

Vehicle-to-Infrastructure (V2I) Safety Applications

System Requirements Document

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Final Report — March 8, 2013

FHWA-JPO-13-061



U.S. Department of Transportation

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16. Abstract This document describes the system requirements for two connected vehicle V2I safety applications related to work zone safety and speed management. Specifically, these applications are: <ul style="list-style-type: none"> • Spot Weather Information Warning (SWIW) • Reduced Speed Zone Warning (RSZW) 					
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Executive Summary

This document describes the System Requirements (SysReq) for two connected vehicle vehicle-to-infrastructure (V2I) safety applications, and the underlying connected vehicle system, for crash avoidance for the U.S. Department of Transportation (USDOT). The SysReq transforms the Connected Vehicle V2I Safety Applications Concept of Operations (ConOps) (100006441-22A) into a set of system requirements for the applications described in the ConOps. The system requirements are focused on functional requirements of the system; performance requirements of the system will be defined later. The SysReq describes the requirements for the system of interest; describes the methods to be used during verification and outlines the verification method for each requirement; and provides traceability to stakeholder needs identified in the ConOps.

This document describes the SysReq for two connected vehicle V2I safety applications related to work zone safety and speed management; these applications are:

- *Spot Weather Information Warning (SWIW)* – Application designed to use standalone weather systems to warn drivers about inclement weather conditions (i.e., fog, wind, adverse surface conditions, etc.) that may impact travel conditions.
- *Reduced Speed Zone Warning (RSZW)* – Application designed to warn drivers of excessive speeds compared with the posted speed limit in reduced speed zones and changed roadway configurations. Reduced speed zones may include school zones, work zones, and populated areas.

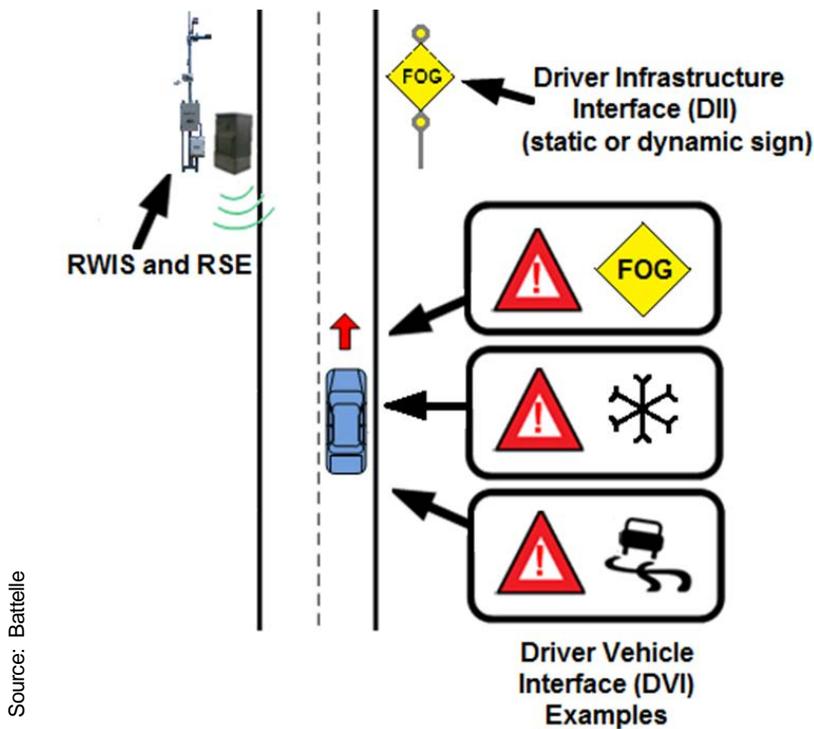
Presently, many infrastructure-based countermeasures or vehicle-autonomous systems have been implemented by public agencies and vehicle OEMs for the purpose of improving safety. These systems, until recently, have not typically integrated these two environments. Integrating data and systems for both roadside infrastructure and the vehicle can provide a richer information set for identifying driving hazards and providing more accurate and timely warnings to drivers of unsafe conditions at an intersection. Connected vehicle systems have the advantage of collecting and sharing real-time data and warnings that are more likely to capture the attention of drivers due to their dynamic nature and improved reliability over static warning signs. As previously discussed, the purpose of this document is to develop the SysReq for two applications that either create new or expand existing safety improvements over the current practice by integrating these infrastructure and vehicle-based technologies.

These safety applications are sub-components of the larger connected vehicle program, which will produce other SysReq documents related to safety, mobility, and the environment. The safety applications in this document complement three V2I safety applications: Red Light Violation Warning (RLVW), Stop Sign Gap Assist (SSGA), and Curve Speed Warning (CSW), which were presented in a separate SysReq document. Other initiatives relevant to the larger USDOT connected vehicle program include the Smart Roadside Initiative, Signal Phase and Timing (SPaT) and Other Related Messages, Transit Connected Vehicles, and more recently the connected vehicle railroad program. This SysReq is limited to describing the expected functionality, operation, and rationale for existence of the two safety applications identified above.

Following is a brief description and graphical illustration of each of the applications in this SysReq.

Spot Weather Information Warning (SWIW)

The objective of SWIW is to provide a cooperative vehicle and infrastructure system that assists drivers in avoiding crashes in areas prone to adverse weather impacts by warning the vehicle driver that a crash-imminent situation is possible, particularly in extreme situations where precautions are not taken, such as reducing speed or seeking an alternate route. The infrastructure application will collect available infrastructure and vehicle data, most importantly from Road Weather Information Systems (RWIS) and process available data to recommend an appropriate advisory message, alert, and/or warning. Depending upon the availability of data for validation (e.g., redundant RWIS data source, traffic speeds, etc.), validation of the recommended message may be required from a back office traffic management center (TMC) before the message is posted on the Driver-Infrastructure Interface (DII). An equipped vehicle approaching an equipped roadway segment will receive a message that includes data regarding the message posted on DII; length of adverse weather impact zone [throughout which the driver-vehicle interface (DVI) message should apply]; weather data collected by RWIS; and, if available, the advisory, enforceable speed, and/or diversion to an alternate route as recommended by the infrastructure application. The driver is issued an advisory message, alert, or warning if the vehicle processing platform determines that, given current operating conditions, a crash-imminent situation is likely to occur due to the weather impacts, and notifies the driver if reduced speed or an alternate route is recommended. Figure ES-1 illustrates the proposed SWIW application design.



Source: Battelle

Figure ES-1. SWIW Illustration

Reduced Speed/Work Zone Warning (RSZW)

The objective of the RSZW is to provide a cooperative vehicle and infrastructure system that helps drivers avoid crashes in reduced speed zones by warning the driver that they are operating at a speed higher than the zone's posted speed limit and/or by providing information regarding changes in roadway configuration (e.g., lane closures, lane shifts), particularly for a crash imminent scenario requiring a lane change. An equipped vehicle approaching a reduced speed zone is issued an alert (and if necessary a warning) if the vehicle application determines that, the driver is at risk of an incident based on current speed and/or changes in the roadway. Similarly, an unequipped vehicle is issued an alert (and if necessary a warning) if the infrastructure application determines that, the driver is at risk of an incident. Figure ES-2 summarizes the proposed RSZW application design.

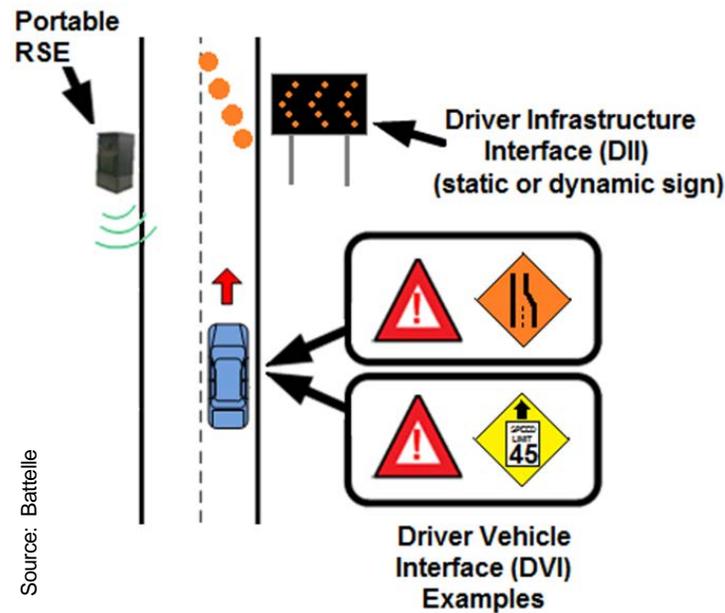


Figure ES-2. RSZW Illustration

Application Benefits

The most significant operational impact of these applications is their effect on increased roadway safety. Expected benefits include:

- Reductions in the number of roadway fatalities
- Reductions in the number and severity of roadway injuries
- Reductions in property damage associated with roadway incidents
- Reductions in the number of near-miss intersection conflict and run-off-road (ROR) incident scenarios.

Additional benefits may include:

- The development of a safety warning system that is deployable nationwide and found to be acceptable, understood, and useful to users, so as to elicit timely and appropriate driver response
- The development of a connected vehicle environment in which emerging technologies can utilize existing infrastructure to enhance safety benefits (eventually incorporating V2V concepts)
- The deployment of technology systems to establish a foundation of communication and technologies that will bridge the gap between current roadway safety conditions with non-equipped vehicles and a saturated connected vehicle environment
- Continued promotion of the institutional relationship between the public (e.g., U.S., state, and local DOTs) and private sectors (e.g., vehicle manufacturers) to further promote transportation safety.

Document Organization

The SysReq includes the following key descriptions and discussions pertinent to V2I safety applications for intersection and roadway safety:

- Section 2 (Referenced Documents) describes the external documentation referenced throughout this document.
- Section 3 (Requirements) describes the requirements for the system of interest.
- Section 4 (Verification) describes the methods to be used during verification and outlines the verification method for each requirement.
- Section 5 (Notes) provides traceability to stakeholder needs, definitions for terms, acronyms, and abbreviations used throughout the document.

1.0 Scope

This document describes the System Requirements (SysReq) for selected connected vehicle vehicle-to-infrastructure (V2I) safety applications for crash avoidance for the U.S. Department of Transportation (USDOT). This document transforms the Connected Vehicle Safety Concept of Operations Document (ConOps) (100006441-22) into a set of system requirements for two of applications described in the ConOps based on the recommendation and priorities of USDOT. The system requirements are focused on functional requirements of the system. Performance requirements of the system are not included and will be defined later. The description of the system of interest is located in Section 3.1. This document has been written with the assumption that the reader possesses a general knowledge associated with connected vehicles and the associated infrastructure surrounding connected vehicles.

This document describes the system requirements for two connected vehicle V2I safety applications related to intersection and roadway safety. Specifically, these applications include:

- Spot Weather Information Warning (SWIW)
- Reduced Speed Zone Warning (RSZW)

These safety applications are sub-components to the larger connected vehicle program which expects to produce other ConOps documents related to safety and mobility applications. This SysReq is restricted to describing the expected functionality, operation, and rationale of the two safety applications identified in the bulleted list above.

