of the EOT location when the emergency brake application started.*

3.3.2.6.4.17 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Suffix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix Length field contains the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix. When the associated track does not have a milepost prefix the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix Length field with the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix.*

3.3.2.6.4.18 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Suffix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field contains the milepost suffix of the EOT location when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field with the milepost suffix of the EOT location when the emergency brake application started.*

3.3.2.6.4.19 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Track Name Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name Length field contains the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name Length field with the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name field.*

3.3.2.6.4.20 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Track Name Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name field contains the name of the track where the EOT was located when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name field with the name of the track where the EOT was located when the emergency brake application started.*

3.3.2.6.4.21 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Railroad SCAC Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Railroad SCAC field contains the railroad SCAC of the subdivision/district in which the EOT was located when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Railroad SCAC field with the railroad SCAC of the subdivision/district in which the EOT was located when the emergency brake application started.*

3.3.2.6.4.22 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End PTC Subdivision/District ID Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End PTC Subdivision/District ID field contains the subdivision/district ID of the subdivision/district in which the EOT was located when the emergency brake application started.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End PTC Subdivision/District ID field with the identification number of the subdivision/district on which the EOT was located when the emergency brake application started.*

3.3.2.6.4.23 Emergency Brake Application Report (P305) Message Start Emergency Braking Position Uncertainty Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Position Uncertainty field contains the position uncertainty, measured in feet, of the provided HOT start emergency braking location. The actual location of the HOT when the emergency brake application started is no further from the provided HOT location than the position uncertainty.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Position Uncertainty field with the position uncertainty, in feet, of where the HOT was located when the emergency brake application started.*

3.3.2.6.4.24 Emergency Brake Application Report (P305) Message Direction of Travel at Start of Emergency Braking Field, Generation Requirements

The Emergency Brake Application Report (P305) message Direction of Travel at Start of Emergency Braking field gives the direction the train was traveling when the emergency brake application started. The enumeration values for this field are given in Table 80.

Table 80: Emergency Brake Application Report (P305) Direction of Travel at Start of Emergency Braking Enumeration Field Values

Value	Description
0	Unknown
1	Increasing Mileposts
2	Decreasing Mileposts

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Direction of Travel at Start of Emergency Braking field with the direction the train was traveling when the emergency brake application started, using the enumeration values given in Table 80.*

3.3.2.6.4.25 Emergency Brake Application Report (P305) Message Train Speed at Start of Emergency Braking Field, Generation Requirements

The Emergency Brake Application Report (P305) message Train Speed at Start of Emergency Braking field contains the speed the train was traveling when the emergency brake application started. The train speed is given in 1/10 miles per hour (multiply this value by 10 for train speed in mph).

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Train Speed at Start of Emergency Braking field with the speed the train was traveling when the emergency brake application started, in 1/10 mph.*

3.3.2.6.4.26 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Position Field, Generation Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Position field contains the location of the HOT when the emergency brake application started. The head end location of the train is given in the ECEF coordinate system.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Position field with the ECEF location of the HOT when the emergency brake application started.*

3.3.2.6.4.27 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides the location of the EOT when emergency braking ended, accurate to 1/1000 of a mile.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost field with the location of the EOT when emergency braking ended.*

3.3.2.6.4.28 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Prefix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix Length field contains the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix. When the associated track does not have a milepost prefix the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix Length field with the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix.*

3.3.2.6.4.29 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Prefix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix field contains the milepost prefix of the location of the HOT when emergency braking was completed.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix field with the milepost prefix of the HOT location when emergency braking was completed.*

3.3.2.6.4.30 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Suffix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix Length field contains the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix. When the associated track does not have a milepost prefix the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix Length field with the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix.*

3.3.2.6.4.31 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Suffix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix field contains the milepost suffix of the location of the HOT when emergency braking ended.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix field with the milepost suffix of the HOT when emergency braking ended.*

3.3.2.6.4.32 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Track Name Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name Length field contains the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name Length field with the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name.*

3.3.2.6.4.33 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Track Name Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name field contains the name of the track where the HOT was located when emergency braking was completed.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name field with the name of the track where the HOT was located when emergency braking ended.*

3.3.2.6.4.34 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Railroad SCAC Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Railroad SCAC field contains the railroad SCAC of the subdivision/district on which the HOT was located when emergency braking was completed.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Railroad SCAC field with the railroad SCAC of the subdivision/district on which the HOT was located when emergency braking was completed.*

3.3.2.6.4.35 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End PTC Subdivision/District ID Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End PTC Subdivision/District ID field contains the subdivision/district ID of the subdivision/district in which the HOT was located when emergency braking was completed.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End PTC Subdivision/District ID field with the identification number of the subdivision/district on which the HOT was located when emergency braking was completed.*

3.3.2.6.4.36 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost field is populated with an MP data type that, when multiplied by 0.0001, provides the location of the EOT when emergency braking was completed, accurate to 1/1000 of a mile.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost field with the location of the EOT when emergency braking was completed.*

3.3.2.6.4.37 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Prefix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix Length field contains the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix. When the associated track does not have a milepost prefix the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix Length field with the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix field.*

3.3.2.6.4.38 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Prefix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix field contains the milepost prefix of the EOT location when emergency braking ended.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix field with the milepost prefix of the EOT when emergency braking ended.*

3.3.2.6.4.39 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Suffix Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix Length field contains the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix. When the associated track does not have a milepost prefix the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix Length field is populated with 0 and no Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix field is present.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix Length field with the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix.*

3.3.2.6.4.40 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Suffix Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix field contains the milepost suffix of the EOT location when emergency braking ended.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop*

Emergency Braking Rear End Milepost Suffix field with the milepost suffix of the EOT location when emergency braking ended.

3.3.2.6.4.41 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Track Name Length Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name Length field contains the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name Length field with the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name.*

3.3.2.6.4.42 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Track Name Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name field contains the name of the track on which the EOT was located when emergency braking was completed.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name field with the name of the track on which the EOT was located when emergency braking was completed.*

3.3.2.6.4.43 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Railroad SCAC Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Railroad SCAC field contains the SCAC of the subdivision/district in which the EOT was located when emergency braking ended.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Railroad SCAC field with the SCAC of the subdivision/district in which the EOT was located when emergency braking ended.*

3.3.2.6.4.44 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End PTC Subdivision/District ID Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End PTC Subdivision/District ID field contains the subdivision/district ID of the subdivision/district in which the EOT was located when emergency braking ended.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End PTC Subdivision/District ID field with the identification number of the subdivision/district in which the EOT was located when emergency braking ended.*

3.3.2.6.4.45 Emergency Brake Application Report (P305) Message Stop Emergency Braking Position Uncertainty Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Position Uncertainty field contains the position uncertainty, measured in feet, of the provided HOT stop emergency braking location. The actual location of the HOT when the emergency brake application was completed is no further from the provided HOT location than the position uncertainty.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Position Uncertainty field with position uncertainty, in feet, of the location of where the HOT was located when emergency braking was completed.*

3.3.2.6.4.46 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Position Field, Generation Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Position field contains the location of the HOT when emergency braking was completed. The HOT location of the train is given in the ECEF coordinate system, in centimeters.

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Position field with the ECEF location of the HOT when emergency braking was completed.*

3.3.2.6.4.47 Emergency Brake Application Report (P305) Message Application Type Field, Generation Requirements

The Emergency Brake Application Report (P305) message Application Type field contains the type of emergency brake application. Table 81 contains the enumeration values used to denote the brake application type.

Table 81: Emergency Brake Application Report (P305) Application Type Enumeration Field Values

Value	Description
0	Unknown
1	Undesired Application (UDE)
2	Engineer-induced (EIE)
3	Conductor-induced
4	PTC-induced

a) *When ITC-PTC BO generates an Emergency Brake Application Report (P305) message, ITC-PTC BO shall populate the Emergency Brake Application Report (P305) message Application Type field with the type of brake application used to stop the train, using the enumeration values in Table 81.*

3.3.2.6.4.48 Emergency Brake Application Report (P305) Message Coordination Number Field, Generation Requirements

The Emergency Brake Application Report (P305) message Coordination Number is generated according to the numbering process described in Section 3.4.2.

3.3.2.6.5 Emergency Brake Application Report (P305) Message Field Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the Emergency Brake Application Report (P305) message fields are given in this section.

3.3.2.6.5.1 Emergency Brake Application Report (P305) Message Railroad SCAC Field, Use Requirements

The Emergency Brake Application Report (P305) message Railroad SCAC dynamic field provides the SCAC for the ITC-PTC BO to which the ITC-PTC OB sent the Emergency Brake Application Report (02084) message.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Railroad SCAC field as an indication of the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Emergency Brake Application Report (02084) message.*

3.3.2.6.5.2 Emergency Brake Application Report (P305) Message Train ID Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Train ID Length field provides the length of the Emergency Brake Application Report (P305) message Train ID field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Train ID Length field as the length of the Emergency Brake Application Report (P305) message Train ID.*

3.3.2.6.5.3 Emergency Brake Application Report (P305) Message Train ID Field, Use Requirements

The Emergency Brake Application Report (P305) message Train ID field provides the train ID of the corresponding train as assigned by the ITC-PTC BO of which received the original Emergency Brake Application Report (02084) message.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Train ID field as an indication of the identification number of the train reporting an emergency brake application.*

3.3.2.6.5.4 Emergency Brake Application Report (P305) Message Start Emergency Braking Time Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Time field is used to show the time that the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Time field as an indication of the time the reported emergency brake application started.*

3.3.2.6.5.5 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost field provides the milepost location of the HOT when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost field as the milepost location of the HOT at the time that the emergency brake application started.*

3.3.2.6.5.6 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Prefix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix Length field provides the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix Length field as the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix field.*

3.3.2.6.5.7 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Prefix Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Prefix field provides the prefix of the milepost location of the HOT when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Head End Milepost Prefix field as the prefix of the milepost location of the HOT when the emergency brake application started.*

3.3.2.6.5.8 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Suffix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix Length field provides the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix Length field as the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field.*

3.3.2.6.5.9 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Milepost Suffix Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Milepost Suffix field provides the suffix of the milepost location of the HOT when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Head End Milepost Suffix field as the suffix of the milepost location of the HOT when the emergency brake application started.*

3.3.2.6.5.10 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Track Name Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name Length field provides the length of the Locomotive System State (P301) message Start Emergency Braking Head End Track Name field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name Length field as the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name field.*

3.3.2.6.5.11 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Track Name Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name field provides the name of the track on which the HOT was located when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Track Name field to identify the name of the track on which the HOT was located when the emergency brake application started.*

3.3.2.6.5.12 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Railroad SCAC Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Railroad SCAC field provides the SCAC of the track on which the HOT was located when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Railroad SCAC field to identify the SCAC of the operating railroad where the HOT was located when the emergency brake application started.*

3.3.2.6.5.13 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End PTC Subdivision/District ID Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End PTC Subdivision/District ID field provides the subdivision/district ID of the subdivision/district in which the HOT was located when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End PTC Subdivision/District ID field to identify the subdivision/district on which the HOT was located when the emergency brake application started.*

3.3.2.6.5.14 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost field provides the milepost location of the EOT when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost field as the milepost location of the EOT at the time that the emergency brake application started.*

3.3.2.6.5.15 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Prefix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix Length field provides the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix Length field as the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix.*

3.3.2.6.5.16 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Prefix Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Prefix field provides the prefix of the milepost location of the EOT when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Rear End Milepost Prefix field as the prefix of the milepost location of the EOT when the emergency brake application started.*

3.3.2.6.5.17 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Suffix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix Length field provides the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix Length field as the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix field.*

3.3.2.6.5.18 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Milepost Suffix Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Milepost Suffix field provides the suffix of the milepost location of the EOT when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Rear End Milepost Suffix field as the suffix of the milepost location of the EOT when the emergency brake application started.*

3.3.2.6.5.19 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Track Name Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name Length field provides the length of the Locomotive System State (P301) message Start Emergency Braking Rear End Track Name field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name Length field as the length of the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name field.*

3.3.2.6.5.20 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Track Name Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name field provides the name of the track where the EOT was located when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Track Name field to identify the name of the track where the EOT was located when the emergency brake application started.*

3.3.2.6.5.21 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End Railroad SCAC Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Railroad SCAC field provides the SCAC of the track on which the EOT was located when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End Railroad SCAC field to identify the SCAC of the operating railroad where the EOT was located when the emergency brake application started.*

3.3.2.6.5.22 Emergency Brake Application Report (P305) Message Start Emergency Braking Rear End PTC Subdivision/District ID Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Rear End PTC Subdivision/District ID field provides the subdivision/district ID of the subdivision/district in which the EOT was located when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Rear End PTC Subdivision/District ID field to identify the subdivision/district in which the EOT was located when the emergency brake application started.*

3.3.2.6.5.23 Emergency Brake Application Report (P305) Message Start Emergency Braking Position Uncertainty Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Position Uncertainty field provides the position uncertainty of the provided HOT location when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Position Uncertainty field as the position uncertainty of the provided HOT location when the emergency brake application started.*

3.3.2.6.5.24 Emergency Brake Application Report (P305) Message Direction of Travel at Start of Emergency Braking Field, Use Requirements

The Emergency Brake Application Report (P305) message Direction of Travel at Start of Emergency Braking field is used to indicate the direction the train was traveling when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall, using the enumeration values given in Table 80, use the Emergency Brake Application Report (P305) message Direction of Travel at Start of Emergency Braking field as the direction the train was traveling when the emergency brake application started.*

3.3.2.6.5.25 Emergency Brake Application Report (P305) Message Train Speed at Start of Emergency Braking Field, Use Requirements

The Emergency Brake Application Report (P305) message Train Speed at start of Emergency Braking field provides the ITC-ATOSS back office with the speed of the train at the time the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Train Speed at Start of Emergency Braking field to provide ITC-ATOSS BO with the speed of the train at the time the emergency brake application started.*