1.1 Document Overview

The intended audience of this SysReq document includes: application developers, wireless and ITS equipment OEMs, State and local DOTs, and USDOT connected vehicle program managers who are managing the safety applications work.

The remainder of this document consists of the following sections and content:

Section 2 (Referenced Documents) describes the external documentation referenced throughout this document.

Section 3 (Requirements) describes the requirements for the system of interest.

Section 4 (Verification) describes the methods to be used during verification and outlines the verification method for each requirement.

Section 5 (Notes) provides traceability to stakeholder needs, definitions for terms, acronyms, and abbreviations used throughout the document.

2.0 Referenced Documents

The following documents form a part of this document to the extent specified herein.

U.S. Department of Transportation

DOT HS 810 697	Crash Warning System Interfaces: Human Factors Insights and Lessons Learned, Final Report (2007)
DOT HS 811 492A	Vehicle Safety Communications – Applications Final Report (2011)
FHWA-RD-03-065	In-Vehicle Display Icons and Other Information Elements, Volume I: Guidelines (2004)
FHWA–RD–98–057	Human Factors Design Guidelines for Advanced Traveler Information Systems (ATIS) and Commercial Vehicle Operations (CVO) (1998)
MUTCD-09	Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 edition National ITS Architecture, Version 7.0 Core System : System Architecture Document (SAD) – Sept. 2011
FHWA/TX-04/0-4475-1	Rose, Elisabeth R. and Ullman, Gerald L. (2003). Evaluation of Dynamic Speed Display Signs (DSDS).
FHWA-JPO-13-060	Concept of Operations for Vehicle-to-Infrastructure (V2I) Safety Applications Traffic Monitoring Guide, May 2001,

Battelle Drawings/Documents

100006441-001	Project Management Plan for Connected Vehicle Safety Concept of Operations
100006441-004	Systems Engineering Management Plan (SEMP) for Connected Vehicle Safety Concept of Operations

Society of Automotive Engineers (SAE)

J2735	Dedicated Short Range Communications (DSRC) Message Set Dictionary (revised 2009)
J1939	Recommended Practice for a Serial Control and Communications Vehicle Network

Institute of Electrical and Electronics Engineers (IEEE)

- | | |
|-------------------|--|
| 1220-2005 | IEEE Standard for Application and Management of the Systems Engineering Process |
| 1362-1998 (R2007) | IEEE Standard for Information Technology – System Definition – Concept of Operations (ConOps) Document |

American Association of State Highway and Transportation Officials (AASHTO)

- | | |
|----------------|---|
| The Green Book | A Policy on Geometric Design of Highways and Streets, 6 th edition. 2011 |
|----------------|---|

American Society of Civil Engineers (ASCE)

- | | |
|------------------------|---|
| ISBN 978-0-7844-0457-7 | Structural Design for Physical Security. Task Committee; Structural Engineering Institute (1999). |
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2.1 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document however supersedes applicable laws and regulations unless a specific exemption has been obtained.

3.0 Requirements

3.1 System Description

This project is sponsored by the USDOT and has a goal of supporting the development and implementation of connected vehicle V2I safety applications. As part of this implementation, the USDOT identified roadway safety priorities for V2I safety applications. The general framework for the connected vehicle V2I safety applications is shown in Figure 3-1. As shown, it includes both vehicle and infrastructure (roadside) application platforms that house the roadside and vehicle components of the V2I applications respectively. This same figure also shows external inputs into the system. The Vehicle Application Platform may utilize vehicle data available through the On Board Diagnostic version 2 (OBD-II) and Controller Area Network (CAN) networks for use by the applications. The Infrastructure Application Platform collects roadside data such as road weather information for use by applications. Diagrams specific to individual safety applications are presented later in this document.

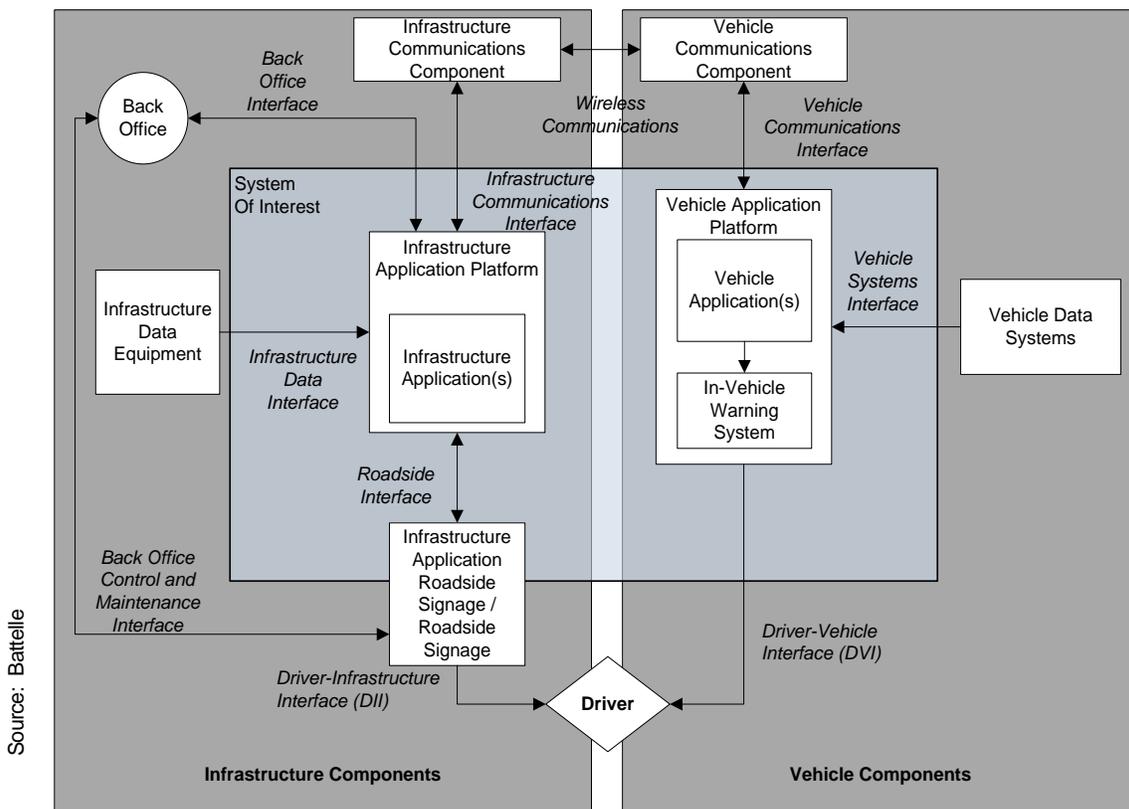


Figure 3-1. General Framework for Connected Vehicle V2I Safety Applications

As shown in Figure 3-1 there many components which make up the System-of-Interest (SOI) and supporting components. These components include:

- System-Of-Interest Components
 - Infrastructure Applications Platform
 - Infrastructure Application(s)
 - Vehicle Application Platform
 - Vehicle Application(s)
 - In-Vehicle Warning System
- Infrastructure Application Roadside Signage Supporting Components
 - Infrastructure Communications Component
 - Vehicle Communications Component
 - Back Office
 - Infrastructure Data Equipment
 - Roadside Signage
 - Driver
 - Vehicle Data Systems
- Interfaces
 - Back Office Interface
 - Infrastructure Data Interface
 - Infrastructure Communications Interface
 - Roadside Interface
 - Driver-Infrastructure Interface (DII)
 - Wireless Communications
 - Vehicle Communications Interface
 - Vehicle Systems Interface
 - Driver-Vehicle Interface

Infrastructure Application Platform

The Infrastructure Application Platform will exchange data with the Infrastructure Communications Component, accept information from the Infrastructure Data Equipment, host the infrastructure-based safety application(s), and communicate with the Roadside Signage/Traffic Signal.

Infrastructure Application(s)

The Infrastructure Application(s) is the infrastructure component of the safety application(s). This contains the infrastructure-based algorithm for one or more of the safety applications.

Vehicle Application Platform

The Vehicle Application Platform will exchange data with the Vehicle Communications Component, accept information from the Vehicle Data Systems, host the vehicle-based safety application, and communicate with the In-Vehicle Warning System.

Vehicle Application(s)

The Vehicle Application(s) is the vehicle component of the safety application(s). This contains the vehicle-based algorithm for one or more of the safety applications.

In-Vehicle Warning System

The In-Vehicle Warning System is the necessary equipment that will provide the indication of a safety application alert and/or warning to the driver. Typically, the indication will be aural and/or visual; however, alternate indications such as haptic warnings may be provided. When multiple safety applications are hosted on the Vehicle Applications Platform, the In-Vehicle Warning System will prioritize alerts and warnings from the multiple safety applications. Note: The placement of the In-Vehicle Warning System shown in Figure 3-1 is intended to show representative functionality and is not meant to restrict implementation.

Infrastructure Application Roadside Signage

The Infrastructure Application Roadside Signage provides infrastructure application specific information to both equipped and non-equipped connected vehicles. This is intended to be an enhancement to the existing Roadside Signage. See Roadside Signage description below.

Infrastructure Communications Component

The Infrastructure Communications Component provides the Infrastructure Application Platform a means to communicate with a Connected Vehicle's Vehicle Communications Component.

Vehicle Communications Component

The Vehicle Communications Component provides the Vehicle Application Platform a means to communicate with an equipped Infrastructure Communications Component.

Back Office

The Back Office represents a system that is located remote or on-site to the Infrastructure and is used by the operator of the Infrastructure Components. The Back Office may be an optional system due to cost constraints of the maintainer of the infrastructure. However, the Back Office system could be used to help facilitate the collection of diagnostic data from the Infrastructure Application. The Back Office may also provide a means to supply dynamic (current) data to the Infrastructure Application or even a remote mechanism for updates to the Infrastructure Application.

Infrastructure Data Equipment

Infrastructure Data Equipment represents equipment that provides infrastructure information to the Infrastructure Application. Some examples may include: Weather Information, Surface Conditions, Visibility, and Vehicle Detection and Speed.

Roadside Signage

An integral part of the infrastructure interface with the driver is the Roadside Signage. For the Infrastructure Application, there may be a need for an application specific addition or enhancement to the Roadside Signage. The Infrastructure Application Roadside Signage component provides application specific information. The Infrastructure Application Roadside Signage / Roadside Signage provides information capabilities for both equipped and non-equipped connected vehicles.

Driver

The Driver is the user of the safety application. The interface to the driver may convey information such as alerts, advisories, and warnings from the infrastructure and/or the vehicle.

Vehicle Data Systems

The Vehicle Data Systems represent systems contained within the vehicle that provide vehicle related information to the Vehicle Application. Information provided may come from a positioning system, vehicle data bus, sensors, actuators on the vehicle, or stability systems. Specific interfaces to the OEM vehicle systems will be dependent on specific information required to support the safety application.

Back Office Interface

The Back Office Interface is an optional interface that may be implemented when a Back Office is present. This interface may be used to support one or more functions between the Infrastructure Applications Platform such as maintenance, installation, system updates, and/or data validation.

Infrastructure Data Interface

The Infrastructure Data Interface is the interface between the Infrastructure Application Platform and the Infrastructure Data Equipment. The Infrastructure Application Platform interfaces with equipment within the Infrastructure to receive information such as Weather Information, Surface Conditions, Visibility, Vehicle Detection, Signal Phase and Timing.

Infrastructure Communications Interface

The Infrastructure Communications Interface is the interface between the Infrastructure Application Platform and the Infrastructure Communications Component. This interface is used by the Infrastructure Applications Platform to transmit and receive information to nearby equipped vehicles.

Roadside Interface

The Roadside Interface is the interface between the Infrastructure Applications Platform and the Roadside Signage. The Infrastructure Applications Platform transmits information, via the Roadside Interface, to the Infrastructure Application Roadside Signage / Roadside Signage regarding advisories, alerts/warnings that need to be displayed to the driver.

Driver-Infrastructure Interface (DII)

The Driver-Infrastructure Interface is the interface between the Roadside Signage and the Driver. This interface is used to provide information indicated by the Roadside Signage to the Driver which may include status of application and any alerts/warnings.

Wireless Communications Interface

The Wireless Communications Interface is the interface between the Infrastructure Communications Component and the Vehicle Communications Component.

Vehicle Communications Interface

The Vehicle Communications Interface is the interface between the Vehicle Application Platform and the Vehicle Communications Component. This interface is used by the Vehicle Applications Platform to transmit information to and receive information from nearby equipped Infrastructure.

Vehicle Systems Interface

The Vehicle Systems Interface is the interface between the Vehicle Application Platform and the Vehicle Data Systems. The Vehicle Application Platform interfaces with equipment within the vehicle to receive such information as Position, Speed, Acceleration, and Heading.

Driver-Vehicle Interface (DVI)

The Driver-Vehicle Interface is the interface between the Vehicle Applications Platform and the Driver. This interface is used to provide information from the Vehicle Applications Platform to the Driver which may include status of application and any alerts/warnings.

Back Office Control and Maintenance Interface

The Back Office Control and Maintenance Interface is the interface between the Back Office or Local On-site operator and the Infrastructure Application Roadside Signage. This interface may be used to support one or more functions such as maintenance, installation, system updates, and/or data validation. When the Back Office is not included in the application, this interface would support a Local On-site operator.

3.1.1 System of Interest – Spot Weather Information Warning Application

Figure 3-2 presents an overview of the SWIW application, and mirrors the general framework diagram presented in Figure 3-1. The overview is illustrated in terms of both infrastructure and vehicle components.

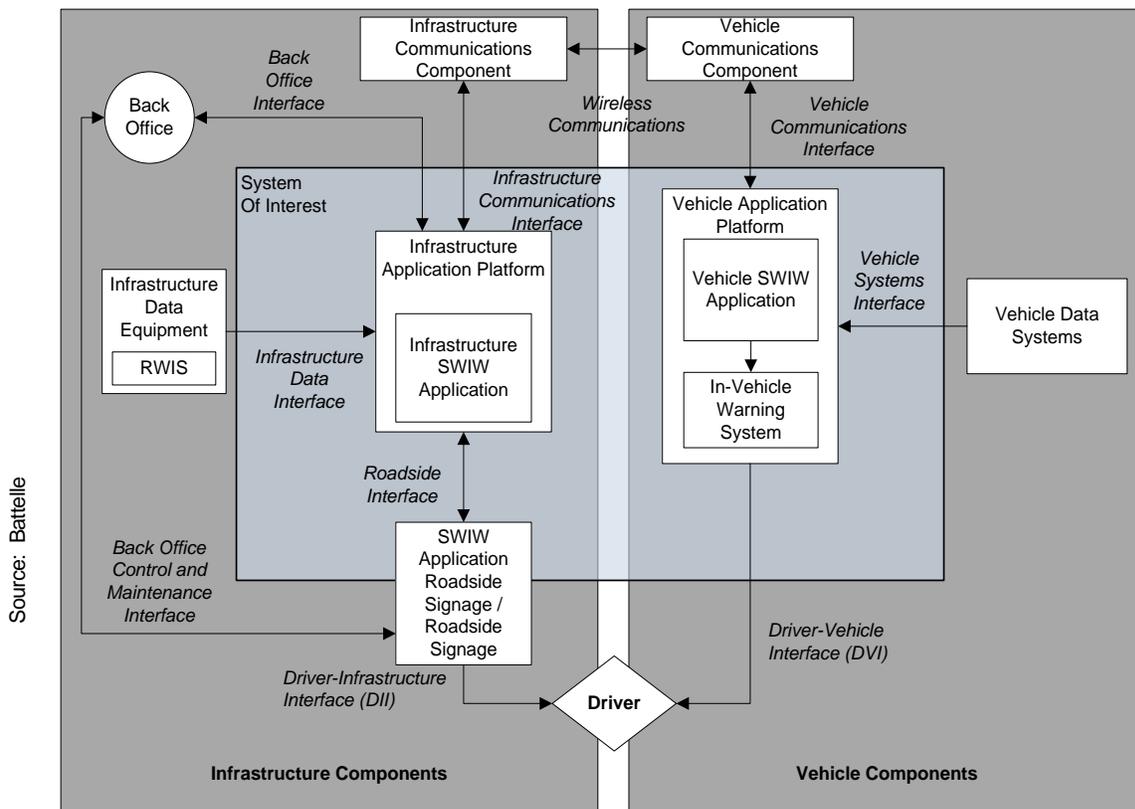


Figure 3-2. Spot Weather Information Warning Application Diagram

The limiting factor in the capabilities of the SWIW application is the availability and coverage of Environmental Sensor Station (ESS) data. The application utilizes available Road Weather Information Systems (RWIS) data from ESS specific to the condition(s) being measured at a given site. Sensors could detect low visibility due to fog or smoke; surface conditions, such as wet or icy pavement; flooding; and high winds that would affect traffic, particularly commercial vehicles. Data required by the infrastructure application for the determination of advisory messages, alerts or warnings would necessarily vary for each of these weather impacts. At a minimum, visibility sensors would be required to detect low visibility; various instruments to monitor surface conditions might include a rain gauge, thermometer, and pavement sensors; flood gauges to monitor stream levels for flooding concerns; and anemometers to monitor for high wind speeds. Other relevant traffic data might include detection of vehicle speeds to be used for suggestions of reduced advisory or enforceable speeds, and/or validation of weather impacts to current traffic conditions. Due to potential reliability concerns with RWIS and the need for minimal false alarms, the availability of a Back Office Traffic Management Center (TMC) and/or traffic data for validation purposes is essential to determine when the application should transmit an advisory message, alert, or warning. When a Back Office TMC is not available, other means for data validation may be selected (e.g. secondary independent sensor-based comparisons). Data available from other connected vehicle equipped vehicles to be used by the application may include temperature and vehicle telematics data (e.g., speed, windshield wiper status, application of traction control). When unsafe conditions are detected and validated, an advisory message, alert, or warning is provided to the driver via available DII and/or DVI. Depending upon the nature of the weather impact, the message may include recommendation for reduced speed or diversion via an alternate route.

3.1.2 System of Interest – Reduced Speed Zone Warning Application

Figure 3-3 presents an overview of the RSZW application, and mirrors the general framework diagram presented in Figure 3-1. The overview is illustrated in terms of both infrastructure and vehicle components.

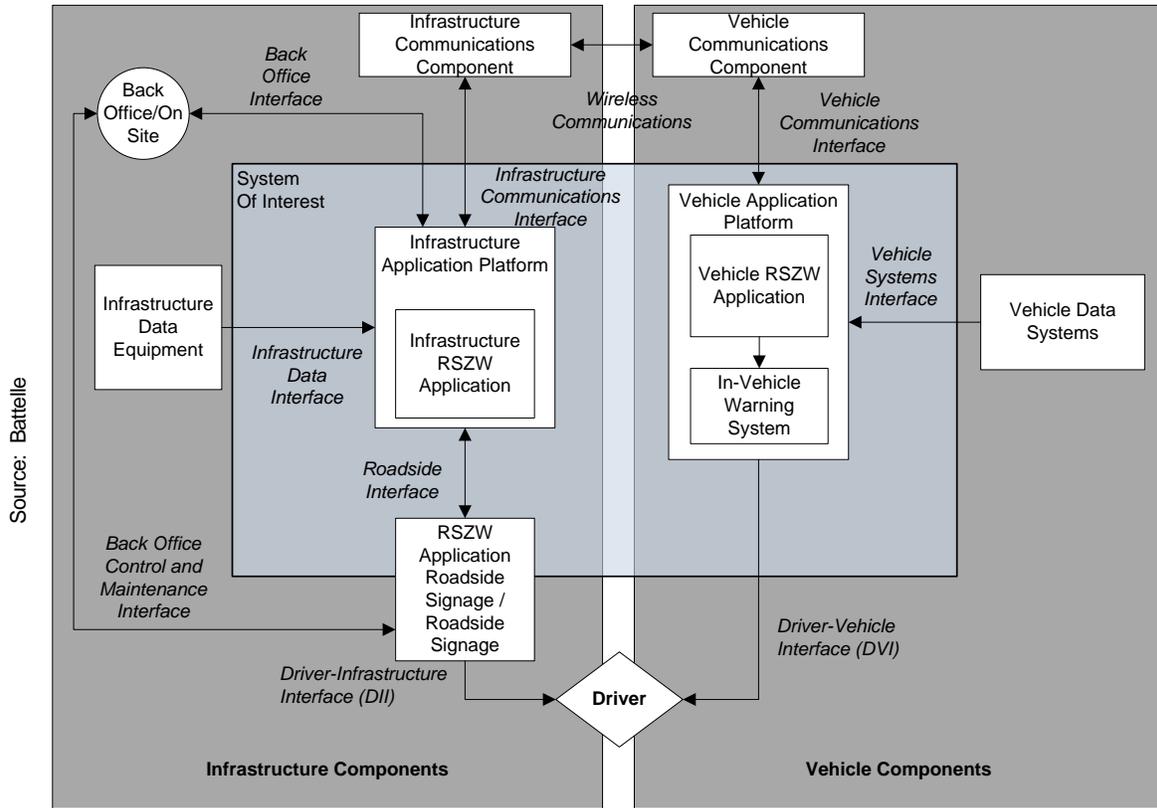


Figure 3-3. Reduced Speed Zone Warning Application Diagram

The RSZW application¹ is used for speed management in reduced speed zones (e.g., school zones) and reduced speed and changing roadway configuration zones (e.g., work zones). In the case of reduced speed zones, the application uses speed measurements taken by the roadside infrastructure and transmits it to the vehicle to determine whether an alert/warning is necessary. In the case of a reduced speed and changing roadway configuration zone, both speed measurements and changed roadside configuration information are provided to the vehicle by the roadside infrastructure.