3.3.2.6.5.26 Emergency Brake Application Report (P305) Message Start Emergency Braking Head End Position Field, Use Requirements

The Emergency Brake Application Report (P305) message Start Emergency Braking Head End Position field provides the ECEF coordinates of the HOT was location when the emergency brake application started.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Start Emergency Braking Head End Position field to as the ECEF coordinates of the position of the HOT when the emergency brake application started.*

3.3.2.6.5.27 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost field provides the milepost location of the HOT when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost field as the milepost location of the HOT when emergency braking was completed.*

3.3.2.6.5.28 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Prefix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix Length field provides the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix Length field as the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix field.*

3.3.2.6.5.29 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Prefix Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Prefix field provides the prefix of the milepost location of the HOT when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Head End Milepost Prefix field as the prefix of the milepost location of the HOT when emergency braking was completed.*

3.3.2.6.5.30 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Suffix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix Length field provides the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix Length field as the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix field.*

3.3.2.6.5.31 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Milepost Suffix Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Milepost Suffix field provides the suffix of the milepost location of the HOT when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Head End Milepost Suffix field as the suffix of the milepost location of the HOT when emergency braking was completed.*

3.3.2.6.5.32 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Track Name Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name Length field provides the length of the Locomotive System State (P301) message Stop Emergency Braking Head End Track Name field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name Length field as the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name field.*

3.3.2.6.5.33 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Track Name Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name field provides the name of the track on which the HOT was located when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Track Name field to identify the name of the track where the HOT was located when emergency braking was completed.*

3.3.2.6.5.34 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Railroad SCAC Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Railroad SCAC field provides the SCAC of the track on which the HOT was located when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Railroad SCAC field to identify the SCAC of the operating railroad on which the HOT was located when emergency braking was completed.*

3.3.2.6.5.35 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End PTC Subdivision/District ID Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End PTC Subdivision/District ID field provides the specific subdivision/district on which the HOT was located when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End PTC Subdivision/District ID field to identify the subdivision/district on which the HOT was located when emergency braking was completed.*

3.3.2.6.5.36 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost field provides the milepost location of the EOT when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost field as the milepost location of the EOT when emergency braking was completed.*

3.3.2.6.5.37 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Prefix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix Length field provides the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix Length field as the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix field.*

3.3.2.6.5.38 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Prefix Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Prefix field provides the prefix of the milepost location of the EOT when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Rear End Milepost Prefix field as the prefix of the milepost location of the EOT when emergency braking was completed.*

3.3.2.6.5.39 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Suffix Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix Length field provides the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix Length field as the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix field.*

3.3.2.6.5.40 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Milepost Suffix Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Milepost Suffix field provides the suffix of the milepost location of the EOT when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Rear End Milepost Suffix field as the suffix of the milepost location of the EOT when emergency braking was completed.*

3.3.2.6.5.41 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Track Name Length Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name Length field provides the length of the Locomotive System State (P301) message Stop Emergency Braking Rear End Track Name field.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name Length field as the length of the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name field.*

3.3.2.6.5.42 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Track Name Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name field provides the name of the track on which the EOT was located when emergency braking ended.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Track Name field to identify the name of the track where the EOT was located when emergency braking was completed.*

3.3.2.6.5.43 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End Railroad SCAC Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Railroad SCAC field provides the SCAC of the track on which the EOT was located when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End Railroad SCAC field to identify the SCAC of the track on which the EOT was located when emergency braking was completed.*

3.3.2.6.5.44 Emergency Brake Application Report (P305) Message Stop Emergency Braking Rear End PTC Subdivision/District ID Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End PTC Subdivision/District ID field provides the subdivision/district ID of the subdivision/district in which the EOT was located when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Rear End PTC Subdivision/District ID field to identify the subdivision/district on which the EOT was located when emergency braking was completed.*

3.3.2.6.5.45 Emergency Brake Application Report (P305) Message Stop Emergency Braking Position Uncertainty Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Position Uncertainty field provides position uncertainty of the provided HOT location for when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Position Uncertainty field position uncertainty of the reported HOT location for when emergency braking was completed.*

3.3.2.6.5.46 Emergency Brake Application Report (P305) Message Stop Emergency Braking Head End Position Field, Use Requirements

The Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Position field provides the ECEF coordinates of where the HOT was located when emergency braking was completed.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall use the Emergency Brake Application Report (P305) message Stop Emergency Braking Head End Position field as the ECEF coordinates of the position of the HOT when emergency braking was completed.*

3.3.2.6.5.47 Emergency Brake Application Report (P305) Message Application Type Field, Use Requirements

The Emergency Brake Application Report (P305) message Application Type field provides the type of brake application.

a) *When ITC-ATOSS BO receives an Emergency Brake Application Report message ITC-ATOSS BO shall, using the enumeration values in Table 81, use the Emergency Brake Application Report (P305) message Application Type field as the application type of the emergency brake application being reported.*

3.3.2.6.5.48 Emergency Brake Application Report (P305) Message Coordination Number Field, Use Requirements

The Emergency Brake Application Report (P305) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.2.7 Train Handling Exception Report (P306) Message, Version 1

The Train Handling Exception Report (P306) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO receives the original Train Handling Exception Report (02085) message from ITC-PTC OB. The Train Handling Exception Report (02085) message is sent from the locomotive to the back office whenever a train handling exception is detected.

3.3.2.7.1 *Train Handling Exception Report (P306) Message EMP Header Parameters*

Message-specific EMP header values for the Train Handling Exception Report (P306) message are specified in Table 82.

Table 82: Train Handling Exception Report (P306) EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P306
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS- P306-1
QoS	Class	3 bits	uint	TBC-IRS- P306-2
	Priority	3 bits	uint	TBC-IRS- P306-3
	Network Preference	3 bits	uint	TBC-IRS- P306-4
	Special Handling	4 bits	uint	TBC-IRS- P306-5
	Service Request	3 bits	uint	TBC-IRS- P306-6

3.3.2.7.1.1 Train Handling Exception Report (P306) Message EMP Header Data Length Field

The EMP header Data Length field for a Train Handling Exception Report (P306) message contains the length, in bytes, of the message body. The Train Handling Exception Report (P306) message contains a record loop that is repeated a variable number of times. The loop is preceded by a counter indicating the number of times the record is repeated.

In order to calculate the value stored in the EMP data length field, the size of the Train Handling Exception Report (P306) message body must be calculated at run time for each Train Handling Exception Report (P306) message generated. The size of a Train Handling Exception Report (P306) message is the sum of:

- 5 bytes for field IDs 1 and 2
- The value of field 2, which is the length of field 3
- 9 bytes for field IDs 4-6
- The value of field 6, which is the length of field 7
- 5 bytes for field IDs 8 and 9
- The value of field 9, which is the length of field 10
- 1 byte for field ID 11
- The value of field 11, which is the length of field 12
- 1 byte for field ID 13
- The value of field 13, which is the length of field 14
- 11 bytes for field IDs 15-18

- The value of field 18, which is the length of field 19
- 1 byte for field ID 20
- The value of field 20, which is the length of field 21
- 1 byte for field ID 22
- The value of field 22, which is the length of field 23
- 26 bytes for field IDs 24-30
- The value of field 30, which is the length of field 31
- 4 bytes for field ID 32

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.7.1.2 Train Handling Exception Report (P306) Message EMP Header Number Field

The Train Handling Exception Report (P306) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.7.2 Train Handling Exception Report (P306) Message Body

The Train Handling Exception Report (P306) message is sent from the locomotive to the back office whenever a train handling exception is detected. If the onboard system has not located the train on mapped track, all of the "Head End" and "Rear End" fields, the "Current Position of Uncertainty" field, and the "Direction of Travel Field" will be populated with zeros.

Table 83: Train Handling Exception Report (P306) Message Body

ID	Field	Size, bytes	Data Type	Description
1.	Railroad SCAC	4	SCAC	Railroad SCAC of the railroad to which the train handling exception is being reported
2.	IRS Version Length	1	uint	Length of the IRS Version field
3.	IRS Version	varies	string	IRS version of ITC-PTC OB to ITC-PTC BO IRS
4.	Vendor Code	4	string	Vendor code, left justified, space filled
5.	System Code	4	string	System code, left justified, space filled
6.	Train ID Length	1	uint	Length of Train ID field
7.	Train ID	varies	string	Train identification number
8.	Head End Milepost	4	MP	Milepost location of HOT
9.	Head End Milepost Prefix Length	1	uint	Length of Head End Milepost Prefix field
10.	Head End Milepost Prefix	varies	string	Head end milepost prefix
11.	Head End Milepost Suffix Length	1	uint	Length of Head End Milepost Suffix field
12.	Head End Milepost Suffix	varies	string	Head end milepost suffix
13.	Head End Track Name Length	1	uint	Length of Head End Track Name field
14.	Head End Track Name	varies	string	Head end track name
15.	Head End Railroad SCAC	4	string	SCAC of current HOT location
16.	Head End PTC Subdivision/District ID	2	uint	PTC subdivision/district in which the HOT is located
17.	Rear End Milepost	4	uint	Multiply by 0.0001 to convert from stored value to milepost number.

ID	Field	Size, bytes	Data Type	Description
18.	Rear End Milepost Prefix Length	1	uint	Length of Rear End Milepost Prefix field
19.	Rear End Milepost Prefix	varies	string	Rear end milepost prefix
20.	Rear End Milepost Suffix Length	1	uint	Rear end milepost suffix length
21.	Rear End Milepost Suffix	varies	string	Rear end milepost suffix
22.	Rear End Track Name Length	1	uint	Length of Rear End Track Name field
23.	Rear End Track Name	varies	string	Rear end track name
24.	Rear End Railroad SCAC	4	string	SCAC of the current EOT location
25.	Rear End PTC Subdivision/District ID	2	uint	PTC subdivision/district in which the EOT is located
26.	Train Speed	4	float	Current train speed
27.	Current Position Uncertainty	2	uint	Current position uncertainty of the HOT, in feet
28.	Direction of Travel	1	enum	Direction of travel. See Table 86.
29.	Locomotive Position	12	ECEF	ECEF position (LSB = 1 centimeter)
30.	Length of Train Handling Exception Description	1	uint	Length of Train Handling Exception Description field
31.	Train Handling Exception Description	varies	string	Textual description of the train handling exception. See Table 87.
32.	Coordination Number	4	uint	ITC-PTC BO-assigned coordination number for use in the resulting Train Handling Exception Report ACK (P206) message.

Range limitations, other than those inherent to the data, are provided in Table 84. These ranges will be enforced by the receiving system.

Table 84: Train Handling Exception Report (P306) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
6	Train ID Length	0 to 30
9	Head End Milepost Prefix Length	0-5 characters
11	Head End Milepost Suffix Length	0-5 characters
13	Head End Track Name Length	0-32 characters
15	Head End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
16	Head End PTC Subdivision/District ID	0 to 9999
18	Rear End Milepost Prefix Length	0-5 characters
20	Rear End Milepost Suffix Length	0-5 characters
22	Rear End Track Name Length	0-32 characters
24	Rear End Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
25	Rear End PTC Subdivision/District ID	0 to 9999
28	Direction of Travel	0 to 2 (Valid enumeration values)

3.3.2.7.3 *Train Handling Exception Report (P306) Message Reliable Messaging Properties*

The Train Handling Exception Report (P306) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 85.

Table 85: Train Handling Exception Report (P306) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Emergency Brake Application Report ACK (P205) message
Number of Retries	TBC-IRS-P306-7
Retry Interval	TBC-IRS-P306-8

3.3.2.7.4 *Train Handling Exception Report (P306) Message Field Generation Requirements*

Requirements placed on ITC-PTC BO in regard to populating the fields in a Train Handling Exception Report (P306) message body are given in this section.

The Train Handling Exception Report (P306) message fields are populated with information from ITC-PTC OB as provided in the Train Handling Exception Report (02085) message. The Train Handling Exception Report (P306) message is a copy of the Train Handling Exception Report (02085) message.

3.3.2.7.4.1 Train Handling Exception Report (P306) Message Railroad SCAC Field, Generation Requirements

The Train Handling Exception Report (P306) message Railroad SCAC field contains the railroad SCAC of the ITC-PTC BO to which ITC-PTC OB sent the original Train Handling Exception Report (02085) message.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Railroad SCAC field with the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Train Handling Exception Report (02085) message.*

3.3.2.7.4.2 Train Handling Exception Report (P306) Message IRS Version Length Field, Generation Requirements

The Train Handling Exception Report (P306) message IRS Version Length field contains the length of the Train Handling Exception Report (P306) message IRS Version.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message IRS Version Length field with the length of the Train Handling Exception Report (P306) message IRS Version.*

3.3.2.7.4.3 Train Handling Exception Report (P306) Message IRS Version Field, Generation Requirements

The Train Handling Exception Report (P306) message IRS Version field contains the version of the IRS that is in use between ITC-PTC OB and ITC-PTC BO. The Train Handling Exception Report (P306) message IRS Version field must have a string length between 1 and 20 characters.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message IRS Version field with the version of the IRS in use between ITC-PTC OB and ITC-PTC BO.*

3.3.2.7.4.4 Train Handling Exception Report (P306) Message Vendor Code Field, Generation Requirements

The Train Handling Exception Report (P306) message Vendor Code field contains a code generated by the component involved in the train handling exception being reported.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Vendor Code field with the vendor code provided in the original Tran Handling Exception Report (02085) message Vendor Code field.*

3.3.2.7.4.5 Train Handling Exception Report (P306) Message System Code Field, Generation Requirements

The Train Handling Exception Report (P306) message System Code field contained code generated by the component involved in the train handling exception being reported.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message System Code field with the system code provided in the original Train Handling Exception Report (02085) message System Code field.*

3.3.2.7.4.6 Train Handling Exception Report (P306) Message Train ID Length Field, Generation Requirements

The Train Handling Exception Report (P306) message Train ID Length field contains length of the Train Handling Exception Report (P306) message Train ID field. If the Train ID is not available, the Train Handling Exception Report (P306) Train ID Length field will be populated with a value of 0 and the Train Handling Exception Report (P306) message Train ID field will not be present.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Train ID Length field with the length of the Train Handling Exception Report (P306) message Train ID field.*

3.3.2.7.4.7 Train Handling Exception Report (P306) Message Train ID Field, Generation Requirements

The Train Handling Exception Report (P306) message Train ID field contains the train ID assigned by the railroad to which the original Train Handling Exception Report (02085) message was sent. If the train ID is not available, the Train Handling Exception Report (P306) message Train ID field will not be present.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Train ID field with the train's identification number.*

3.3.2.7.4.8 Train Handling Exception Report (P306) Message Head End Milepost Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Milepost field contains the milepost location of the HOT, represented as an MP data type, and accurate to 1/1000 mile.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Milepost field with the milepost location of the HOT.*

3.3.2.7.4.9 Train Handling Exception Report (P306) Message Head End Milepost Prefix Length Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Milepost Prefix Length field contains the length of the Train Handling Exception Report (P306) message Head End Milepost Prefix. When the associated track does not have a milepost prefix the Train Handling Exception Report (P306) message Head End Milepost Prefix Length field is populated with 0 and no Train Handling Exception Report (P306) message Head End Milepost Prefix field is present.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Milepost Prefix Length field with the length of the Train Handling Exception Report (P306) message Head End Milepost Prefix field.*

3.3.2.7.4.10 Train Handling Exception Report (P306) Message Head End Milepost Prefix Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Milepost Prefix field contains the milepost prefix of HOT location when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Milepost Prefix field with the milepost prefix of HOT location at the time the train handling exception was detected.*

3.3.2.7.4.11 Train Handling Exception Report (P306) Message Head End Milepost Suffix Length Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Milepost Suffix Length field contains the length of the Train Handling Exception Report (P306) message Head End Milepost Suffix Head End Milepost Suffix. When the associated track does not have a milepost suffix the Train Handling Exception Report (P306) message Head End Milepost Suffix Length field is populated with 0 and no Train Handling Exception Report (P306) message Head End Milepost Suffix field is present.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Milepost Suffix Length field with the length of the Train Handling Exception Report (P306) message Head End Milepost Suffix.*

3.3.2.7.4.12 Train Handling Exception Report (P306) Message Head End Milepost Suffix Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Milepost Suffix field contains the milepost suffix of HOT location when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Milepost Suffix field with the milepost suffix of the HOT location at the time the train handling exception was detected.*

3.3.2.7.4.13 Train Handling Exception Report (P306) Message Head End Track Name Length Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Track Name Length field contains the length of the Train Handling Exception Report (P306) message Head End Track Name field.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Track Name Length field with the length of the Train Handling Exception Report (P306) message Head End Track Name.*

3.3.2.7.4.14 Train Handling Exception Report (P306) Message Head End Track Name Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Track Name field contains the name of the track on which the HOT was located when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Track Name field with the name of the track on which the HOT was located when the train handling exception was detected.*

3.3.2.7.4.15 Train Handling Exception Report (P306) Message Head End Railroad SCAC Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End Railroad SCAC field contains the SCAC of the track on which the HOT was located when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End Railroad SCAC field with the SCAC of the track on which the HOT was located when the train handling exception was detected.*

3.3.2.7.4.16 Train Handling Exception Report (P306) Message Head End PTC Subdivision/District ID Field, Generation Requirements

The Train Handling Exception Report (P306) message Head End PTC Subdivision/District ID field contains the subdivision/district ID of the subdivision/district on which the HOT was located when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Head End PTC Subdivision/District ID field with the subdivision/district ID of the subdivision/district on which the HOT was located when the train handling exception was detected.*

3.3.2.7.4.17 Train Handling Exception Report (P306) Message Rear End Milepost Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Milepost field contains the milepost location, accurate to 1/1000 mile, of the EOT when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Milepost field with the milepost location of the EOT when the train handling exception was detected.*

3.3.2.7.4.18 Train Handling Exception Report (P306) Message Rear End Milepost Prefix Length Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Prefix Length field contains the length of the Train Handling Exception Report (P306) message Rear End Milepost Prefix. When the associated track does not have a milepost prefix the Train Handling Exception Report (P306) message Rear End Milepost Prefix Length field is populated with 0 and no Train Handling Exception Report (P306) message Rear End Milepost Prefix field is present.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Milepost Prefix Length field with the length of the Train Handling Exception Report (P306) message Rear End Milepost Prefix field.*

3.3.2.7.4.19 Train Handling Exception Report (P306) Message Rear End Milepost Prefix Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Prefix field contains the prefix of the milepost location of the EOT when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Milepost Prefix field with the prefix of the milepost location of the EOT when the train handling exception was detected.*

3.3.2.7.4.20 Train Handling Exception Report (P306) Message Rear End Milepost Suffix Length Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Suffix Length field contains the length of the Train Handling Exception Report (P306) message Rear End Milepost Suffix. When the associated track does not have a milepost suffix the Train Handling Exception Report (P306) message Rear End Milepost Suffix Length field is populated with 0 and no Train Handling Exception Report (P306) message Rear End Milepost Suffix field is present.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Milepost Suffix*

Length field with the length of the Train Handling Exception Report (P306) message Rear End Milepost Suffix field.

3.3.2.7.4.21 Train Handling Exception Report (P306) Message Rear End Milepost Suffix Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Suffix field contains the suffix of the milepost location of the EOT when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Milepost Suffix field with the suffix of the milepost location of the EOT when the train handling exception was detected.*

3.3.2.7.4.22 Train Handling Exception Report (P306) Message Rear End Track Name Length Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Track Name Length field contains the length of the Train Handling Exception Report (P306) message Rear End Track Name.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Track Name Length field with the length of the Train Handling Exception Report (P306) message Rear End Track Name field.*

3.3.2.7.4.23 Train Handling Exception Report (P306) Message Rear End Track Name Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Track Name field contains the name of the track on which the EOT was located when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Track Name field with the name of the track on which the EOT was located when the train handling exception was detected.*

3.3.2.7.4.24 Train Handling Exception Report (P306) Message Rear End Railroad SCAC Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End Railroad SCAC field contains the SCAC of the subdivision/district in which the EOT was located when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End Railroad SCAC field with the SCAC of the subdivision/district in which the EOT was located when the train handling exception was detected.*

3.3.2.7.4.25 Train Handling Exception Report (P306) Message Rear End PTC Subdivision/District ID Field, Generation Requirements

The Train Handling Exception Report (P306) message Rear End PTC Subdivision/District ID field contains the subdivision/district ID of the subdivision/district in which the EOT was located when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Rear End PTC Subdivision/District ID field with the subdivision/district ID of the subdivision/district in which the EOT was located when the train handling exception was detected.*

3.3.2.7.4.26 Train Handling Exception Report (P306) Message Train Speed Field, Generation Requirements

The Train Handling Exception Report (P306) message Train Speed field contains the speed of the train, as reported by the ITC-PTC OB, when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Train Speed field with the speed, in mph, of the train when the train handling exception was detected.*

3.3.2.7.4.27 Train Handling Exception Report (P306) Message Current Position Uncertainty Field, Generation Requirements

The Train Handling Exception Report (P306) message Current Position Uncertainty field contains the position uncertainty, measured in feet, of the provided HOT location. The actual location of the HOT when the original Train Handling Exception Report (02085) message was generated is no further from the provided HOT location than the position uncertainty.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Current Position Uncertainty field with position uncertainty of the reported HOT location.*

3.3.2.7.4.28 Train Handling Exception Report (P306) Message Direction of Travel Field, Generation Requirements

The Train Handling Exception Report (P306) message Direction of Travel field gives the direction the train was traveling when the train handling exception was detected. The direction the train was traveling is defined by increasing or decreasing milepost values. The enumeration values for this field are given in Table 86.

Table 86: Train Handling Exception Report (P306) Direction of Travel Enumeration Field Values

Value	Description
0	Unknown
1	Increasing Mileposts
2	Decreasing Mileposts

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Direction of Travel field*

with the direction the train was traveling when the train handling exception was detected, using the enumeration values given in Table 86.

3.3.2.7.4.29 Train Handling Exception Report (P306) Message Locomotive Position Field, Generation Requirements

The Train Handling Exception Report (P306) message Locomotive Position field contains the ECEF location of the HOT when the train handling exception was detected.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Locomotive Position field with the ECEF location of the HOT when the train handling exception was detected.*

3.3.2.7.4.30 Train Handling Exception Report (P306) Message Length of Train Handling Exception Description Field, Generation Requirements

The Train Handling Exception Report (P306) message Length of Train Handling Exception Description field contains the length of the Train Handling Exception Report (P306) message Train Handling Exception Description field.

a) *When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Length of Train Handling Exception Description field with the length of the Train Handling Exception Report (P306) message Train Handling Exception Description field.*

3.3.2.7.4.31 Train Handling Exception Report (P306) Message Train Handling Exception Description Field, Generation Requirements

The Train Handling Exception Report (P306) message Handling Exception Description field contains a textual description of the train handling exception. While the interface allows for any textual description the current descriptions are enumerated in Table 87.

Table 87: Train Handling Exception Report (P306) Train Handling Exception Description Field Values

Train Handling Exception	Train Handling Exception Description
Power Braking	POWER BRAKING
Heavy Reduction Braking	HEAVY REDUCT BRAKING
Brake Pipe Continuity	BRAK PIPE CONTINUITY
Independent Braking (Type 1)	INDEP BRAKING TYPE 1
Independent Braking (Type 2)	INDEP BRAKING TYPE 2
Independent Braking on Heavy Grade	INDEP BRAK ON GRADE
Failure to Bail-off Independent Brakes after Automatic Brake Application	FAILURE TO BAIL OFF
Crew Induced Emergency Braking	CREW EMERGENCY BRAKE
Dynamic Brake (Type 1)	DYNAMIC BRAKE TYPE 1
Dynamic Brake (Type 2)	DYNAMIC BRAKE TYPE 2
Cab Signal	CAB SIGNAL
EOT Failure	EOT FAILURE
Use of Excessive Tractive Effort when Starting Train	EXCESS TE STARTING
Stopped with Brakes Released	STOPPED W BRAKES REL

Train Handling Exception	Train Handling Exception Description
DC Locomotive Holding Train at Standstill with Power and Automatic Brakes Released	DC LOCO HOLD TRAIN
Throttle Modulation	THROTTLE MODULATION
Train Induced Emergency Braking	TI EMERGENCY BRAKING
Short Duration Braking Cycle	SHORT DUR BRAK CYCLE
Long Duration Braking Cycle	LONG DUR BRAK CYCLE
Multiple Brake Reductions	MULT BRAKE REDUCTION

a) When ITC-PTC BO generates a Train Handling Exception Report (P306) message, ITC-PTC BO shall populate the Train Handling Exception Report (P306) message Train Handling Exception Description field with the description of the train handling exception.

3.3.2.7.4.32 Train Handling Exception Report (P306) Message Coordination Number Field, Generation Requirements

The Train Handling Exception Report (P306) message Coordination Number is generated according to the numbering process described in Section 3.4.2.

3.3.2.7.5 Train Handling Exception Report (P306) Message Field Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the Train Handling Exception Report (P306) message fields are given in this section.

3.3.2.7.5.1 Train Handling Exception Report (P306) Message Railroad SCAC Field, Use Requirements

The Train Handling Exception Report (P306) message Railroad SCAC field provides the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Train Handling Exception Report (02085) message.

a) When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Railroad SCAC field as an indication of the SCAC for the ITC-PTC BO to which the ITC-PTC OB sent the original Train Handling Exception Report (02085) message.

3.3.2.7.5.2 Train Handling Exception Report (P306) Message IRS Version Length Field, Use Requirements

The Train Handling Exception Report (P306) message IRS Version Length field provides ITC-PTC BO with the length of the following Train Handling Exception Report (P306) message IRS Version field.

a) When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message IRS Version Length field as the length of the Train Handling Exception Report (P306) message IRS Version field.