The RSZW application works when the infrastructure data equipment detects and measures the speed of an approaching vehicle and sends this information along with the reduced speed zone posted speed limit and current DII signage to the approaching vehicle. In the case of a work zone, roadway configuration and geometry information are also provided to the approaching vehicle. The vehicle application utilizes the data provided, along with its own system data (vehicle speed and vehicle position), to determine whether the vehicle needs to slow down. If deemed necessary, the driver is alerted and/or warned. In the case of a work zone, roadside configuration information is always presented to the driver, regardless of the need for a speed-related alert/warning.

¹ For this application, Work Zone is considered a special case of the reduced speed zone warning. It includes configuration information as well as reduced speed. For a detailed description of both the general case and work zone specific case, see *Vehicle-to-Infrastructure (V2I) Safety Applications: Concept of Operations Document, Final Report, March 8, 2013, FHWA-JPO-13-060*

3.2 Common Requirements

The following list of requirements have been identified as being common to the two applications (RSZW, SWIW) documented in this Systems Requirements document.

Flexibility of System to Range of Drivers and Driver Capabilities

[SYS-REQ-401] The safety application shall support all drivers capable of obtaining a license. (UN-COM-001)

Affected Infrastructure

[SYS-REQ-402] The safety application shall complement and augment existing infrastructure. (UN-COM-002)

Affected Vehicles

[SYS-REQ-403] The safety application shall function for defined vehicle classes and types. (UN-COM-023)

Environmental Conditions

[SYS-REQ-404] The safety application shall not be affected by TBD weather (pavement and atmospheric) and lighting conditions. (UN-COM-003)

Performance Location

[SYS-REQ-405] The safety application shall function on public roadways where required resources for the application exist. (UN-COM-004)

Vehicle Position Accuracy

[SYS-REQ-406] The vehicle position provided to the Vehicle Application shall support lane-specific alerts and/or warnings, as warranted. (UN-COM-005)

Interoperability with other On-Board Systems

[SYS-REQ-407] The safety application shall not preclude interoperability and integration with onboard safety systems. (UN-COM-006)

False/Missed Alarms

[SYS-REQ-408] Infrastructure data shall support an application's probability of false alarm (Pfa) of less than {TBD}. (UN-COM-007)

[SYS-REQ-409] Infrastructure data shall support an application's probability of missed alarm (Pma) of less than {TBD}. (UN-COM-007)

Consideration of Human Factors

[SYS-REQ-410] The safety application alerts and/or warnings shall conform to human factors guidelines issued by the FHWA, NHTSA, and SAE. (UN-COM-008)

Self-Diagnostics (Infrastructure)

[SYS-REQ-411] The Infrastructure Application Platform shall perform self-diagnostics upon power up and at periodic predetermined intervals. (UN-COM-009)

[SYS-REQ-412] The Infrastructure Application shall determine the operating level/mode of operational, degraded, or failure based on the results of a self-diagnostic test. (UN-COM-009)

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Intelligent Transportation System Joint Program Office

[SYS-REQ-413] The Infrastructure Application shall set the operational status corresponding to the operational level mode as follows:

1. Operational – online
2. Degraded – online
3. Failure – offline

(UN-COM-009)

[SYS-REQ-414] The Infrastructure Application shall log self-diagnostic test information which contains, at a minimum, the following information:

1. Online/Offline status (set to offline if infrastructure application cannot perform its intended function)
2. Self-diagnostic test information
 - a. Date and time of test
 - b. Result of test (Pass/Fail)
 - c. Additional information to the nature of a failed test including but not limited to the particular infrastructure component.

(UN-COM-009, UN-COM-010)

[SYS-REQ-415] The Infrastructure Application shall maintain historical information of self-diagnostic tests for a predetermined period in non-volatile storage. Non-volatile storage refers to storage that remains intact even when there is no power. (It is left up to the implementer to determine if the retention of data is a fixed window of time or if it is based on a fixed amount of storage.) (UN-COM-009)

[SYS-REQ-416] The Infrastructure Application shall take itself off-line when a self-diagnostic test has failed. (UN-COM-009)

[SYS-REQ-460] When possible, the infrastructure application shall communicate this status to the vehicle, DII, and corresponding infrastructure. (UN-COM-009)

[SYS-REQ-417] The Infrastructure Application shall restore or maintain itself on-line when self-diagnostic tests are passed or when the Infrastructure Application is found to be degraded. (UN-COM-009)

[SYS-REQ-418] (Optional) The Infrastructure Application may report operational status to the Back Office, when Back Office is present, at predetermined periodic intervals. (UN-COM-010)

[SYS-REQ-420] The Infrastructure Application Platform and Infrastructure Application shall not present inaccurate or misleading information to the driver in the event of a malfunction within the Infrastructure Application Platform or Infrastructure Application. (UN-COM-009)

Maintenance

[SYS-REQ-419] The Infrastructure Components of the Application Platform shall provide a maintenance interface to facilitate installation, configuration, upgrades, diagnostics, and maintenance of the Infrastructure Application. (UN-COM-022)

Self-Diagnostics (Vehicle)

[SYS-REQ-421] The Vehicle Application Platform shall perform self-diagnostics upon power up and at periodic intervals when the vehicle is operating. (UN-COM-009)

[SYS-REQ-422] The Vehicle Application shall determine the operating level/mode of operational, degraded, or failure based on the results of a self-diagnostic test. (UN-COM-009)

[SYS-REQ-423] The Vehicle Application shall set the operational status corresponding to the operational level mode as follows:

1. Operational – online
2. Degraded – online
3. Failure – offline

(UN-COM-009)

[SYS-REQ-424] The Vehicle Application shall log self-diagnostic test failure which contains, at a minimum, the following information:

1. Date and time of test failure
2. Additional information to the nature of a failed test

(UN-COM-009)

[SYS-REQ-425] The Vehicle Application shall maintain historical information of self-diagnostic test failures for a predetermined period in non-volatile storage. Non-volatile storage refers to storage that remains intact even when there is no power. (It is left up to the implementer to determine if the retention of data is a fixed window of time, if it is based on a fixed amount of storage, if it is until cleared.) (UN-COM-009)

[SYS-REQ-426] The Vehicle Application shall take itself off-line when a self-diagnostic test has failed. When possible, the vehicle application must communicate this status to the driver. (UN-COM-009)

[SYS-REQ-427] The Vehicle Application shall restore or maintain itself on-line when self-diagnostic tests are passed or when the Infrastructure Application is found to be degraded. (UN-COM-009)

Impact of Unauthorized Physical Access

[SYS-REQ-428] The Vehicle Application shall be disabled if physical tampering is detected. (UN-COM-014)

[SYS-REQ-429] The Infrastructure Components shall provide physical protection from access. (UN-COM-014)

[SYS-REQ-458] The Infrastructure Application shall be disabled if physical tampering is detected. (UN-COM-014)

Notification of Invasion

[SYS-REQ-430] The Vehicle and Infrastructure Components shall allow owners/operators of the respective components to identify that unauthorized physical access has occurred. (UN-COM-015)

[SYS-REQ-431] Deleted and combined with SYS-REQ-430

Communications Security

[SYS-REQ-432] The wireless communications link shall have communications security to ensure the authenticity of all its messages in accordance to the standards prescribed by the overall USDOT connected vehicle program. (UN-COM-016)

Connected Vehicle Security Performance

[SYS-REQ-433] The message authentication for Infrastructure Communications and Vehicle Communications wireless link shall be fast enough to support the objectives of the safety application. (UN-COM-017)

System Upgrades

[SYS-REQ-434] Vehicle and infrastructure component and application upgrades shall be compatible with and not adversely impact the performance of previous versions of the components and applications. (UN-COM-018)

Class of Roadway

[SYS-REQ-435] The Vehicle and infrastructure application shall function for all defined functional classes of roadway and levels of service (LOS) where the application is installed or is being used. {Note: The defined functional classes of roadways can be found in FHWA's "Functional Classification Guidelines". The defined LOS can be found in AASHTO's "A Policy on Geometric Design of Highways and Streets".} (UN-COM-019)

Interoperability with other Infrastructure Systems

[SYS-REQ-436] The application system shall be interoperable and support integration with current infrastructure based safety systems, with other future connected vehicle-enabled systems, and other future infrastructure based safety systems. (UN-COM-020)

Issuance of Alerts and/or Warnings

[SYS-REQ-437] The infrastructure safety application alerts and/or warnings shall only be issued when the current inputs to the application warrant an alert or warning. (UN-COM-021)

[SYS-REQ-438] The vehicle safety application alerts and/or warnings shall only be issued when the current inputs to the application warrant an alert or warning. (UN-COM-024)

Priority of Alerts and/or Warning

[SYS-REQ-439] The vehicle safety application platform shall include a threat arbitrator for alerts/warnings presented to the driver in cases where multiple safety alerts/warnings are indicated simultaneously. (UN-COM-024)

Infrastructure Maintenance

[SYS-REQ-440] Roadside infrastructure shall be maintained by the infrastructure owner/operator. {The infrastructure owner/operator may designate a third-party to maintain the roadside infrastructure acting on their behalf.} (UN-COM-022, OP-COM-08)

[SYS-REQ-459] The Infrastructure Applications Platform shall be maintained by the designated personnel. (OP-COM-08)

Driver-Infrastructure Interface

[SYS-REQ-441] The Infrastructure Application shall provide indication to the driver via the roadside signage/DII when the Infrastructure Application is not working (i.e. online/offline). (OP-COM-02)

[SYS-REQ-442] The Safety Application Roadside Signage shall provide advisory messages, alerts, and/or warnings to drivers of equipped and non-equipped vehicles. (OC-COM-01, OC-COM-03)

Driver-Vehicle Interface

[SYS-REQ-443] The Vehicle Application shall provide indication to the driver when the Vehicle and/or Infrastructure Applications are not working (i.e. online/offline). (OP-COM-02)

[SYS-REQ-444] The Safety Application DVI shall follow industry-accepted human factor guidelines to minimize the amount of driver training for using the application. (OP-COM-06)

[SYS-REQ-445] The Application DVI shall not conflict with what was sent and displayed on the Application DII. (OC-COM-02, OC-COM-03)

[SYS-REQ-446] The Vehicle Application shall not provide information conflicting with that of infrastructure roadside signage (e.g. non-equipped infrastructure) {Note: There are a limited number of and limited locations for roadside infrastructure. Due to restricted financial resources, State and local DOTs, and private partners, in cooperation with the USDOT, must determine the number of- and the location of installations. This decision will be based on several factors which include (but are not limited to): pre-existing infrastructure, retrofit capabilities, historic collision statistics, and collision potential.} (OC-COM-02)

[SYS-REQ-447] The Application DVI shall provide advisory messages, alerts, and/or warnings to the driver. {The look and feel of the warning is dependent on the design selected and installed by the onboard system supplier and/or vehicle manufacturer.} (OC-COM-04)

Wireless Communications Interface

[SYS-REQ-448] The Infrastructure Applications Platform shall be capable of using connected vehicle technology, as defined by USDOT, as its enabling foundation. (OP-COM-01)