3.3.2.7.5.3 Train Handling Exception Report (P306) Message IRS Version Field, Use Requirements

The Train Handling Exception Report (P306) message IRS Version field provides the IRS version currently implemented in the ITC-PTC OB to ITC-PTC BO interface.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message IRS Version field as an indication of the IRS version in use between ITC-PTC OB and ITC-PTC BO.*

3.3.2.7.5.4 Train Handling Exception Report (P306) Message Vendor Code Field, Use Requirements

The Train Handling Exception Report (P306) message Vendor Code field contains a code generated by the component involved in the train handling exception being reported.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Vendor Code field as the vendor code provided by the component involved in the train handling exception.*

3.3.2.7.5.5 Train Handling Exception Report (P306) Message System Code Field, Use Requirements

The Train Handling Exception Report (P306) message System Code field contains a code generated by the component involved in the train handling exception being reported.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message System Code field as the system code provided by the component involved in the train handling exception.*

3.3.2.7.5.6 Train Handling Exception Report (P306) Message Train ID Length Field, Use Requirements

The Train Handling Exception Report (P306) message Train ID Length field provides the length of the Train Handling Exception Report (P306) message Train ID field.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Train ID Length field as the length of the Train Handling Exception Report (P306) message Train ID.*

3.3.2.7.5.7 Train Handling Exception Report (P306) Message Train ID Field, Use Requirements

The Train Handling Exception Report (P306) message Train ID field provides the train ID assigned by the railroad to which the original Train Handling Exception Report (02085) message was sent.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Train ID field as an indication of the train ID of the train involved in the reported exception.*

3.3.2.7.5.8 Train Handling Exception Report (P306) Message Head End Milepost Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Milepost field provides the milepost location of the HOT when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Milepost field as the milepost location of the HOT when the train handling exception was detected.*

3.3.2.7.5.9 Train Handling Exception Report (P306) Message Head End Milepost Prefix Length Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Milepost Prefix Length field provides the length of the Train Handling Exception Report (P306) message Head End Milepost Prefix field. When the associated track does not have a milepost prefix the Train Handling Exception Report (P306) message Head End Milepost Prefix Length field is populated with 0 and no Train Handling Exception Report (P306) message Head End Milepost Prefix field is present.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Milepost Prefix Length field as the length of the Train Handling Exception Report (P306) message Head End Milepost Prefix.*

3.3.2.7.5.10 Train Handling Exception Report (P306) Message Head End Milepost Prefix Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Milepost Prefix field provides the prefix of the milepost location of the HOT when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Milepost Prefix field as the prefix of the milepost location of the HOT when the train handling exception was detected.*

3.3.2.7.5.11 Train Handling Exception Report (P306) Message Head End Milepost Suffix Length Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Milepost Suffix Length field is used as the length of the Train Handling Exception Report (P306) message Head End Milepost Suffix field. When the associated track does not have a milepost suffix the Train Handling Exception Report (P306) message Head End Milepost Suffix Length field is populated with 0 and no Train Handling Exception Report (P306) message Head End Milepost Suffix field is present.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Milepost Suffix Length field as the length of the Train Handling Exception Report (P306) message Head End Milepost Suffix.*

3.3.2.7.5.12 Train Handling Exception Report (P306) Message Head End Milepost Suffix Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Milepost Suffix field provides the suffix of the milepost location of the HOT when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Milepost Suffix field as the suffix of the milepost location of the HOT when the train handling exception was detected.*

3.3.2.7.5.13 Train Handling Exception Report (P306) Message Head End Track Name Length Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Track Name Length field provides the length of the Train Handling Exception Report (P306) message Head End Track Name field.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Track Name Length field as the length of the Train Handling Exception Report (P306) message Head End Track Name.*

3.3.2.7.5.14 Train Handling Exception Report (P306) Message Head End Track Name Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Track Name field provides the name of the track on which the HOT was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Track Name field to identify the name of the track on which the HOT was located when the train handling exception was detected.*

3.3.2.7.5.15 Train Handling Exception Report (P306) Message Head End Railroad SCAC Field, Use Requirements

The Train Handling Exception Report (P306) message Head End Railroad SCAC field provides the SCAC of the track on which the HOT was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End Railroad SCAC field to identify the SCAC of the operating railroad on which the HOT was located when the train handling exception was detected.*

3.3.2.7.5.16 Train Handling Exception Report (P306) Message Head End PTC Subdivision/District ID Field, Use Requirements

The Train Handling Exception Report (P306) message Head End PTC Subdivision/District ID field provides the subdivision/district ID of the subdivision/district in which the HOT was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Head End PTC Subdivision/District ID field to identify the subdivision/district ID of the subdivision/district in which the HOT was located when the train handling exception was detected.*

3.3.2.7.5.17 Train Handling Exception Report (P306) Message Rear End Milepost Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Milepost field provides the milepost location of the EOT when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Milepost field as the milepost location of the EOT when the train handling exception was detected.*

3.3.2.7.5.18 Train Handling Exception Report (P306) Message Rear End Milepost Prefix Length Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Prefix Length field provides the length of the Train Handling Exception Report (P306) message Rear End Milepost Prefix field. When the associated track does not have a milepost prefix the Train Handling Exception Report (P306) message Rear End Milepost Prefix Length field is populated with 0 and no Train Handling Exception Report (P306) message Rear End Milepost Prefix field is present.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Milepost Prefix Length field as the length of the Train Handling Exception Report (P306) message Rear End Milepost Prefix.*

3.3.2.7.5.19 Train Handling Exception Report (P306) Message Rear End Milepost Prefix Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Prefix field provides the prefix of the milepost location of the EOT when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Milepost Prefix field as the prefix of the milepost location of the EOT when the train handling exception was detected.*

3.3.2.7.5.20 Train Handling Exception Report (P306) Message Rear End Milepost Suffix Length Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Suffix Length field provides the length of the Train Handling Exception Report (P306) message Rear End Milepost Suffix field. When the associated track does not have a milepost suffix the Train Handling Exception Report (P306) message Rear End Milepost Suffix Length field is populated with 0 and no Train Handling Exception Report (P306) message Rear End Milepost Suffix field is present.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Milepost Suffix Length field as the length of the Train Handling Exception Report (P306) message Rear End Milepost Suffix.*

3.3.2.7.5.21 Train Handling Exception Report (P306) Message Rear End Milepost Suffix Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Milepost Suffix field provides the suffix of the milepost location of the EOT when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Milepost Suffix*

field as the suffix of the milepost location of the EOT when the train handling exception was detected.

3.3.2.7.5.22 Train Handling Exception Report (P306) Message Rear End Track Name Length Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Track Name Length field provides the length of the Train Handling Exception Report (P306) message Rear End Track Name field.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Track Name Length field as the length of the Train Handling Exception Report (P306) message Rear End Track Name.*

3.3.2.7.5.23 Train Handling Exception Report (P306) Message Rear End Track Name Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Track Name field provides the name of the track on which the EOT was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Track Name field to identify the name of the track on which the EOT was located when the train handling exception was detected.*

3.3.2.7.5.24 Train Handling Exception Report (P306) Message Rear End Railroad SCAC Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End Railroad SCAC field provides the SCAC of the track on which the EOT was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End Railroad SCAC field to identify the SCAC of the track on which the EOT was located when the train handling exception was detected.*

3.3.2.7.5.25 Train Handling Exception Report (P306) Message Rear End PTC Subdivision/District ID Field, Use Requirements

The Train Handling Exception Report (P306) message Rear End PTC Subdivision/District ID field provides the specific subdivision/district ID of the subdivision/district in which the EOT was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Rear End PTC Subdivision/District ID field to identify the subdivision/district in which the EOT was located when the train handling exception was detected.*

3.3.2.7.5.26 Train Handling Exception Report (P306) Message Train Speed Field, Use Requirements

The Train Handling Exception Report (P306) message Train Speed field provides the ITC-ATOSS back office with the speed, in mph, of the train when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Train Speed field as an indication of the speed of the train reporting the exception at the time the train handling exception was detected.*

3.3.2.7.5.27 Train Handling Exception Report (P306) Message Current Position Uncertainty Field, Use Requirements

The Train Handling Exception Report (P306) message Current Position Uncertainty field provides position uncertainty of the location given for where the HOT was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Current Position Uncertainty field as the position uncertainty of the reported position of the HOT when the train handling exception was detected.*

3.3.2.7.5.28 Train Handling Exception Report (P306) Message Direction of Travel Field, Use Requirements

The Train Handling Exception Report (P306) message Direction of Travel field provides the direction the train was traveling when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall, using the enumeration values given in Table 86, use the Train Handling Exception Report (P306) message Direction of Travel field as an indication of the direction the train was traveling when the train handling exception was detected.*

3.3.2.7.5.29 Train Handling Exception Report (P306) Message Locomotive Position Field, Use Requirements

The Train Handling Exception Report (P306) message Locomotive Position field provides the coordinates of where the lead locomotive was located when the train handling exception was detected.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Locomotive Position field as an indication of the ECEF coordinates of the position of the HOT when the train handling exception was detected.*

3.3.2.7.5.30 Train Handling Exception Report (P306) Message Length of Train Handling Exception Description Field, Use Requirements

The Train Handling Exception Report (P306) message Length of Train Handling Exception Description field provides the length of the Train Handling Exception Report (P306) message Train Handling Exception Description field.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Train ID Length field as the length of the Train Handling Exception Report (P306) message Train ID.*

3.3.2.7.5.31 Train Handling Exception Report (P306) Message Train Handling Exception Description Field, Use Requirements

The Train Handling Exception Report (P306) message Handling Exception Description field is used to provide a textual description of the train handling exception.

a) *When ITC-ATOSS BO receives a Train Handling Exception Report (P306) message ITC-ATOSS BO shall use the Train Handling Exception Report (P306) message Train Handling Exception Description field as a description of the train handling exception being reported.*

3.3.2.7.5.32 Train Handling Exception Report (P306) Message Coordination Number Field, Use Requirements

The Train Handling Exception Report (P306) message Coordination Number field is used according to the process described in Section 3.4.3.

3.3.2.8 Locomotive Fault Report (P307) Message, Version 1

The Locomotive Fault Report (P307) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO receives the original Locomotive Fault Report (02087) message from ITC-PTC OB. The Locomotive Fault Report (P307) message is sent to report a change in state for an individual fault.

3.3.2.8.1 Locomotive Fault Report (P307) Message EMP Header Parameters

Message-specific EMP header values for the Locomotive Fault Report (P307) message are specified in Table 88.

Table 88: Locomotive Fault Report (P307) Message EMP Header Parameters

Field		Size (bytes)	Data Type	Value
Message Type		2	uint	P307
Message Version		1	uint	1
Flags	Time Stamp Format	1 bit	enum	1 (Absolute time)
	Encryption	1 bit	enum	0 (No encryption)
	Compression	1 bit	enum	0 (No compression)
	Data integrity	2 bits	enum	2 (HMAC)
Time To Live		2	uint	TBC-IRS- P307-1
QoS	Class	3 bits	uint	TBC-IRS- P307-2
	Priority	3 bits	uint	TBC-IRS- P307-3
	Network Preference	3 bits	uint	TBC-IRS- P307-4
	Special Handling	4 bits	uint	TBC-IRS- P307-5
	Service Request	3 bits	uint	TBC-IRS- P307-6

3.3.2.8.1.1 Locomotive Fault Report (P307) Message EMP Header Data Length Field

The EMP header Data Length field for a Locomotive Fault Report (P307) message contains the length, in bytes, of the message body. The Locomotive Fault Report (P307) message contains a record loop that is repeated a variable number of times. The loop is preceded by a counter indicating the number of times the record is repeated.

In order to calculate the value stored in the EMP data length field, the size of the Locomotive Fault Report (P307) message body must be calculated at run time for each Locomotive Fault Report (P307) message generated. The size of a Locomotive Fault Report (P307) message is the sum of:

- 5 bytes for field IDs 1 and 2
- The value of field ID 2 for the variable-length field 3
- 18 bytes for field IDs 4-9
- 1 byte multiplied by the value of field ID 9 for field ID 9.1
- 1 byte multiplied by the value of field ID 9 for field ID 9.2
- 1 byte multiplied by the value of field ID 9.2 for field ID 9.2.1
- 2 bytes multiplied by the value of field ID 9.2 for field ID 9.2.2
- 1 byte multiplied by the value of field ID 9.2 for field ID 9.2.3
- The sum of the values of each instance of field ID 9.2 for each instance of field 9.2.4
- 7 bytes for field ID 9.2.5
- 4 bytes for field ID 10

Requirements for setting the EMP header size are given in Section 3.2.1.5.

3.3.2.8.1.2 Locomotive Fault Report (P307) Message EMP Header Number Field

The Locomotive Fault Report (P307) message EMP header number field is calculated according to the numbering process described in Section 3.4.2.

3.3.2.8.2 Locomotive Fault Report (P307) Message Body

The Locomotive Fault Report (P307) message is sent to report a change in state for an individual fault (Table 89).

The components indicated in this message will be populated in the same order as they are listed in the Vendor Component Data Dictionary. The faults will be listed according to the order that they change state, with the most recent being listed first. The Locomotive Fault Report (P307) message is limited to 255 faults, which are allocated on a first come, first served basis. Once the Locomotive Fault Report (P307) message limit of 255 faults has been reached, each additional component will populate the "Number of Fault State Changes" field with a zero. If there are no active faults to report for a component the "Number of Fault State Changes" is populated with a zero for that component. The faults are independently reported from each source and are not merged (i.e., the same fault reported from all three PTC CPU slices would result in three entries in this message).

Table 89: Locomotive Fault Report (P307) Message Body

ID	Field	Size (bytes)	Data Type	Description
1	Railroad SCAC	4	SCAC	SCAC of the railroad to which the fault is being reported
2	IRS Version Length	1	uint	Length of the IRS Version field
3	IRS Version	varies	string	ITC-PTC OB to ITC-PTC BO IRS version
4	Vendor Code	4	string	Vendor code, left justified, space filled
5	System Code	4	string	System code, left justified, space filled
6	Locomotive State Time	7	uint	UTC time locomotive state was sampled
7	Locomotive State Summary	1	enum	Locomotive state summary. See Table 92
8	Locomotive State	1	enum	Locomotive state. See Table 93
9	Number of Components	1	uint	Number of components included in this message
<Start Component record loop>				Repeat once for each component
9.1	Component	1	uint	Numeric code for component, provided in Vendor Component Data Dictionary
9.2	Number of Fault State Changes	1	uint	Number of faults included in this message for this component
<Start Fault State Change record loop>				Repeat once for each fault state change
9.2.1	Fault State	1	enum	Fault state. See Table 94
9.2.2	Fault Code	2	uint	Unique code number for the fault, provided in the Vendor Component Data Dictionary
9.2.3	Length of Fault Name Text	1	uint	Length of Fault Name Test field
9.2.4	Fault Name Text	varies	string	Description of fault, provided in the Vendor Component Data Dictionary
9.2.5	Time Fault Detected	7	uint	UTC time when fault changed to its present state
<End Fault State Change record loop>				
<End Component record loop>				
10	Coordination Number	4	uint	ITC-PTC BO-assigned coordination number for use in the resulting Locomotive Fault Report ACK (P207) message.

Range limitations, other than those inherent to the data, are provided in Table 90. These ranges will be enforced by the receiving system.

Table 90: Locomotive Fault Report (P307) Message Field Ranges

ID	Field	Range
1	Railroad SCAC	Capital letters, left justified, space filled; must contain at least two letters
2	IRS Version Length	1 to 20
7	Locomotive State Summary	0 to 2 (Valid enumeration values)
8	Locomotive State	0 to 11 (Valid enumeration values)
9.2.1	Fault State	0 to 2 (Valid enumeration values)
9.2.3	Length of Fault Name Text	0 to 64

3.3.2.8.3 Locomotive Fault Report (P307) Message Reliable Messaging Properties

The Locomotive Fault Report (P307) message is a reliable message as defined in Section 3.4.4. The reliable messaging parameters are given in Table 91.

Table 91: Locomotive Fault Report (P307) Message Reliable Messaging Properties

Parameter	Value
Acknowledge Message	Emergency Brake Application Report ACK (P205) message
Number of Retries	TBC-IRS-P306-7
Retry Interval	TBC-IRS-P306-8

3.3.2.8.4 Locomotive Fault Report (P307) Message Field Generation Requirements

Requirements placed on ITC-PTC BO in regard to populating the fields in a Locomotive Fault Report (P307) message body are given in this section.

The Locomotive Fault Report (P307) message fields are populated with information from ITC-PTC OB as provided in the Locomotive Fault Report (02087) message. The Locomotive Fault Report (P307) message is a copy of the Locomotive Fault Report (02087) message.

3.3.2.8.4.1 Locomotive Fault Report (P307) Message Railroad SCAC Field, Generation Requirements

The Locomotive Fault Report (P307) message Railroad SCAC field contains the railroad SCAC for the ITC-PTC BO to which the ITC-PTC OB sent the original Locomotive Fault Report (02087) message.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message Railroad SCAC field with the SCAC of the ITC-PTC BO to which the ITC-PTC OB sent the original Locomotive Fault Report (02087) message.*

3.3.2.8.4.2 Locomotive Fault Report (P307) Message IRS Version Length Field, Generation Requirements

The Locomotive Fault Report (P307) message IRS Version Length field contains the length, in bytes, of the Locomotive Fault Report (P307) message IRS Version field.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message IRS Version Length field with the length, in bytes, of the Locomotive Fault Report (P307) message IRS Version field.*

3.3.2.8.4.3 Locomotive Fault Report (P307) Message IRS Version Field, Generation Requirements

The Locomotive Fault Report (P307) message IRS Version field contains the version of the IRS that is in use between ITC-PTC OB and ITC-PTC BO.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message IRS Version field with the version of the IRS in use between ITC-PTC OB and ITC-PTC BO.*

3.3.2.8.4.4 Locomotive Fault Report (P307) Message Vendor Code Field, Generation Requirements

The Locomotive Fault Report (P307) message Vendor Code field contains a vendor-provided code associated with the component reporting the fault.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message Vendor Code field with vendor code supplied in the original Locomotive Fault Report (02087) message.*

3.3.2.8.4.5 Locomotive Fault Report (P307) Message System Code Field, Generation Requirements

The Locomotive Fault Report (P307) message System Code field contains the system code provided by the component involved in the locomotive fault.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message System Code field with the system code supplied in the original Locomotive Fault Report (02087) message.*

3.3.2.8.4.6 Locomotive Fault Report (P307) Message Locomotive State Time Field, Generation Requirements

The Locomotive Fault Report (P307) message Locomotive State Time field contains the time the that the Locomotive State was sampled. The Locomotive Fault Report message Locomotive State Time field is stored as a 7-byte unsigned integer in the format YYYYMMDDHHMMSS where YYYY is 2 bytes in size and MM, DD, HH, MM, SS are each 1 byte in size. In binary coded decimal, the 4 Ys represent the 4 digits of the year, the first two Ms the two digits of the month, the two Ds the two digits of the day, the two Hs the two digits of the hour, the second two Ms the two digits of the minutes, and the two Ss the two digits of the seconds.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message Locomotive State Time field with the time at which the Locomotive State was sampled.*

3.3.2.8.4.7 Locomotive Fault Report (P307) Message Locomotive State Summary Field, Generation Requirements

The Locomotive Fault Report (P307) message Locomotive State Summary field provides a summary of the current locomotive state at the time indicated by the Locomotive Fault Report (P307) message Locomotive State Time field. The enumeration values are given in Table 92.

Table 92: Locomotive Fault Report (P307) Message Locomotive State Summary Field Enumeration Values

Value	Description
0	Not Used
1	Controlling
2	Non-controlling

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message Locomotive State Summary field with an*

enumeration value from Table 92, indicating the locomotive state at the time indicated by the Locomotive Fault Report (P307) message Locomotive State Time field.

3.3.2.8.4.8 Locomotive Fault Report (P307) Message Locomotive State Field, Generation Requirements

The Locomotive Fault Report (P307) message Locomotive State field indicates the current locomotive state recorded at the time given in the Locomotive Fault Report (P307) message Locomotive State Time field. The enumeration values are given in Table 93.

Table 93: Locomotive Fault Report (P307) Message Locomotive State Field Enumeration Values

Value	Description
0	Not Used
1	Reserved
2	Initializing
3	Disengaged
4	Cut Out
5	Active
6	Restricted
7	Failed
8	ATO Disengaged
9	Shadow Active
10	Attended Active
11	ATO Active

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message Locomotive State field with an enumeration value from Table 93 indicating the locomotive state at the time shown in the Locomotive Fault Report (P307) message Locomotive State Time field.*

3.3.2.8.4.9 Locomotive Fault Report (P307) Message Number of Components Field, Generation Requirements

The Locomotive Fault Report (P307) message Number of Components dynamic field provides the number of Locomotive Fault Report (P307) message Component records within the component record loop. Each Locomotive Fault Report (P307) message Component record consists of the Locomotive Fault Report (P307) message dynamic fields Component and Number of fault State Changes, as well as one complete instance of the Locomotive Fault Report (P307) message Fault State Change record loop.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message Number of Components field with the total number of components being reported.*

b) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall repeat the Locomotive Fault Report (P307) message Component record loop once for each component being reported.*

3.3.2.8.4.10 Locomotive Fault Report (P307) Message Component Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Report (P307) message Component dynamic field provides the numeric code assigned to the component being reported on as provided in the Vendor Component Data Dictionary.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate the Locomotive Fault Report (P307) message Component field with the numeric code assigned to the component being reported on as provided in the Vendor Component Data Dictionary.*

3.3.2.8.4.11 Locomotive Fault Report (P307) Message Number of Fault State Changes Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Report (P307) message Number of Fault State Changes dynamic field provides the number of faults included in the corresponding Locomotive Fault Report (P307) message Component record. The Locomotive Fault Report (P307) message Fault State Change record loop is repeated once for each fault state change being reported for the corresponding component. Each instance of the Locomotive Fault Report (P307) message Fault State Change record consists of the Locomotive Fault Report (P307) dynamic fields Fault State, Fault Code, Length of Fault Name Text, Fault Name Text, and Time Fault Detected.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message ITC-PTC BO shall populate each instance of the Locomotive Fault Report (P307) message Number of Fault State Changes dynamic field with the number of faults being reported for the corresponding component.*

b) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message ITC-PTC BO shall repeat the Locomotive Fault Report (P307) message Fault State Change record loop once for each fault being reported for the corresponding component.*

3.3.2.8.4.12 Locomotive Fault Report (P307) Message Fault State Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Report (P307) message Fault State dynamic field provides the state of the corresponding fault. Enumeration values are given in Table 94.

Table 94: Locomotive Fault Report (P307) Fault State Field Enumeration Values

Value	Description
0	Clear
1	Active
2	Intermittent

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Report (P307) message Fault State dynamic field using the enumeration values given in Table 94.*

3.3.2.8.4.13 Locomotive Fault Report (P307) Message Fault Code Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Report (P307) message Fault Code dynamic field provides the unique code number for the fault as provided in the Vendor Component Data Dictionary for the component shown in the corresponding Locomotive Fault Report (P307) message Component field.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Report (P307) message Fault Code dynamic field with the code number of the corresponding fault.*

3.3.2.8.4.14 Locomotive Fault Report (P307) Message Length of Fault Name Text Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Report (P307) message Length of Fault Name Text dynamic field provides the length of the corresponding Locomotive Fault Report (P307) message Fault Name Text dynamic field.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Report (P307) message Length of Fault Name Text dynamic field with the length of the corresponding Locomotive Fault Report (P307) message Fault Name Text field.*

3.3.2.8.4.15 Locomotive Fault Report (P307) Message Fault Name Text Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Report (P307) message Fault Name Text dynamic field provides a description of the corresponding fault as provided in the Vendor Component Data Dictionary.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Report (P307) message Fault Name Text field with a description of the corresponding fault.*

3.3.2.8.4.16 Locomotive Fault Report (P307) Message Time Fault Detected Dynamic Field, Generation Requirements

Each instance of the Locomotive Fault Report (P307) message Time Fault Detected fields contains the time the corresponding fault was first detected. The Locomotive Fault Report message Time Fault Detected dynamic field is stored as a 7-byte unsigned integer in the format YYYYMMDDHHMMSS where YYYY is 2 bytes in size and MM, DD, HH, MM, SS are each 1 byte in size. In binary coded decimal, the 4 Ys represent the 4 digits of the year, the first two Ms the two digits of the month, the two Ds the two digits of the day, the two Hs the two digits of the hour, the second two Ms the two digits of the minutes, and the two Ss the two digits of the seconds.

a) *When ITC-PTC BO generates a Locomotive Fault Report (P307) message, ITC-PTC BO shall populate each instance of the Locomotive Fault Report (P307) message Time Fault Detected field with the time at which the corresponding fault was first detected.*

3.3.2.8.4.17 Locomotive Fault Report (P307) Message Coordination Number Field, Generation Requirements

The Locomotive Fault Report (P307) message Coordination Number is generated according to the numbering process described in Section 3.4.3.

3.3.2.8.5 Locomotive Fault Report (P307) Message Field, Use Requirements

Requirements placed on ITC-PTC BO regarding the verification and use of the Locomotive Fault Report (P307) message fields are given in this section.

3.3.2.8.5.1 Locomotive Fault Report (P307) Message Railroad SCAC Field, Use Requirements

The Locomotive Fault Report (P307) message Railroad SCAC field provides the SCAC for the BOS to which the ITC-PTC OB sent the Locomotive Fault Report (02087) message.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use the Locomotive Fault Report (P307) message Railroad SCAC field as an indication of the SCAC of the ITC-PTC BO to which ITC-PTC OB sent the original Locomotive Fault Report (02087) message.*

3.3.2.8.5.2 Locomotive Fault Report (P307) Message IRS Version Length Field, Use Requirements

The Locomotive Fault Report (P307) message IRS Version Length field provides the length, in bytes, of the Locomotive Fault Report (P307) message IRS Version field.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use the Locomotive Fault Report (P307) message IRS Version Length field as the length, in bytes, of the Locomotive Fault Report (P307) message IRS Version field.*

3.3.2.8.5.3 Locomotive Fault Report (P307) Message IRS Version Field, Use Requirements

The Locomotive Fault Report (P307) message IRS Version field provides the IRS version currently implemented for the ITC-PTC OB to ITC-PTC BO interface.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use the Locomotive Fault Report (P307) message IRS Version field as an indication of the IRS version in use between ITC-PTC OB and ITC-PTC BO.*

3.3.2.8.5.4 Locomotive Fault Report (P307) Message Vendor Code Field, Use Requirements

The Locomotive Fault Report (P307) message Vendor Code field provides the vendor code associated with the fault being described in the Locomotive Fault Report (P307) message.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use the Locomotive Fault Report (P307) message Vendor Code as the vendor code associated with the locomotive fault being reported on.*

3.3.2.8.5.5 Locomotive Fault Report (P307) Message System Code Field, Use Requirements

The Locomotive Fault Report (P307) message System Code field provides the system code associated with the fault being described in the Locomotive Fault Report (P307) message.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use the Locomotive Fault Report (P307) message System Code field to identify the system code associated with the locomotive fault being reported on.*

3.3.2.8.5.6 Locomotive Fault Report (P307) Message Locomotive State Time Field, Use Requirements

The Locomotive Fault Report (P307) message Locomotive State Time field is used to indicate the time that the locomotive state was sampled. The Locomotive Fault Report message Locomotive State Time field is stored as a 7-byte unsigned integer in the format YYYYMMDDHHMMSS where YYYY is 2 bytes in size and MM, DD, HH, MM, SS are each 1 byte in size. In binary coded decimal, the 4 Ys represent the 4 digits of the year, the first two Ms the two digits of the month, the two Ds the two digits of the day, the two Hs the two digits of the hour, the second two Ms the two digits of the minutes, and the two Ss the two digits of the seconds.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use the Locomotive Fault Report (P307) message Locomotive State Time field as the time the locomotive state was sampled.*

3.3.2.8.5.7 Locomotive Fault Report (P307) Message Locomotive State Summary Field, Use Requirements

The Locomotive Fault Report (P307) message Locomotive State Summary field provides the locomotive state summary at the time indicated by the Locomotive Fault Report (P307) message Locomotive State Time field.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall, using the enumeration values given in Table 92, use the Locomotive Fault Report (P307) message Locomotive State Summary field as an indication of the locomotive state.*

3.3.2.8.5.8 Locomotive Fault Report (P307) Message Locomotive State Field, Use Requirements

The Locomotive Fault Report (P307) Locomotive State field is used to provide the operational readiness of the locomotive.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall, using the enumeration values in Table 93, use the Locomotive Fault Report (P307) message Locomotive State field as the operating state of the locomotive at the time shown in the Locomotive Fault Report (P307) message Locomotive State Time field.*