[SYS-REQ-449] The Infrastructure Applications Platform shall communicate with an Infrastructure Communications Component that supports prioritization scheme as defined in J2735:2009 or the current standard, to messages such that safety-enhancing messages will have priority over non-safety-enhancing messages if the Infrastructure Communications Component is used as a means of communication. (OP-COM-03)

[SYS-REQ-450] The Infrastructure Applications Platform shall be available and capable of transmitting to a Vehicle Applications Platform, TBD percent of the time. {This requirement is supports reliability and availability of the Infrastructure Applications Platform to. The specific level of reliability and availability will be defined subsequently in the Performance Requirements.} (OP-COM-07)

[SYS-REQ-451] The Vehicle Applications Platform shall be capable of using connected vehicle technology, as defined by USDOT, as its enabling foundation. (OP-COM-01)

[SYS-REQ-452] The Vehicle Applications Platform shall communicate with a Vehicle Communications Component that supports prioritization scheme as defined in J2735:2009 or the current standard, to messages such that safety-enhancing messages will have priority over non-

safety-enhancing messages if the Infrastructure Communications Component is used as a means of communication. (OP-COM-03)

In-Vehicle Warning System

[SYS-REQ-453] The In-Vehicle Warning System shall generate aural, visual, and/or haptic alerts/warnings within {TBD} of being triggered by the Vehicle Application. {Note: The alert/warning provided to the driver by the equipped vehicle may vary. The look and feel of the warning is dependent on the design selected and installed by the vehicle system supplier and/or vehicle manufacturer.} (OC-COM-04)

[SYS-REQ-454] The vehicle safety application shall issue alerts/warnings, when warranted, to the In-Vehicle Warning System. {The infrastructure applications provides data to the vehicle application, not to the In-Vehicle Warning System.} (OP-COM-09)

Infrastructure Data

[SYS-REQ-455] The Infrastructure Application Platform shall receive data from the Infrastructure Data Equipment contains a period of time the data is valid for issuing safety alerts/warnings. (OP-COM-04)

Operating Policies

[SYS-REQ-456] The safety application shall not violate the operating agency's policies. {Regional policies may exist and may vary from one region to another.} (OP-COM-05)

Customization

[SYS-REQ-457] Customization for individual driving habits shall not be required for initial deployment. {During the initial deployment, there will be limited amount of data available. As data becomes available to the safety application over time, algorithms may be enhanced to include all available and relevant information.} (OC-COM-05)

3.3 Safety Applications Requirements

3.3.1 Spot Weather Information Warning (SWIW) Application

[SYS-REQ-501] The SWIW application shall function on public roadways – with the power and resources necessary for the application to function – regardless of geographic area. (UN-SWIW-301)

3.3.1.1 Interface Requirements

3.3.1.1.1 Back Office Interface

[SYS-REQ-502] The interface between the Back Office and the Infrastructure Components, when a Back office is present, shall have a secured communications link meeting the standards prescribed by the connected vehicle architecture and the infrastructure owner/operator. (UN-SWIW-310)

[SYS-REQ-503] (Optional) The Infrastructure SWIW Application may provide a connection into the Back Office to send the Infrastructure computed advisories, alerts or warnings for validation. (UN-SWIW-303, UN-SWIW-310)

3.3.1.1.2 Infrastructure Data Interface

[SYS-REQ-504] The Infrastructure Application Platform shall receive from the Infrastructure Data Equipment, at a minimum, the following SWIW information:

1. Road-weather data for the specified road-weather condition
2. Infrastructure-based information on prevailing speed of traffic (Optional)
3. Information for detected vehicles (Optional)
 - a. Vehicle operating speed
 - b. Vehicle telematics data
 - c. Vehicle configuration data

(UN-SWIW-302, UN-SWIW-304, UN-SWIW-305)

[SYS-REQ-505] The Infrastructure Application Platform shall receive from the Infrastructure Data Equipment accurate and up-to-date roadside configuration data. {The operating agency (or a contractor operating on the agency's behalf) maintains and provides an accurate and up-to-date roadside configuration data.} (OP-SWIW-13)

3.3.1.1.3 Roadside Interface

[SYS-REQ-506] The Infrastructure SWIW Application shall provide the SWIW message to the SWIW Application Roadside Signage. (OC-COM-03)

3.3.1.1.4 Driver-Infrastructure Interface

[SYS-REQ-507] The SWIW Application Roadside Signage shall provide SWIW advisory messages, alerts, and/or warnings to drivers of equipped and non-equipped vehicles. (OP-SWIW-08)

[SYS-REQ-508] (Optional) The SWIW Application may provide advisory or enforceable speeds. {Note: Not all locations allow for variable speed limits. Agencies may wish to avoid conflicts with existing static speed limit signage.} (OP-SWIW-17)

[SYS-REQ-509] The SWIW Application Roadside Signage shall revert to a predefined default signage state when the SWIW Application is offline. (UN-SWIW-308)

[SYS-REQ-510] The SWIW Application DII shall use a prohibitive frame. (UN-SWIW-307)

3.3.1.1.5 Driver-Vehicle Interface

[SYS-REQ-511] (Optional) The SWIW Application recommended speed limits shall not exceed posted or variable enforceable speed limits. {Note: Not all locations allow for variable speed limits. Agencies may wish to avoid conflicts with existing static speed limit signage.} (OP-SWIW-17)

[SYS-REQ-512] The SWIW Application DVI shall use a prohibitive frame (i.e., indicating to a driver when that a condition or speed may be unsafe). (UN-SWIW-07)

3.3.1.1.6 Vehicle Systems Interface

[SYS-REQ-513] The Vehicle SWIW Application shall require data describing the host vehicle which includes at a minimum the following:

1. Vehicle Positioning information
2. Vehicle Speed
3. Road-weather information (if available)

(UN-COM-006)

3.3.1.1.7 Infrastructure Communications Interface

[SYS-REQ-514] The Infrastructure Communications Platform shall be capable transmitting and receiving SWIW information to a Vehicle Applications Platform that is {TBD or less} feet away. (UN-COM-006)

[SYS-REQ-515] The Infrastructure Applications Platform shall be capable of wirelessly transmitting SWIW information received from the Infrastructure SWIW Application to a Vehicle Applications Platform. (UN-COM-006)

[SYS-REQ-516] The Infrastructure Application Platform shall provide vehicle information (i.e., vehicle telematics data) received from the Vehicle Application Platform to the Infrastructure SWIW Application. (UN-COM-006)

3.3.1.1.8 Vehicle Communications Interface

[SYS-REQ-517] The Vehicle Application Platform shall provide the roadway information (i.e., any data collected by the roadside infrastructure) received from the Infrastructure Application Platform to the Vehicle SWIW Application. (UN-COM-006)

3.3.1.2 Infrastructure Components

[SYS-REQ-518] Move to Common Requirement SYS-REQ-459 Infrastructure SWIW Application

[SYS-REQ-519] The Infrastructure SWIW Application shall provide to the Infrastructure Communications Component the following SWIW information to be transmitted to the vehicle:

1. Road-weather data (including raw, processed, and quality check data)
2. Current DII Message
3. Duration and/or distance of applicability for the adverse weather impact zone
4. Location of weather impact zone (if applicable)
5. Infrastructure application recommended advisory speed (Optional)
6. Infrastructure application recommendation to divert to alternate route (Optional)

(UN-COM-006, UN-SWIW-302, UN-SWIW-306, UN-SWIW-309)

[SYS-REQ-520] The Infrastructure SWIW Application shall provide the SWIW information to the Infrastructure Communications Component before the applicability of the information expires. (UN-COM-006)

[SYS-REQ-521] Deleted – Duplicate of SYS-REQ-521 [SYS-REQ-522] The Infrastructure SWIW Application shall validate alerts and warnings prior to transmitting to the Roadside Signage.

{Validation of the recommended alert/warning can be either automated with additional data comparison or by manual inspection.} (UN-SWIW-303)

[SYS-REQ-523] The Infrastructure SWIW Application shall transmit the SWIW Message to the SWIW Application Roadside Signage when the road-weather condition(s) exceeds a threshold determined by the operating agency (or a contractor operating on the agency's behalf). {Weather-impact thresholds may include but are not limited to high wind speed, visibility distance, measured precipitation, or temperature.} (UN-SWIW-302)

3.3.1.3 Vehicle Components

3.3.1.3.1 Vehicle SWIW Application

[SYS-REQ-524] The Vehicle SWIW Application shall use one or more of the following inputs to generate the SWIW advisories, alerts or warnings:

1. Road-weather data (including raw, processed, and quality check data)
2. Current DII Message
3. Duration and/or distance of applicability for the adverse weather impact zone
4. Location of weather impact zone (if applicable)
5. Infrastructure application recommended advisory speed
6. Infrastructure application recommendation to divert to alternate route
7. Vehicle Speed
8. Vehicle Telematics
9. Vehicle collected weather information

(UN-COM-006, UN-SWIW-302, UN-SWIW-305, UN-SWIW-309, OC-SWIW-04)

[SYS-REQ-525] The Vehicle SWIW Application shall provide to the Vehicle Communications Component the following SWIW information to be transmitted to the Infrastructure:

1. Vehicle Speed
2. Vehicle Telematics (Optional)
3. Vehicle collected Road-weather data (Optional)

(UN-SWIW-305)

[SYS-REQ-526] The Vehicle SWIW Application shall only provide alerts and warnings for an individual host vehicle. {Note: SWIW application is single-vehicle based and does not detect other vehicles.} (OC-SWIW-05)

[SYS-REQ-527] The Vehicle SWIW Application shall issue an advisory, alert, and/or warning to the In-Vehicle Warning System when the available weather data and vehicle telematics data exceeds the pre-determined weather-impact threshold. {Weather-impact thresholds may include but are not limited to high wind speed, visibility distance, measured precipitation, or temperature.} (UN-SWIW-302)

[SYS-REQ-528] The Vehicle SWIW Application shall issue an advisory, alert and/or warning to the In-Vehicle Warning System when the vehicle proceeds beyond the turnoff for alternate route or when reduced speed was recommended and vehicle does not reduce speed. (UN-SWIW-302)

3.3.1.3.2 In-Vehicle Warning System

In-Vehicle Warning System requirements were included in the common requirements.