3.3.2.8.5.9 Locomotive Fault Report (P307) Message Number of Components Field, Use Requirements

The Locomotive Fault Report (P307) message Number of Components field provides the number of components associated with the fault being reported, and how many times the Locomotive Fault Report (P307) Component record loop was repeated.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use each instance of the Locomotive Fault Report (P307) message Number of Components field as the number of components about which fault information is being reported.*

b) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall extract one Locomotive Fault Report message Component record for each fault state change indicated by the Locomotive Fault Report message Number of Components field.*

3.3.2.8.5.10 Locomotive Fault Report (P307) Message Component Dynamic Field, Use Requirements

The Locomotive Fault Report (P307) message Component dynamic field provides the numeric code assigned to the component being reported on as provided in the Vendor Component Data Dictionary.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use each instance of the Locomotive Fault Report (P307) message Component field as the numeric code of the corresponding component.*

3.3.2.8.5.11 Locomotive Fault Report (P307) Message Number of Fault State Changes Field, Use Requirements

The Locomotive Fault Report (P307) message Number of Fault State Changes provides the number of components associated with the corresponding fault state change, and the number of times the Locomotive Fault Report (P307) message Fault State Change record loop is repeated.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use each instance of the Locomotive Fault Report (P307) message Number of Fault State Changes dynamic field as the number of fault state changes being provided for the corresponding component.*

b) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall extract one Locomotive Fault Report message Fault State Change record for each fault state change indicated by each instance the Locomotive Fault Report message Number of Fault State Changes field.*

3.3.2.8.5.12 Locomotive Fault Report (P307) Message Fault State Dynamic Field, Use Requirements

The Locomotive Fault Report (P307) message Fault State dynamic field provides the state of the fault in the corresponding component. See Table 94.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall, using enumeration values from Table 94, use each instance of the Locomotive Fault Report (P307) message Fault State dynamic field as an indication of the state of the corresponding fault.*

3.3.2.8.5.13 Locomotive Fault Report (P307) Message Fault Code Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Report (P307) message Fault Code field provides the code for the corresponding fault.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use each instance of the Locomotive Fault Report (P307) message Fault Code dynamic field as an indication of the fault code for the corresponding fault.*

3.3.2.8.5.14 Locomotive Fault Report (P307) Message Length of Fault Name Text Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Report (P307) message Length of Fault Name Text dynamic field provides the length of the corresponding Locomotive Fault Report (P307) message Fault Name Text dynamic field.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use each instance of the Locomotive Fault Report (P307) message Length of Fault Name Text dynamic field as the length of the corresponding Locomotive Fault Report (P307) message Fault Name Text field.*

3.3.2.8.5.15 Locomotive Fault Report (P307) Message Fault Name Text Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Report (P307) message Fault Name Text dynamic field provides a description of the fault as provided in the Vendor Component Data Dictionary for the component shown in the corresponding Locomotive Fault Report (P307) message Component dynamic field.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use each instance of the Locomotive Fault Report (P307) message Fault Name Text field as a description of the corresponding fault.*

3.3.2.8.5.16 Locomotive Fault Report (P307) Message Time Fault Detected Dynamic Field, Use Requirements

Each instance of the Locomotive Fault Report (P307) message Time Fault Detected dynamic fields provides the time at which the fault shown in the Locomotive Fault Report (P307) message Component field changed to the state shown in the Locomotive Fault Report (P307) message Fault State field. The Locomotive Fault Report message Time Fault Detected dynamic field is stored as a 7-byte unsigned integer in the format YYYYMMDDHHMMSS where YYYY is 2 bytes in size and MM, DD, HH, MM, SS are each 1 byte in size. In binary coded decimal, the 4 Ys represent the 4 digits of the year, the first two Ms the two digits of the month, the two Ds the two digits of the day, the two Hs the two digits of the hour, the second two Ms the two digits of the minutes, and the two Ss the two digits of the seconds.

a) *When ITC-ATOSS BO receives a Locomotive Fault Report (P307) message ITC-ATOSS BO shall use each instance of the Locomotive Fault Report (P307) message Time Fault Detected field to report the time at which the corresponding fault changes to its present state.*

3.3.2.8.5.17 Locomotive Fault Report (P307) Message Coordination Number Field, Use Requirements

The Locomotive Fault Report (P307) message Coordination Number field is used according to the process described in Section 3.4.3.

3.4 Message Generation Functions

3.4.1 Data Validity

When a message is generated, the data contained within the message must be valid and up to date, within the constraints of the subsystem generating the message. When a subsystem generates a message, it may also be in the process of calculating new values of which would be included in the message. The subsystem will populate messages with the old values until the new values become available at which point any new messages generated will be populated with the new values.

Some messages include an enumeration value, flag, or other value to indicate the presence of invalid data in a specific field; record loops may have the record set to 0 if valid records cannot be provided. A field is set to indicate invalid data only when the corresponding subsystem requirements allow for it. At all other times, the field is populated with valid data.

a) When an application generates a message, the application shall populate each field in the message with the most recent information available.

3.4.2 Message Numbering

The message number is stored in the EMP header Message Number field and is used to discard duplicate messages and to place each individual message within a sequence. When a session between ITC-ATOSS BO and ITC-PTC BO is established the first message sent of any message type (ID) is set to 0. For the remainder of the session, each new message of the same message type (ID) increments the EMP header Message Number of the previous message number by 1. As described in Section 3.5.1.1.6 the receiving application then discards any message received of which has an EMP header Message Number less than or equal to the EMP header Message Number of the most recently received message of that message type (ID).

The message number is not incremented when a message is resent as part of the reliable messaging process. A new message is not generated; the original is simply retransmitted. This allows the receiving subsystem to discard any duplicate messages if either the transmission infrastructure or the reliable messaging process result in duplicate messages.

a) When an application generates the first message of a specific message type (ID), the application shall set the EMP header Message number field to 0.

b) When an application generates another message of a specific message type (ID), the application shall set the EMP header Message Number field to 1 greater than the EMP header Message Number field of the previous message of the same message type (ID).

3.4.3 Coordination Numbers

Coordination numbers are used to associate replies to the requesting message. When an unsolicited message may trigger a reply, the unsolicited message contains a new coordination number. Every new coordination number must be unique within a session; this includes coordination numbers used in messages of a different type (ID). Each reply contains the coordination number of the message being replied to. This allows association of the reply to the message that triggered the reply even if several messages of the same type were received at the same time.

a) *When an application generates an unsolicited message, and the message contains a coordination number, the application shall set the coordination number to a unique value.*

b) *When an application replies to a message, and the reply contains a coordination number, the application shall set the coordination number of the reply to the coordination number of the message being replied to.*

3.4.4 Reliable Messaging Process

The communication link between ITC-ATOSS BO and ITC-PTC BO is not considered completely reliable. Some messages in this IRS include an application-layer reliable messaging process to ensure message delivery. When a message includes reliable delivery, reliable messaging properties are included in the message description and the message is referred to as a reliable message. The message description will specify the number of retries, the retry interval, and the acknowledge message. The acknowledge message description describes the configuration of the acknowledge message to serve as an ACK or NACK. Some acknowledge messages deliver data in addition to the ACK status; these messages do not have ACK in the message name. Some messages that deliver data in addition to the ACK status may be sent either as an ACK or unsolicited. If a message that may serve as an ACK is sent unsolicited, the ACK status field will include an option to identify unsolicited messages.

If an ACK is not received within the retry interval, or if a NACK is received, the sending application will resend the original message, and again wait for an ACK. This will be repeated until an ACK is received or the retry limit is reached. If the retry limit is reached, and an ACK not received within the retry interval following the last retry, a delivery failure has occurred. Procedures on handling this failure are given in the ITC-ATOSS BO Subsystem requirements document and ITC-PTC BO Subsystem requirements document.

Because the ACK itself may be lost the receiving subsystem must resend the ACK if a duplicate reliable message is received. This may result in multiple ACKs being sent for one message both due to loss of the original ACK and due to message duplication by ITCM. Duplicate ACKs contain the same coordination number and are discarded by the subsystem receiving them.

A NACK is normally generated when a reliable message is discarded by the receiving application. The only case in which discarding a message does not generate a NACK is the reception of a message defined in this IRS from a subsystem not part of the ITC-ATOSS BO-to-ITC-PTC BO interface established during session initialization. Such messages are discarded without a NACK as part of the EMP header source address field verification in Section 3.5.1.1.10. In the requirements below, application, sending application, and receiving application are used as defined in Section 1.5 and refer only to ITC-ATOSS BO and ITC-PTC BO.

A NACK may also be generated if an application is unable to fulfill a request. For example, during system initialization ITC-ATOSS BO may request information from ITC-PTC BO that is not yet available. In such cases the NACK message will indicate the specific failure and will be handled according to the startup procedures.

a) *When an application successfully receives a reliable message from the sending application, and the reliable message is a request which can be fulfilled, the receiving application shall send an ACK in reply.*

b) *When an application successfully receives a reliable message from the sending application, and the reliable message is a request which cannot be fulfilled, the receiving application shall send a NACK indicating that the request cannot be fulfilled.*

c) *If, for any reason other than reception of a duplicate message, a receiving application discards a reliable message from a sending application, the receiving application shall send a NACK in reply.*

d) *If, due to the reception of a duplicate message, a receiving application discards a reliable message from a sending application, the receiving application shall send an ACK in reply.*

e) *When an application sends a reliable message to a receiving application, an ACK is not received within the retry interval, and the number of retries for that message has not been reached, the sending application shall resend the message.*

f) *An application shall not resend a reliable message more than the number of retries specified in the message description.*

g) *When a NACK is received by an application within the retry interval for the message the NACK is in response to, and the number of retries for that message has not been reached, the application shall resend the message.*

h) *When a sending application resends a message to a receiving application, the sending application shall update the EMP header message time field.*

i) *When a sending application resends a message to a receiving application, the sending application shall not alter any fields other than the EMP header message time field.*

j) *When an application generates an ACK then the application shall use the acknowledge message defined for the type of message to which the ACK is in response to.*

k) *When an application generates a NACK then the application shall use the acknowledge message defined for the type of message for which the NACK is in response to.*

l) *When an application generates an acknowledge message then the application shall use the enumeration values given in the ACK status enumeration table for the specific acknowledge message being generated.*

3.4.5 Maximum Messaging Rate

An application must not flood the interface with messages. Sending too many messages too quickly may overload the receiving application or the network. It is assumed that solicited messages, such as ACKs and data requests, will not be solicited at a rate higher than they can be processed. Unsolicited messages of the same message type (ID) are not to be sent at a rate greater than one per TBC-IRS-P2-P3-3 microseconds.

a) *An application shall not send more than one unsolicited message of the same message type (ID) in any interval of TBC-IRS-P2-P3-3 microseconds.*

3.4.6 Data Types

The data type for each field contained within a message is defined in the message body description. When an application generates a message, the application must encode the data in each field using the specified data type. When an application receives a message, the application assumes the data in each field was encoded as the specified data type.

a) *When an application populates a message field, the application shall populate the field with data of the data type specified for the field being populated.*

b) *When an application receives a message, the application shall interpret the contents of each field as being of the data type specified for the specific field being interpreted.*

3.5 Received Message Functions

3.5.1 Message Verification

All messages must be verified before being accepted. Message verification is broken into three categories: EMP header verification, message body verification, and EMP footer verification.

3.5.1.1 EMP Header Verification

Verification of data contained in EMP header fields is a common procedure for all received messages.

3.5.1.1.1 EMP Header Protocol Version Field Verification

Once communication between ITC-ATOSS BO and ITC-PTC BO has been established, both subsystems are expected to consistently use the same version of the EMP. If the EMP header version number changes during a session, an error has occurred, and the contents of the message cannot be trusted.

a) *If ITC-ATOSS BO receives a message from ITC-PTC BO and the EMP header protocol version is not the version established during session initialization, ITC-ATOSS BO shall discard that message.*

b) *If ITC-PTC BO receives a message from ITC-ATOSS BO and the EMP header protocol version is not the version established during session initialization, ITC-PTC BO shall discard that message.*

3.5.1.1.2 EMP Header Message Type (ID) Field Verification

The EMP header message type (ID) field is used to identify the message type (ID), allowing the receiving application to correctly interpret the message.

a) *When a receiving application receives an interoperable message from a sending application, the receiving application shall use the value in the EMP header message type (ID) field as the message type (ID) of the received message.*

b) *If a receiving application receives an interoperable message from a sending application, and the value in the EMP header message type (ID) field does not match any message type (ID) described in this IRS, the receiving application shall discard the message.*

3.5.1.1.3 EMP Header Message Version Field Verification

The IRS version is selected during session initialization as described in section the ITC-PTC BO and ITC-ATOSS Subsystem Requirements documents. Once session initialization is complete, only messages in the active IRS version are accepted.

a) *When the IRS version synchronization procedure has not been completed, an application shall accept any interoperable message regardless of the contents of the EMP message version field.*

b) *When the IRS version synchronization procedure has been completed, an application shall discard any messages for which the EMP header message version field does not match the message version number given in the message description for the received message type (ID).*

3.5.1.1.4 EMP Header Flags Verification

During message verification the receiving application checks the EMP header Flags bits 3 and 4: Data Integrity for conformance with the IRS. The EMP header Flags bits 3 and 4: Data Integrity are treated as a single field storing values ranging from 0 to 3. If the EMP flags are not configured according to the requirements given in Section 3.2.1.4, and the requirements given in the description for the specific message received, the message should be rejected. Requirements for performing a CRC or HMAC check, if needed, are given in Section 3.5.1.3. Messages that do not support data integrity have the EMP footer Data Integrity field set to 0. If the footer is non-zero and no data integrity is specified in the EMP Header Flags field, then an error has occurred.

a) *If an application receives a message for which the message description specifies no data integrity and the EMP header Flags Data Integrity field is not set to 0, the application shall discard the message.*

b) *If an application receives a message for which the message description specifies a CRC and the EMP header Flags Data Integrity field is not set to 1, the application shall discard the message.*

c) *If an application receives a message for which the message description specifies an HMAC and the EMP header Flags Data Integrity is not set to 2, the application shall discard the message.*

d) *If an application receives a message in which the EMP header Flags Data Integrity field is set to 3, the application shall discard the message.*

3.5.1.1.5 EMP Header Data Length Field Verification

If the length of a received message does not match the provided data length, a message should be rejected. For example, if several bytes are lost in transmission, the length of the message will differ from the length given in the EMP header.

a) *If an application receives a message in which the EMP header Data Length field does not match the size, in bytes, of the body of the received message, the application shall discard the message.*

b) *If an application receives a message in which the value in the EMP header Data Length field does not match the size of the message calculated per the message description, the application shall discard the message.*

3.5.1.1.6 EMP Header Message Number Field Verification

The message numbering process is described in Section 3.4.2. If two messages with the same message type (ID) and the same message number are received, then either an error or a duplicate message has occurred, and the duplicate message is discarded. ITCM routing may result in duplicate messages and ITCM requires the receiving application to handle duplicate messages. The reliable messaging process also may result in duplicate messages. To allow for easy identification of duplicate messages, any message with an EMP header Message Number less than or equal to the most recently received message of the same message type (ID) is assumed to be either a duplicate or stale message.

The reliable messaging process described in Section 3.4.4 requires that an ACK be sent for each duplicate message received. This is the only case in which a discarded message may generate an ACK. If message duplication by ITCM results in multiple ACKs being received for a single message the duplicate ACKs will be discarded.

a) *If a receiving application receives a message which has an EMP header Message Number less than or equal to that of prior message with the same message type (ID), then the receiving application shall discard the message.*

3.5.1.1.7 EMP Header Message Time Field Verification

The EMP header message time field should be interpreted according to the EMP header time stamp format flag. A time stamp format flag of 0 indicates relative time, which is the time elapsed since the last message of that type was created. A time stamp format flag of 1 indicates absolute time, which is the UTC time of message creation.

a) *When an application receives a message in which the EMP header Flags bit 0: Time Stamp Format, is set to 1 the application shall interpret the EMP header Message Time field as the UTC time of message creation.*

b) *When an application receives a message in which the EMP header Flags bit 0: Time Stamp Format, is set to 1 the receiving application shall interpret the EMP header Message Time Field as the number of seconds elapsed since midnight, January 1, 1970.*

c) *When the EMP header Flags bit 0: Time Stamp Format, is set to 0 the receiving application shall interpret the EMP header Message Time Field as the number of seconds since the last message of the same type was created by the sending application.*

d) *If an application receives a message in which the EMP header Flags bit 0: Time Stamp Format, is set to 1, and the EMP header Message Time Field indicates that the message is older than TBC-IRS-P2-P3-3 seconds, the receiving application shall discard the message.*

3.5.1.1.8 EMP Header Routing Quality of Service Flags Verification

The QoS flags are used in message routing and do not concern the receiving system.

3.5.1.1.9 EMP Header Time to Live Field Verification

Time to live is used to prevent stale or corrupted messages from flooding the network; it does not concern the receiving system.

3.5.1.1.10 EMP Header Source Address Field Verification

Only messages from the sending application with which the receiving application is communicating should be accepted as part of the communication defined in this IRS. Any messages identified by this IRS, but not sent by the sending application, are assumed to be either erroneous or malicious and are discarded.

a) *If, as part of the Class D link established to support this interface, an application receives a message in which the EMP header source address is not a valid EMP address for the application with which the receiving application is communicating, the message shall be discarded.*

3.5.1.1.11 EMP Header Destination Address Field Verification

An application should only accept messages addressed to it. All other messages should be rejected.

a) *If a receiving application receives a message, and the EMP header destination address is not a valid address for the receiving application, then the receiving application shall discard the message.*

3.5.1.2 Message Body Verification

When an application receives a message, the contents of the message must be checked for compliance with the listed valid ranges. Many fields do not have any range limits and any value of which can fit within the provided data type and size is presumed to be valid. Some fields have restrictions on their valid range and an out-of-range value renders the message invalid. If any fields within a message are out of range the message is invalid and must be discarded. Any range limits placed on fields within a message is listed in a Message Field Ranges table within the message body description.

a) *If an application receives a message containing one or more out-of-range values the application shall discard the message.*

3.5.1.3 EMP Footer Verification

The EMP footer contains a data integrity check value as specified in the EMP header flags Section 3.2.1.4. A data integrity check is performed based on the setting of the data integrity flags. If no data integrity value is provided, the footer is to be set to 0. If the footer is non-zero and the data integrity flags indicate no data integrity check, it is likely that the flag bits themselves were corrupted. The selection of the data integrity check is specified on a message-by-message basis.

a) *If an application receives a message in which the data integrity field is set to zero, and a non-zero value is in the EMP footer, the application shall discard the message.*

b) *When an application receives a message in which the data integrity field is set to 1, the application shall perform a CRC check as specified in S-9354.*

c) *If a message fails a CRC check the application shall discard the failing message.*

d) *When an application receives a message, and the data integrity field is set to 2, the application shall perform an HMAC check.*

e) *If a message fails an HMAC check the application shall discard the failing message.*

4.0 ITC-ATOSS BO & ITC-PTC BO PROCESS DEFINITIONS

Process definitions herein provide an overview of the message flow for common messaging processes. For detailed descriptions and requirements to implement the process refer to the ITC-ATO Concept of Operation, ITC-ATO System requirements, ITC-PTC BO Subsystem Requirements, and ITC-ATOSS BO Segment requirements documentation.

4.1 Polling Process

ITC-ATOSS BO periodically sends an ITC-ATOSS BO to ITC-PTC BO Poll (P200) message to ITC-PTC BO which provides ITC-PTC BO with a list of all ATO trains currently registered with ITC-ATOSS BO. ITC-PTC BO replies with the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message to provide ITC-ATOSS BO with a list of all trains currently registered with ITC-PTC BO and to acknowledge the receipt of the ITC-ATOSS BO to ITC-PTC BO Poll (P200) message.

This polling process serves three purposes:

1) Maintain a keep-alive message exchange between ITC-PTC BO and the ITC-ATOSS BO,
2) Ensure ITC-PTC BO and ITC-ATOSS BO are aware of which trains are currently registered with each BO.
3) Ensure constant sharing of important status information.

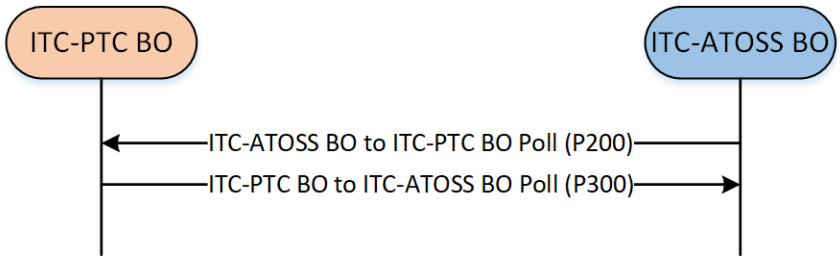

Figure 2: Polling Process Flow Diagram

4.1.1 Poll Message Reliability

The ITC-PTC ATOSS to ITC-PTC BO Poll (P200) is a reliable message and will be resent if an ITC-PTC BO to ITC-ATOSS BO Poll (P300) message is not received in reply. If the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message is lost the ITC-PTC ATOSS to ITC-PTC BO Poll (P200) is resent after the ACK timeout is reached, which will result in the ITC-PTC BO to ITC-ATOSS BO Poll (P300) message being resent.

4.2 ITC-PTC OB Forwarded Messages

ITC-PTC BO forwards a number of messages from each ITC-PTC OB to ITC-ATOSS BO. For every message ITC-ATOSS BO receives from ITC-PTC BO, ITC-ATOSS BO sends a corresponding ACK message according to the Reliable Messaging Process in Section 3.4.4. Forwarding messages from ITC-PTC BO to ITC-ATOSS BO that originated from ITC-PTC OB provides ITC-ATOSS BO with the information that may be needed to manage ATO trains. Communication between ITC-PTC OB and ITC-PTC BO is outside of the scope of this document.

4.2.1 Locomotive System State Process

When ITC-PTC BO receives a Locomotive System State (02010) message from ITC-PTC OB it is forwarded to ITC-ATOSS BO as the Locomotive System State (P301) message. The Locomotive System State (P301) message provides updates describing the current state of the ITC-PTC OB subsystem of a given locomotive. The Locomotive System State (P301) message provides ITC-ATOSS with the following information:

- Railroad SCAC
- IRS version
- Reason for sending
- Time locomotive state was sampled
- Current and previous locomotive state summaries
- Clearance number
- Train ID
- Fault code
- HOT and EOT location, SCAC, and subdivision/district

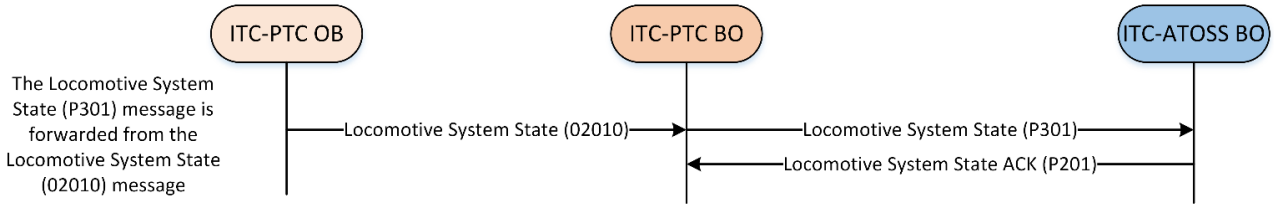

Figure 3: Locomotive System State Flow Diagram

4.2.2 Onboard Violation Report Process

The Onboard Violation Report (P302) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO originally receives the Onboard Violation Report (02070) message from ITC-PTC OB. The Onboard Violation Report (P302) message is sent when the violation occurs and periodically while the violation exists. The Onboard Violation Report (P302) provides ITC-ATOSS with the following information:

- Railroad SCAC
- Violation start time
- HOT and EOT location, SCAC and subdivision/district
- Locomotive information
- Location of the violation

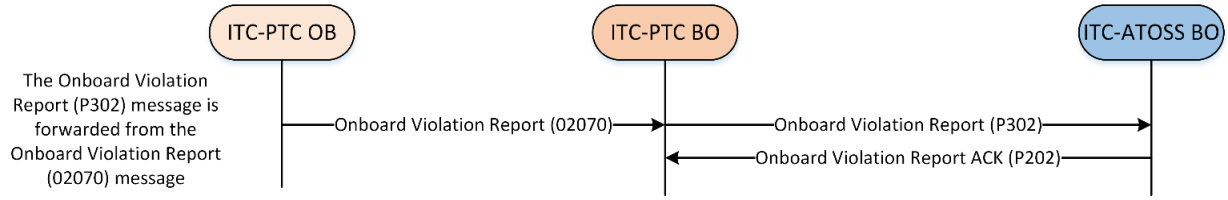

Figure 4: Onboard Violation Report Flow Diagram

4.2.3 Onboard Violation Cleared Process

The Onboard Violation Cleared (P303) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO originally receives the Onboard Violation Cleared (02072) message from ITC-PTC OB, then the Onboard Violation Cleared (P303) message is forwarded to ITC-ATOSS BO. The Onboard Violation Cleared (P303) message is sent from the locomotive to the back office to report when the train is no longer violating its authority. The Onboard Violation Cleared (P3030) message provides ITC-ATOSS BO with the following information:

- Railroad SCAC
- Subdivision/district ID of the point of violation
- Violation start and cleared times
- Locomotive ID

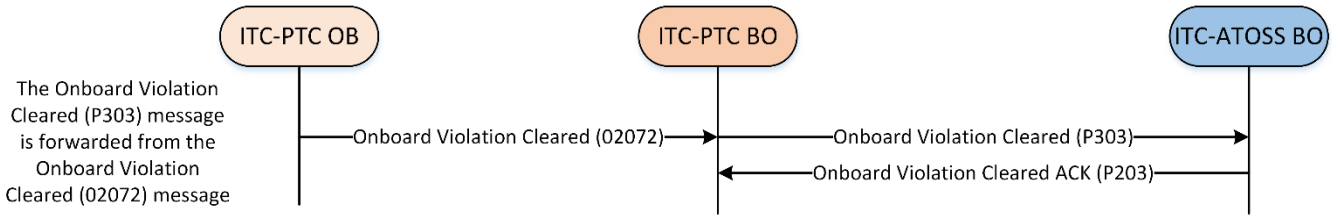

Figure 5: Onboard Violation Cleared Flow Diagram

4.2.4 Locomotive Fault Report Process

The Locomotive Fault Report (P307) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO originally receives the Locomotive Fault Report (02087) message from ITC OB. The Locomotive Fault Report (P307) message is sent to report a change in state for an individual fault. This message is sent unsolicited upon fault change. In order to limit communication network bandwidth usage, a time filter is applied. The Locomotive Fault Report (P307) provides ITC-ATOSS BO with the following information:

- Railroad SCAC
- IRS Version
- Vendor and system codes
- Locomotive state and state summary
- A collection of components involved in the fault
- The fault state, code, name, text, and time for each component