3.3.2 Reduced Speed Zone Warning (RSZW) Application

3.3.2.1 Interface Requirements

3.3.2.1.1 Back Office Interface

[SYS-REQ-601] The interface between the Back Office and the Infrastructure Components, when a Back office is present, shall have a secured communications link meeting the standards prescribed by the connected vehicle architecture and the infrastructure owner/operator. (OC-COM-01)

[SYS-REQ-602] Roadside configuration data provided by the Back Office to Infrastructure Application Platform or RSZW Application Roadside Signage shall be maintained and updated within {TBD timeframe} of the affected change. (OP-COM-08)

3.3.2.1.2 Infrastructure Data Interface

[SYS-REQ-603] The Infrastructure Application Platform shall receive from the Infrastructure Data Equipment the following information:

1. Posted Reduced Speed Zone Speed Limit
2. Roadway Work Zone Configuration Information {when information is applicable}
3. Roadway Work Zone Operations Information (legal movements – cones, barrels, etc.) {when information is applicable}
4. Vehicle Speed of detected vehicle or highest vehicle speed if more than one vehicle is detected

{Note: Roadway Work Zone Configuration Information and Roadway Work Zone Operations Information may not be necessary in all situations, but the Infrastructure Application Platform needs to accommodate for it. A school zone is an example of where roadway work zone configuration information may not be needed.}

(OP-RSZW-14, OP-RSZW-17)

[SYS-REQ-604] The Infrastructure Application Platform shall receive from the Infrastructure Data Equipment roadside configuration data that is accurate and the period of time the data is valid for issuing safety alerts/warnings. {The period of time the data is valid will be defined in the Performance Requirements.} (OP-COM-04)

3.3.2.1.3 Roadside Interface

[SYS-REQ-605] The Infrastructure RSZW Application shall provide to the RSZW Application Roadside Signage the applicable current DII Message. {The Current DII Message may contain RSZW alert/warning messages, roadway configuration information, or a default DII message} (OP-RSZW-14)

3.3.2.1.4 Driver-Infrastructure Interface

[SYS-REQ-606] The RSZW Application Roadside Signage shall provide RSZW information and warnings to drivers of equipped and non-equipped vehicles. (OP-RSZW-05)

[SYS-REQ-607] The RSZW Application Roadside Signage shall provide alerts and/or warnings when at least one vehicle speed is determined to be above the posted reduced speed zone speed limit or speed specified by the local operator in time for the driver to take action. (UN-RSZW-501)

[SYS-REQ-608] The RSZW Application Roadside Signage shall provide advisory, alerts and/or warnings for changed roadway configurations in time for the driver to take action. (UN-RSZW-508, OP-RSZW-16)

[SYS-REQ-609] The RSZW Application Roadside Signage shall provide the driver with information regarding roadway configuration changes and posted speed limit using Federal and State best practices. (OP-RSZW-20, OC-RSZW-06)

[SYS-REQ-610] The RSZW Application Roadside Signage shall revert to a predefined default signage state when the RSZW Application is offline. (UN-RSZW-506)

3.3.2.1.5 Driver-Vehicle Interface

[SYS-REQ-611] The Vehicle RSZW Application shall provide advisories, alerts and/or warnings when the vehicle speed is determined to be above the posted reduced speed zone speed limit. {Note: The intention of this requirement is that the RSZW Application provides no notifications when the driver of a vehicle is driving at or below the posted reduced speed zone speed limit.} (UN-RSZW-501, OP-RSZW-15)

[SYS-REQ-628] The Vehicle RSZW Application shall provide advisories, alerts and/or warnings within TBD time in order for the driver to take action. (UN-RSZW-501, OP-RSZW-15)

[SYS-REQ-612] The Vehicle RSZW Application shall provide advisories, alerts, and/or warnings when the vehicle is affected by changed roadway configurations. (UN-RSZW-508, OP-RSZW-16)

[SYS-REQ-613] The RSZW Application DVI shall use a prohibitive frame (i.e., indicating to a driver when a condition or speed may be unsafe). (OP-RSZW-20, OC-RSZW-06)

3.3.2.1.6 Vehicle Systems Interface

[SYS-REQ-614] The Vehicle RSZW Application shall provide road-level advisories, alerts or warnings. It shall provide lane-level advisories, alerts or warnings when lane-level positioning accuracy is available and warranted. (UN-COM-005)

[SYS-REQ-615] The Vehicle RSZW Application shall require data from the host vehicle which includes, at a minimum the following:

1. Vehicle Positioning information
2. Vehicle Speed

(UN-COM-005)

3.3.2.1.7 Infrastructure Communications Interface

[SYS-REQ-616] The Infrastructure Applications Platform shall be capable transmitting and receiving information to a Vehicle Applications Platform that is {TBD or less} feet away. (UN-COM-006)

[SYS-REQ-617] The Infrastructure Applications Platform shall be capable of wirelessly transmitting RSZW information received from the Infrastructure RSZW Application to a Vehicle Applications Platform. (UN-COM-006)

3.3.2.1.8 Vehicle Communications Interface

[SYS-REQ-618] The Vehicle Application Platform shall be capable of providing the received roadway information to the Vehicle RSZW Application. (UN-COM-006)

3.3.2.2 Infrastructure Components

[SYS-REQ-619] Moved to Common Requirement SYS-REQ-459

3.3.2.2.1 Infrastructure RSZW Application

[SYS-REQ-620] The Infrastructure RSZW Application shall provide to the Infrastructure Communications Component at a minimum the following RSZW information to be transmitted to the vehicle:

1. Posted Speed Limit
2. Roadway Workzone Configuration Information {when applicable}
3. Roadway Workzone Operations Information (legal movements – cones, barrels, etc.) {when applicable}
4. Vehicle Speed of detected vehicle or highest vehicle speed if more than one vehicle is detected
5. Current DII Message (alert/warning/default) {default condition occurs when no alert and no warnings are present}

(OP-RSZW-14, OP-RSZW-17, OP-RSZW-19)

[SYS-REQ-621] The Infrastructure RSZW Application shall provide to the Infrastructure Communications Component the RSZW information within TBD time. {The TBD time will be defined subsequently in the Performance Requirements to allow time for the driver to receive, process and react if necessary.} (UN-COM-006)

[SYS-REQ-622] The Infrastructure RSZW Application shall determine when a RSZW alert/warning is warranted based on the Posted Reduced Speed Zone Speed Limit and the detected vehicle's speed. (UN-RSZW-501, OP-RSZW-05, OP-RSZW-14, OP-RSZW-17)

[SYS-REQ-623] The Infrastructure RSZW Application shall determine, if applicable, the appropriate DII message pertaining to roadway configuration changes and provided it to the RSZW Application Roadside Signage. (OP-RSZW-05, OP-RSZW-16)

3.3.2.3 Vehicle Components

3.3.2.3.1 Vehicle RSZW Application

[SYS-REQ-624] The Vehicle RSZW Application shall only provide alerts and warnings for an individual host vehicle. {Note: RSZW application is single-vehicle based and does not detect other vehicles.} (OC-RSZW-04)

[SYS-REQ-625] The Vehicle RSZW Application shall use the following inputs, at a minimum, for the RSZW alerts and/or warnings:

1. Posted Reduced Speed Zone Speed Limit
2. Roadway Workzone Configuration Information {when information is applicable}

3. Roadway Workzone Operations Information (legal movements – cones, barrels, etc.) {when information is applicable}
4. Current DII Message (alert/warning/default) {default condition occurs when no alert and no warnings are present}
5. Diagnostic information of Infrastructure Application (online/offline status)
6. Vehicle Data
 - a. Vehicle Positioning information
 - b. Vehicle Speed
 - c. Vehicle Acceleration
 - d. Vehicle Heading

(OP-RSZW-14, OP-RSZW-17, OP-RSZW-19)

[SYS-REQ-626] The Vehicle RSZW Application shall generate an alert for a vehicle approaching an RSZW equipped roadway when the vehicle speed is determined to be greater than the reduced speed zone speed limit. (UN-RSZW-501, OP-RSZW-19)

[SYS-REQ-627] The Vehicle RSZW Application shall generate a warning (i.e., a more urgent alert) for a vehicle approaching an RSZW equipped roadway and in danger of a hazard given current speed and distance to the roadway configuration change merge point. (UN-RSZW-508, OP-RSZW-16, OP-RSZW-19)

3.3.2.3.2 In-Vehicle Warning System

The In-Vehicle Warning System requirements were included in the common requirements.

4.0 Verification

This section describes how and when the system requirements will be verified in order to ascertain that the system of interest conforms to the requirements in Section 3 of this specification. The specification developer is to include the verification requirements and boundary conditions that will be used to verify each requirement. Section 4 should be arranged in an orderly sequence that will indicate clearly the method of verification that will be applied for each requirement. A cross reference matrix will provide correlation of each Section 3 requirement to the appropriate Section 4 verification method.

4.1 Verification Methods

Acceptable methods of verification are documented in this section.

4.1.1 Analysis (A)

Analysis is a verification method that utilizes established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements are met.

4.1.2 Demonstration (D)

Demonstration is a verification method that generally denotes the actual operation, adjustment, or re-configuration of items to provide evidence that the designed functions were accomplished under specific scenarios.

4.1.3 Inspection (I)

A verification method that consists of investigation, without the use of special laboratory appliances or procedures, of items to determine conformance to those specified requirements. Examination is generally nondestructive and typically includes the use of sight, hearing, smell, touch; and/or simple physical manipulation of the system when it is safe to do so. Inspection can also be applied to the project work products. For instance, verifying that software is developed using a certain programming language would be verified by inspection.

4.1.4 Test (T)

Testing is a verification method that generally denotes the determination of properties by instrumentation and measurement. This method includes functional operation, and involves the application of established scientific principles and procedures.

Table 4-1. Requirements Verification Matrix

Requirement/Verification Cross-Reference Matrix			
<p><u>METHOD OF VERIFICATION</u> NA – NOT APPLICABLE A – ANALYSIS D – DEMONSTRATION I – INSPECTION T – TEST</p>			
Section 3 Requirement		Requirement ID	Verification Method
Para.	Title		
3	REQUIRMENTS	N/A	
3.1	System Description	N/A	
3.1.1	System of Interest – Reduced Speed Zone Warning Application	N/A	
3.1.2	System of Interest – Spot Weather Information Warning Application	N/A	
3.2	Common Requirements	SYS-REQ-401	A
3.2	Common Requirements	SYS-REQ-402	D
3.2	Common Requirements	SYS-REQ-403	A
3.2	Common Requirements	SYS-REQ-404	D
3.2	Common Requirements	SYS-REQ-405	A
3.2	Common Requirements	SYS-REQ-406	D
3.2	Common Requirements	SYS-REQ-407	A
3.2	Common Requirements	SYS-REQ-408	A
3.2	Common Requirements	SYS-REQ-409	A
3.2	Common Requirements	SYS-REQ-410	A
3.2	Common Requirements	SYS-REQ-411	D
3.2	Common Requirements	SYS-REQ-412	D
3.2	Common Requirements	SYS-REQ-413	D
3.2	Common Requirements	SYS-REQ-414	D
3.2	Common Requirements	SYS-REQ-415	D
3.2	Common Requirements	SYS-REQ-416	D
3.2	Common Requirements	SYS-REQ-460	D
3.2	Common Requirements	SYS-REQ-417	D
3.2	Common Requirements	SYS-REQ-418	D
3.2	Common Requirements	SYS-REQ-419	D
3.2	Common Requirements	SYS-REQ-420	D
3.2	Common Requirements	SYS-REQ-421	D

Table 4-1. Requirements Verification Matrix (Continued)

Requirement/Verification Cross-Reference Matrix			
<p>METHOD OF VERIFICATION NA – NOT APPLICABLE A – ANALYSIS D – DEMONSTRATION I – INSPECTION T – TEST</p>			
Section 3 Requirement		Requirement ID	Verification Method
Para.	Title		
3.2	Common Requirements	SYS-REQ-422	D
3.2	Common Requirements	SYS-REQ-423	D
3.2	Common Requirements	SYS-REQ-424	D
3.2	Common Requirements	SYS-REQ-425	D
3.2	Common Requirements	SYS-REQ-426	D
3.2	Common Requirements	SYS-REQ-427	D
3.2	Common Requirements	SYS-REQ-428	D
3.2	Common Requirements	SYS-REQ-429	I
3.2	Common Requirements	SYS-REQ-458	I
3.2	Common Requirements	SYS-REQ-430	I
3.2	Common Requirements	SYS-REQ-431	I
3.2	Common Requirements	SYS-REQ-432	D
3.2	Common Requirements	SYS-REQ-433	D
3.2	Common Requirements	SYS-REQ-434	A
3.2	Common Requirements	SYS-REQ-435	A
3.2	Common Requirements	SYS-REQ-436	D
3.2	Common Requirements	SYS-REQ-437	D
3.2	Common Requirements	SYS-REQ-438	D
3.2	Common Requirements	SYS-REQ-439	D
3.2	Common Requirements	SYS-REQ-440	I
3.2	Common Requirements	SYS-REQ-459	I
3.2	Common Requirements	SYS-REQ-441	D
3.2	Common Requirements	SYS-REQ-442	D
3.2	Common Requirements	SYS-REQ-443	D
3.2	Common Requirements	SYS-REQ-444	D
3.2	Common Requirements	SYS-REQ-445	D
3.2	Common Requirements	SYS-REQ-446	D
3.2	Common Requirements	SYS-REQ-447	D
3.2	Common Requirements	SYS-REQ-448	D

Table 4-1. Requirements Verification Matrix (Continued)

Requirement/Verification Cross-Reference Matrix			
<p>METHOD OF VERIFICATION NA – NOT APPLICABLE A – ANALYSIS D – DEMONSTRATION I – INSPECTION T – TEST</p>			
Section 3 Requirement		Requirement ID	Verification Method
Para.	Title		
3.2	Common Requirements	SYS-REQ-449	D
3.2	Common Requirements	SYS-REQ-450	I
3.2	Common Requirements	SYS-REQ-451	D
3.2	Common Requirements	SYS-REQ-452	D
3.2	Common Requirements	SYS-REQ-453	T
3.2	Common Requirements	SYS-REQ-454	D
3.2	Common Requirements	SYS-REQ-455	I
3.2	Common Requirements	SYS-REQ-456	A
3.2	Common Requirements	SYS-REQ-457	A
3.3	Safety Applications Requirements	N/A	
3.3.1	Spot Weather Information Warning (SWIW) Application	SYS-REQ-501	A
3.3.1.1	Interface Requirements	N/A	
3.3.1.1.1	Back Office Interface	SYS-REQ-502	D
3.3.1.1.1	Back Office Interface	SYS-REQ-503	D
3.3.1.1.2	Infrastructure Data Interface	SYS-REQ-504	D
3.3.1.1.2	Infrastructure Data Interface	SYS-REQ-505	I
3.3.1.1.3	Roadside Interface	SYS-REQ-506	D
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-507	D
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-508	D
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-509	D
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-510	D
3.3.1.1.5	Driver-Vehicle Interface	SYS-REQ-511	D
3.3.1.1.6	Vehicle Systems Interface	SYS-REQ-512	D
3.3.1.1.6	Vehicle Systems Interface	SYS-REQ-513	D
3.3.1.1.7	Infrastructure Communications Interface	SYS-REQ-514	T
3.3.1.1.7	Infrastructure Communications Interface	SYS-REQ-515	D

Table 4-1. Requirements Verification Matrix (Continued)

Requirement/Verification Cross-Reference Matrix			
<p>METHOD OF VERIFICATION NA – NOT APPLICABLE A – ANALYSIS D – DEMONSTRATION I – INSPECTION T – TEST</p>			
Section 3 Requirement		Requirement ID	Verification Method
Para.	Title		
3.3.1.1.7	Infrastructure Communications Interface	SYS-REQ-516	D
3.3.1.1.8	Vehicle Communications Interface	SYS-REQ-517	D
3.3.1.2	Infrastructure Components	SYS-REQ-518	I
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-519	D
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-520	D
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-521	D
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-522	D
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-523	D
3.3.1.3	Vehicle Components	N/A	
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-524	D
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-525	D
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-526	D
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-527	D
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-528	D
3.3.1.3.2	In-Vehicle Warning System	N/A	
3.3.2	Reduced Speed Zone Warning (RSZW) Application	N/A	
3.3.2.1	Interface Requirements	N/A	
3.3.2.1.1	Back Office Interface	SYS-REQ-601	D
3.3.2.1.1	Back Office Interface	SYS-REQ-602	D
3.3.2.1.2	Infrastructure Data Interface	SYS-REQ-603	D
3.3.2.1.2	Infrastructure Data Interface	SYS-REQ-604	D
3.3.2.1.3	Roadside Interface	SYS-REQ-605	D
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-606	D
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-607	D
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-608	D
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-609	D
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-610	D

Table 4-1. Requirements Verification Matrix (Continued)

Requirement/Verification Cross-Reference Matrix			
<p>METHOD OF VERIFICATION NA – NOT APPLICABLE A – ANALYSIS D – DEMONSTRATION I – INSPECTION T – TEST</p>			
Section 3 Requirement		Requirement ID	Verification Method
Para.	Title		
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-611	D
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-628	D
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-612	D
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-613	D
3.3.2.1.6	Vehicle Systems Interface	SYS-REQ-614	D
3.3.2.1.6	Vehicle Systems Interface	SYS-REQ-615	D
3.3.2.1.7	Infrastructure Communications Interface	SYS-REQ-616	T
3.3.2.1.7	Infrastructure Communications Interface	SYS-REQ-617	D
3.3.2.1.8	Vehicle Communications Interface	SYS-REQ-618	D
3.3.2.2	Infrastructure Components	SYS-REQ-619	I
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-620	D
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-621	D
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-622	D
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-623	D
3.3.2.3	Vehicle Components	N/A	
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-624	D
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-625	D
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-626	D
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-627	D
3.3.2.3.2	In-Vehicle Warning System	N/A	

5.0 Notes

5.1 Traceability Matrix

Table 5-1. Requirements to User Need, Operational Policies, and Operation Constraints Matrix

Section 3 Requirement		Requirement ID	Need, Policy, Constraint
Para.	Title		
3	REQUIRMENTS	N/A	
3.1	System Description	N/A	
3.1.1	System of Interest – Reduced Speed Zone Warning Application	N/A	
3.1.2	System of Interest – Spot Weather Information Warning Application	N/A	
3.2	Common Requirements	SYS-REQ-401	UN-COM-001
3.2	Common Requirements	SYS-REQ-402	UN-COM-002
3.2	Common Requirements	SYS-REQ-403	UN-COM-023
3.2	Common Requirements	SYS-REQ-404	UN-COM-003
3.2	Common Requirements	SYS-REQ-405	UN-COM-004
3.2	Common Requirements	SYS-REQ-406	UN-COM-005
3.2	Common Requirements	SYS-REQ-407	UN-COM-006
3.2	Common Requirements	SYS-REQ-408	UN-COM-007
3.2	Common Requirements	SYS-REQ-409	UN-COM-007
3.2	Common Requirements	SYS-REQ-410	UN-COM-008
3.2	Common Requirements	SYS-REQ-411	UN-COM-009
3.2	Common Requirements	SYS-REQ-412	UN-COM-009
3.2	Common Requirements	SYS-REQ-413	UN-COM-009
3.2	Common Requirements	SYS-REQ-414	UN-COM-009, UN-COM-010
3.2	Common Requirements	SYS-REQ-415	UN-COM-009
3.2	Common Requirements	SYS-REQ-416	UN-COM-009
3.2	Common Requirements	SYS-REQ-460	UN-COM-009
3.2	Common Requirements	SYS-REQ-417	UN-COM-009
3.2	Common Requirements	SYS-REQ-418	UN-COM-010
3.2	Common Requirements	SYS-REQ-419	UN-COM-022
3.2	Common Requirements	SYS-REQ-420	UN-COM-009

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Table 5-1. Requirements to User Need, Operational Policies, and Operation Constraints Matrix (Continued)

Section 3 Requirement		Requirement ID	Need, Policy, Constraint
Para.	Title		
3.2	Common Requirements	SYS-REQ-421	UN-COM-009
3.2	Common Requirements	SYS-REQ-422	UN-COM-009
3.2	Common Requirements	SYS-REQ-423	UN-COM-009
3.2	Common Requirements	SYS-REQ-424	UN-COM-009
3.2	Common Requirements	SYS-REQ-425	UN-COM-009
3.2	Common Requirements	SYS-REQ-426	UN-COM-009
3.2	Common Requirements	SYS-REQ-427	UN-COM-009
3.2	Common Requirements	SYS-REQ-428	UN-COM-014
3.2	Common Requirements	SYS-REQ-429	UN-COM-014
3.2	Common Requirements	SYS-REQ-458	UN-COM-014
3.2	Common Requirements	SYS-REQ-430	UN-COM-015
3.2	Common Requirements	SYS-REQ-431	UN-COM-015
3.2	Common Requirements	SYS-REQ-432	UN-COM-016
3.2	Common Requirements	SYS-REQ-433	UN-COM-017
3.2	Common Requirements	SYS-REQ-434	UN-COM-018
3.2	Common Requirements	SYS-REQ-435	UN-COM-019
3.2	Common Requirements	SYS-REQ-436	UN-COM-020
3.2	Common Requirements	SYS-REQ-437	UN-COM-021
3.2	Common Requirements	SYS-REQ-438	UN-COM-024
3.2	Common Requirements	SYS-REQ-439	UN-COM-024
3.2	Common Requirements	SYS-REQ-440	UN-COM-022, OP-COM-08
3.2	Common Requirements	SYS-REQ-459	OP-COM-08
3.2	Common Requirements	SYS-REQ-441	OP-COM-02
3.2	Common Requirements	SYS-REQ-442	OC-COM-01, OC-COM-03
3.2	Common Requirements	SYS-REQ-443	OP-COM-02
3.2	Common Requirements	SYS-REQ-444	OP-COM-06
3.2	Common Requirements	SYS-REQ-445	OC-COM-02, OC-COM-03
3.2	Common Requirements	SYS-REQ-446	OC-COM-02
3.2	Common Requirements	SYS-REQ-447	OC-COM-04
3.2	Common Requirements	SYS-REQ-448	OP-COM-01
3.2	Common Requirements	SYS-REQ-449	OP-COM-03
3.2	Common Requirements	SYS-REQ-450	OP-COM-07
3.2	Common Requirements	SYS-REQ-451	OP-COM-01
3.2	Common Requirements	SYS-REQ-452	OP-COM-03
3.2	Common Requirements	SYS-REQ-453	OC-COM-04

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Table 5-1. Requirements to User Need, Operational Policies, and Operation Constraints Matrix (Continued)