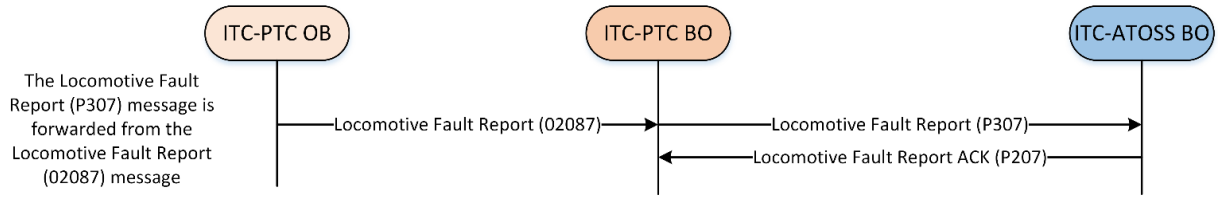

Figure 6: Locomotive Fault Report Flow Diagram

4.2.5 Locomotive Fault Summary Report Process

The Locomotive Fault Summary Report (P304) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO originally receives the Locomotive Fault Summary Report (02081) message from ITC-PTC OB. The Locomotive Fault Summary Report (P304) message is sent from ITC-PTC BO to ITC-ATOSS BO to report any active fault/failure. The Locomotive Fault Summary Report (P304) message provides ITC-ATOSS BO with the following information:

- Railroad SCAC
- IRS Version
- Reason for sending
- Vendor and system code
- A collection of components
- The fault code, name text, and time the fault was detected for every component
- Locomotive state, and state summary

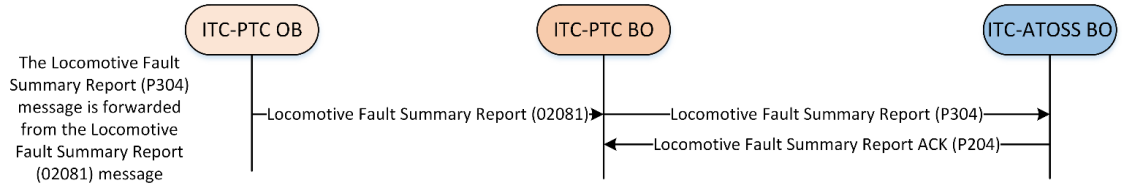

Figure 7: Locomotive Fault Summary Report Flow Diagram

4.2.6 Emergency Brake Application Report Process

The Emergency Brake Application Report (P305) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO originally receives the Emergency Brake Application Report (02084) message from ITC-PTC OB. The Emergency Brake Application Report (02084) message is sent from the locomotive to the back office whenever the train comes to a stop after an emergency brake application occurs. The Emergency Brake Application (P305) message provides ITC-ATOSS BO with the following information:

- Railroad SCAC
- Train ID
- HOT and EOT SCAC, subdivision/district ID and location where emergency breaking started
- Position uncertainty, train direction and train speed when breaking began
- HOT and EOT SCAC, subdivision/district ID and location where emergency breaking stopped
- Position uncertainty, train direction and train speed when breaking stopped
- Brake application type

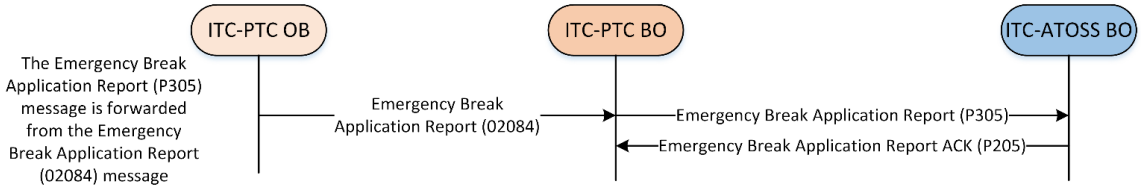

Figure 8: Emergency Break Application Report Flow Diagram

4.2.7 Train Handling Exception Report Process

The Train Handling Exception Report (P306) message is sent by the ITC-PTC BO to the ITC-ATOSS BO. ITC-PTC BO originally receives the Train Handling Exception Report (02085) message from ITC-PTC OB. The Train Handling Exception Report (02085) message is sent from the locomotive to the back office whenever a pre-defined train handling exception is detected. The Train Handling Exception Report (P306) message provides ITC-ATOSS BO with the following information:

- Railroad SCAC
- IRS Version
- Vendor and system code
- Train ID
- HOT and EOT subdivision/district ID, SCAC and location
- Locomotive Speed, position uncertainty, direction, and position
- Train handling exception description

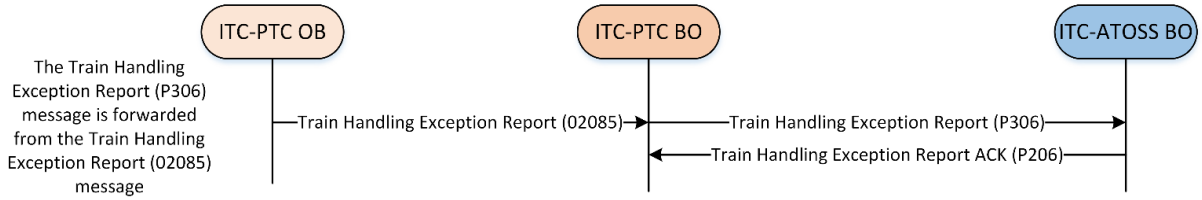

Figure 9: Train Handling Exception Report Flow Diagram

Appendix. Configurable Parameters

Configurable parameters identified in this document are defined in the following tables. Table 95 provides general configurable parameters that are specific to this IRS but not to any one message.

Table 95: General Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-P2-P3-1	Maximum message age		60	s
TBC-IRS-P2-P3-2	Poll rate		10	s
TBC-IRS-P2-P3-3	Minimum time between unsolicited messages of the same type		1,000	µs
TBC-IRS-P2-P3-4	ITC-ATOSS BO Preferred IRS version		1	N/A
TBC-IRS-P2-P3-5	ITC-PTC BO Preferred IRS version		1	N/A
TBC-IRS-P2-P3-6	ITC-ATOSS BO Acceptable IRS version		1	N/A
TBC-IRS-P2-P3-7	ITC-PTC BO Acceptable IRS version		1	N/A

Note: The IRS version range is determined by the 1-byte value provided for transmitting it during version negotiation. When the preferred and acceptable IRS versions are selected, they will be limited to the IRS version numbers available at the time.

Table 96 contains configurable parameters specific to the Class D link established between ITC-PTC BO and ITC-ATOSS BO.

Table 96: Class D Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-P2-P3-CD-1	TCP port for ITC-ATOSS BO to ITC-PTC BO link	1028 to 49150	TBD	N/A
TBC-IRS-P2-P3-CD-2	Log traffic (ITC-ATOSS BO)	Yes/No	No	N/A
TBC-IRS-P2-P3-CD-3	Log traffic (ITC-PTC BO)	Yes/No	No	N/A
TBC-IRS-P2-P3-CD-4	Keep-alive interval	0 to 60,000	60,000	ms
TBC-IRS-P2-P3-CD-5	Keep-alive ACK timeout	0 to 60,000	30,000	ms
TBC-IRS-P2-P3-CD-6	Data ACK enabled	Yes/No	Yes	N/A
TBC-IRS-P2-P3-CD-7	Data ACK timeout	1 to 60,000	30,000	N/A
TBC-IRS-P2-P3-CD-8	Data NACK retry limit	0 to 10	3	retries
TBC-IRS-P2-P3-CD-9	ACK timer delay	Yes/No	No	N/A
TBC-IRS-P2-P3-CD-10	Retransmit delay	0 to 10,000	5,000	ms
TBC-IRS-P2-P3-CD-11	Connection attempt timeout	0 to 60,000	60,000	ms
TBC-IRS-P2-P3-CD-12	Connection delay	0 to 60,000	60,000	ms
TBC-IRS-P2-P3-CD-13	Connection retry limit	-1 to 10,000 (-1=forever)	-1	retries
TBC-IRS-P2-P3-CD-14	Reconnection limit	-1 to 10,000 (-1=forever)	-1	retries

Table 97 contains configurable parameters specific to individual messages generated by ITC-ATOSS BO for transmission to ITC-PTC BO. Parameters which apply to multiple messages are given in Table 95.

Table 97: ITC-ATOSS BO to ITC-PTC BO Message-Specific Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-P200-1	P200 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P200-2	P200 EMP Class	0 to 7	0	N/A
TBC-IRS-P200-3	P200 EMP Priority	0 to 7	4	N/A
TBC-IRS-P200-4	P200 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P200-5	P200 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P200-6	P200 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P201-1	P201 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P201-2	P201 EMP Class	0 to 7	0	N/A
TBC-IRS-P201-3	P201 EMP Priority	0 to 7	5	N/A
TBC-IRS-P201-4	P201 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P201-5	P201 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P201-6	P201 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P202-1	P202 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P202-2	P202 EMP Class	0 to 7	0	N/A
TBC-IRS-P202-3	P202 EMP Priority	0 to 7	7	N/A
TBC-IRS-P202-4	P202 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P202-5	P202 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P202-6	P202 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P203-1	P203 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P203-2	P203 EMP Class	0 to 7	0	N/A
TBC-IRS-P203-3	P203 EMP Priority	0 to 7	7	N/A
TBC-IRS-P203-4	P203 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P203-5	P203 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P203-6	P203 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P204-1	P204 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P204-2	P204 EMP Class	0 to 7	0	N/A
TBC-IRS-P204-3	P204 EMP Priority	0 to 7	4	N/A
TBC-IRS-P204-4	P204 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P204-5	P204 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P204-6	P204 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P205-1	P205 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P205-2	P205 EMP Class	0 to 7	0	N/A
TBC-IRS-P205-3	P205 EMP Priority	0 to 7	4	N/A
TBC-IRS-P205-4	P205 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P205-5	P205 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P205-6	P205 EMP Service Request	0 to 15	0	N/A

TBC	Description	Range	Default	Units
TBC-IRS-P206-1	P206 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P206-2	P206 EMP Class	0 to 7	0	N/A
TBC-IRS-P206-3	P206 EMP Priority	0 to 7	4	N/A
TBC-IRS-P206-4	P206 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P206-5	P206 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P206-6	P206 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P207-1	P207 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P207-2	P207 EMP Class	0 to 7	0	N/A
TBC-IRS-P207-3	P207 EMP Priority	0 to 7	4	N/A
TBC-IRS-P207-4	P207 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P207-5	P207 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P207-6	P207 EMP Service Request	0 to 15	0	N/A

Table 98 contains configurable parameters specific to individual messages generated by ITC-PTC BO for transmission to ITC-ATOSS BO. Parameters which apply to multiple messages are given in Table 95.

Table 98: ITC-PTC BO to ITC-ATOSS BO Message-Specific Configurable Parameters

TBC	Description	Range	Default	Units
TBC-IRS-P300-1	P300 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P300-2	P300 EMP Class	0 to 7	0	N/A
TBC-IRS-P300-3	P300 EMP Priority	0 to 7	4	N/A
TBC-IRS-P300-4	P300 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P300-5	P300 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P300-6	P300 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P300-7	P300 Number of retries	N/A	3	retries
TBC-IRS-P300-8	P300 Retry interval	N/A	3	s
TBC-IRS-P301-1	P301 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P301-2	P301 EMP Class	0 to 7	0	N/A
TBC-IRS-P301-3	P301 EMP Priority	0 to 7	5	N/A
TBC-IRS-P301-4	P301 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P301-5	P301 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P301-6	P301 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P301-7	P301 Number of retries	N/A	3	retries
TBC-IRS-P301-8	P301 Retry interval	N/A	3	s
TBC-IRS-P302-1	P302 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P302-2	P302 EMP Class	0 to 7	0	N/A
TBC-IRS-P302-3	P302 EMP Priority	0 to 7	7	N/A
TBC-IRS-P302-4	P302 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P302-5	P302 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P302-6	P302 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P302-7	P302 Number of retries	N/A	3	retries

TBC	Description	Range	Default	Units
TBC-IRS-P302-8	P302 Retry interval	N/A	3	s
TBC-IRS-P303-1	P303 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P303-2	P303 EMP Class	0 to 7	0	N/A
TBC-IRS-P303-3	P303 EMP Priority	0 to 7	7	N/A
TBC-IRS-P303-4	P303 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P303-5	P303 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P303-6	P303 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P303-7	P303 Number of retries	N/A	3	retries
TBC-IRS-P303-8	P303 Retry interval	N/A	3	s
TBC-IRS-P304-1	P304 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P304-2	P304 EMP Class	0 to 7	0	N/A
TBC-IRS-P304-3	P304 EMP Priority	0 to 7	4	N/A
TBC-IRS-P304-4	P304 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P304-5	P304 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P304-6	P304 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P304-7	P304 Number of retries	N/A	3	retries
TBC-IRS-P304-8	P304 Retry interval	N/A	3	s
TBC-IRS-P305-1	P305 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P305-2	P305 EMP Class	0 to 7	0	N/A
TBC-IRS-P305-3	P305 EMP Priority	0 to 7	4	N/A
TBC-IRS-P305-4	P305 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P305-5	P305 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P305-6	P305 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P305-7	P305 Number of retries	N/A	3	retries
TBC-IRS-P305-8	P305 Retry interval	N/A	3	s
TBC-IRS-P306-1	P306 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P306-2	P306 EMP Class	0 to 7	0	N/A
TBC-IRS-P306-3	P306 EMP Priority	0 to 7	4	N/A
TBC-IRS-P306-4	P306 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P306-5	P306 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P306-6	P306 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P306-7	P306 Number of retries	N/A	3	retries
TBC-IRS-P306-8	P306 Retry interval	N/A	3	s
TBC-IRS-P307-1	P307 EMP Time to Live	0 to 65,535	64	s
TBC-IRS-P307-2	P307 EMP Class	0 to 7	0	N/A
TBC-IRS-P307-3	P307 EMP Priority	0 to 7	4	N/A
TBC-IRS-P307-4	P307 EMP Network Preference	0 to 7	0	N/A
TBC-IRS-P307-5	P307 EMP Special Handling	0 to 15	0	N/A
TBC-IRS-P307-6	P307 EMP Service Request	0 to 15	0	N/A
TBC-IRS-P307-7	P307 Number of retries	N/A	3	retries
TBC-IRS-P307-8	P307 Retry interval	N/A	3	s