Section 3 Requirement		Requirement ID	Need, Policy, Constraint
Para.	Title		
3.2	Common Requirements	SYS-REQ-454	OP-COM-09
3.2	Common Requirements	SYS-REQ-455	OP-COM-04
3.2	Common Requirements	SYS-REQ-456	OP-COM-05
3.2	Common Requirements	SYS-REQ-457	OC-COM-05
3.3	Safety Applications Requirements	N/A	
3.3.1	Spot Weather Information Warning (SWIW) Application	SYS-REQ-501	UN-SWIW-301
3.3.1.1	Interface Requirements	N/A	
3.3.1.1.1	Back Office Interface	SYS-REQ-502	UN-SWIW-310
3.3.1.1.1	Back Office Interface	SYS-REQ-503	UN-SWIW-303, UN-SWIW-310
3.3.1.1.2	Infrastructure Data Interface	SYS-REQ-504	UN-SWIW-302, UN-SWIW-304, UN-SWIW-305
3.3.1.1.2	Infrastructure Data Interface	SYS-REQ-505	OP-SWIW-13
3.3.1.1.3	Roadside Interface	SYS-REQ-506	OC-COM-03
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-507	OP-SWIW-08
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-508	OP-SWIW-17
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-509	UN-SWIW-308
3.3.1.1.4	Driver-Infrastructure Interface	SYS-REQ-510	UN-SWIW-307
3.3.1.1.5	Driver-Vehicle Interface	SYS-REQ-511	OP-SWIW-17
3.3.1.1.5	Driver-Vehicle Interface	SYS-REQ-512	UN-SWIW-07
3.3.1.1.6	Vehicle Systems Interface	SYS-REQ-513	UN-COM-006
3.3.1.1.7	Infrastructure Communications Interface	SYS-REQ-514	UN-COM-006
3.3.1.1.7	Infrastructure Communications Interface	SYS-REQ-515	UN-COM-006
3.3.1.1.7	Infrastructure Communications Interface	SYS-REQ-516	UN-COM-006
3.3.1.1.8	Vehicle Communications Interface	SYS-REQ-517	UN-COM-006
3.3.1.2	Infrastructure Components	SYS-REQ-518	OP-SWIW-13
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-519	UN-COM-006, UN-SWIW-302, UN-SWIW-306, UN-SWIW-309
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-520	UN-COM-006
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-521	UN-COM-006
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-522	UN-SWIW-303
3.3.1.2.1	Infrastructure SWIW Application	SYS-REQ-523	UN-SWIW-302
3.3.1.3	Vehicle Components	N/A	

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Table 5-1. Requirements to User Need, Operational Policies, and Operation Constraints Matrix (Continued)

Section 3 Requirement		Requirement ID	Need, Policy, Constraint
Para.	Title		
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-524	UN-COM-006, UN-SWIW-302, UN-SWIW-305, UN-SWIW-309, OC-SWIW-04
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-525	UN-SWIW-305
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-526	OC-SWIW-05
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-527	UN-SWIW-302
3.3.1.3.1	Vehicle SWIW Application	SYS-REQ-528	UN-SWIW-302
3.3.1.3.2	In-Vehicle Warning System	N/A	
3.3.2	Reduced Speed Zone Warning (RSZW) Application	N/A	
3.3.2.1	Interface Requirements	N/A	
3.3.2.1.1	Back Office Interface	SYS-REQ-601	OC-COM-01
3.3.2.1.1	Back Office Interface	SYS-REQ-602	OP-COM-08
3.3.2.1.2	Infrastructure Data Interface	SYS-REQ-603	OP-RSZW-14, OP-RSZW-17
3.3.2.1.2	Infrastructure Data Interface	SYS-REQ-604	OP-COM-04
3.3.2.1.3	Roadside Interface	SYS-REQ-605	OP-RSZW-14
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-606	OP-RSZW-05
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-607	UN-RSZW-501
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-608	UN-RSZW-508, OP-RSZW-16
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-609	OP-RSZW-20, OC-RSZW-06
3.3.2.1.4	Driver-Infrastructure Interface	SYS-REQ-610	UN-RSZW-506
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-611	UN-RSZW-501, OP-RSZW-15
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-628	UN-RSZW-501, OP-RSZW-15
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-612	UN-RSZW-508, OP-RSZW-16
3.3.2.1.5	Driver-Vehicle Interface	SYS-REQ-613	OP-RSZW-20, OC-RSZW-06
3.3.2.1.6	Vehicle Systems Interface	SYS-REQ-614	UN-COM-005
3.3.2.1.6	Vehicle Systems Interface	SYS-REQ-615	UN-COM-005
3.3.2.1.7	Infrastructure Communications Interface	SYS-REQ-616	UN-COM-006
3.3.2.1.7	Infrastructure Communications Interface	SYS-REQ-617	UN-COM-006
3.3.2.1.8	Vehicle Communications Interface	SYS-REQ-618	UN-COM-006
3.3.2.2	Infrastructure Components	SYS-REQ-619	OP-RSZW-12
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-620	OP-RSZW-14, OP-RSZW-17, OP-RSZW-19
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-621	UN-COM-006
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-622	UN-RSZW-501, OP-RSZW-05, OP-RSZW-14, OP-RSZW-17
3.3.2.2.1	Infrastructure RSZW Application	SYS-REQ-623	OP-RSZW-05, OP-RSZW-16

Table 5-1. Requirements to User Need, Operational Policies, and Operation Constraints Matrix (Continued)

Section 3 Requirement		Requirement ID	Need, Policy, Constraint
Para.	Title		
3.3.2.3	Vehicle Components	N/A	
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-624	OC-RSZW-04
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-625	OP-RSZW-14, OP-RSZW-17, OP-RSZW-19
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-626	UN-RSZW-501, OP-RSZW-19
3.3.2.3.1	Vehicle RSZW Application	SYS-REQ-627	UN-RSZW-508, OP-RSZW-16, OP-RSZW-19
3.3.2.3.2	In-Vehicle Warning System	N/A	

5.2 Acronyms and Abbreviations

AAHSTO	American Associated of State Highway and Transportation Officials
ASCE	American Society of Civil Engineers
ATIS	Advanced Traveler Information Systems
CAN	Controller Area Network
ConOps	Concept of Operations
CVO	Commercial Vehicle Operations
DII	Driver-Infrastructure Interface
DOTs	Departments of Transportation
DSRC	Dedicated Short Range Communications
DVI	Driver-Vehicle Interface
ESS	Environmental Sensor Station
FHWA	Federal Highway Administration
IEEE	Institute of Electrical and Electronics Engineers
ITS	Intelligent Transportation Systems
LOS	Levels of Service
MUTCD	Manual on Uniform Traffic Control Devices
OBD-II	On Board Diagnostic version 2
OEMs	Original Equipments Manufacturers
RSZW	Reduced Speed Zone Warning
RWIS	Road Weather Information Systems
SAE	Society of Automotive Engineers
SEMP	Systems Engineering Management Plan
SOI	System-of-Interest
SWIW	Spot Weather Information Warning
TBD	To Be Determined
TMC	Traffic Management Center
USDOT	United States Department of Transportation
V2I	Vehicle-to-Infrastructure

5.3 Terms and Definitions

Advisory Message – An informative message to the driver regarding current roadway conditions; less urgent, i.e., not necessarily crash-imminent, than an alert or warning.

Alert – A cautionary message about an anticipated crash scenario and/or vehicle conflict; more urgent than an advisory message, less urgent than a warning.

Connected Vehicle – In the context of this document, refers to the methods, data and technologies used in the bi-directional exchange of information between infrastructure and vehicles for purposes of improving safety, mobility and environmental conditions.

Degraded – Mode of the safety application where it is capable of providing a subset of its intended function(s).

Failure – Mode of the safety application where the safety application is incapable of providing any of its intended function(s).

False Alarm – Situation where the safety application provides an alert/warning to the driver when the conditions do not warrant an alert/warning.

Functional Class of Roadway – The functional class of roadways are defined in FHWA “Functional Classification Guidelines”. Revised 1989.

Missed Alarm – Situation where the safety application does not provide an alert/warning to a driver when the conditions warrant an alert/warning.

Non-volatile Storage – Type of storage that remains intact even when there is no power.

Offline – State of the safety application where the safety application is not processing data or providing advisories, alerts and/or warnings.

Online – State of the safety application where the safety application is functioning and providing advisories, alerts and/or warnings.

Operational – Mode of the safety application where the safety application is capable of providing all of its intended function(s).

Perform – To work in a manner to achieve the desired outcome.

Physical Security – Describes measures that are designed to deny access to unauthorized personnel (including attackers or even accidental intruders) from physically accessing a building, facility, resource, or stored information; and guidance on how to design structures to resist potentially hostile acts.² Physical security can be as simple as a locked door on a roadside cabinet.

Prohibitive Reference Frame – Indicates when *unsafe* conditions are present, as opposed to “safe” conditions; “unsafe” is much easier to quantify than “safe,” indicates the requirement that users also apply their own judgment, and can lessen liability issues as compared to indicating a more definitive ‘permissive’ notification of when conditions are “safe”.

² Task Committee; Structural Engineering Institute (1999). *Structural Design for Physical Security*. ASCE. [ISBN 978-0-7844-0457-7](https://doi.org/10.1061/(ASCE)1098-0784(2000)10:1(7-17)).

Roadside Configuration Data – Data provided from the infrastructure data equipment or back office that details the lane(s), roadway geometry, and/or map of the area needed by a safety application

Road Weather Information – Data on road and weather conditions that may impact vehicle safety including visibility, wind speed, precipitation, air and road surface temperature, road surface condition, etc.

Roadway Work Zone Configuration Information – Data on work zone configuration elements that may impact vehicle safety including lane shifts, lane reductions, etc.

Roadway Work Zone Operations Information – Data on work zone operational elements that may impact vehicle safety including buffer zones, traffic control setup, temporary pavement markings, temporary traffic barriers, road closures, changed lighting conditions (during night work), etc.

Threshold – A point in both time and/or location, depending on the specific application, that the application would reach a decision point resulting in an action being taken. This action would typically be expected to include alerts and/or warnings issued to the driver, but could also include additional actions.

Vehicle Type – Identification of vehicle role (e.g., ambulance, police cruiser, maintenance vehicle, etc.) as specific class of vehicle satisfies in the surface transportation system. A specific, standardized nomenclature does not exist.

Vehicle Class – One of 13 FHWA designations of motorized vehicles ranging in size from a Class 1 Motorcycle through a Class 13 – Seven or more axle truck.³

Vehicle Telematics Data – Data made available from vehicle electronic systems that could be utilized by the connected vehicle in-vehicle application. Examples include vehicle operating speed; operational status of windshield wipers, headlights, etc.; driver application of brakes or accelerator; etc.

Warning – An urgent message for a more immediate, potentially crash imminent scenario and/or vehicle conflict; more urgent than both an advisory message and alert.

³ Traffic Monitoring Guide, USDOT, May 2001, <http://www.fhwa.dot.gov/ohim/tmgguide/tmg4.htm#app4c>

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