Connected Vehicle Pilot Deployment Program Phase 2

System Design Document (SDD) – Tampa (THEA)

U.S. Department of Transportation

Produced by Tampa Hillsborough Expressway Authority
U.S. Department of Transportation
Intelligent Transportation Systems (ITS) Joint Program Office

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16. Abstract

The Tampa Hillsborough Expressway Authority (THEA) Connected Vehicle (CV) Pilot Deployment Program is intended to develop a suite of applications that utilize vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communication technology to reduce traffic congestion, improve safety, and decrease emissions. These CV applications support a flexible range of services from advisories, roadside alerts, transit mobility enhancements, and pedestrian safety. The pilot is conducted in three phases. Phase 1 includes the planning for the CV pilot including the concept of operations development. Phase 2 is the design, development, and testing phase. Phase 3 includes a real-world demonstration of the applications developed as part of this pilot.

This document represents the System Design Document.

The System Design Document is intended to provide the design for the pilot system. The design is based on the Concept of Operations, System Requirements Specification, and the System Architecture Document.

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1 Introduction

1.1 Purpose of the System Design Document

The System Design Document (SDD) describes the detailed design of the subsystems and modules and provides traceability from System Requirements Specification (SyRS) to system design. The SDD provides the connection between the system implementation and how the Tampa CV Pilot meets its requirements.

1.2 Document Overview

The document describes the purpose of each subsystem/component and its function within the overall system and how each subsystem/component will be built. The system design is divided into the infrastructure and in-vehicle subsystems. The infrastructure design includes the Roadside Units (RSU), the Master Server, and the pedestrian applications. The in-vehicle design includes the Onboard Units (OBU).

1.3 Assumptions

The following statements are assumptions on which the design is based:

- There is ample bandwidth to transfer data from the OBUs via DSRC, Personal Information Devices (PID) via WiFi to RSUs.

- There is ample bandwidth to transfer data from the RSUs via WiFi or Fiber to the Master Server.
- There is ample bandwidth to update OBUs apps from the RSU via DSRC.
- The traditional detection devices such as radars are adequate to provide the additional vehicle detection for the Intelligent Signal System (I-SIG) work as designed.
- The commercial SCMS POC will be delivered on schedule and be able to provide as promised features.
- The 5.9 DSRC spectrum will remain fully available for implementation as designed without limitation by changing regulations/rules.
- The Public Data Hub will facilitate a demark connection point that is internet based and does not require infrastructure beyond that of the Pilot's secure internet connection. "Demark connection point" is a common term that identifies where one system ends and another starts. The Public Data Hub will provide information and coordination for this connection, i.e.: IP Address, login info, upload speeds etc.

1.4 Constraints

The following statements have been identified as constraints of the system:

- There is fixed bandwidth to transfer data and apps.
- Adjusting signal timing to address intersection issues will be limited by the existing signal timing plan. Expected Fiber Optic cable is delayed until after pilot completion. Project is now constrained to bandwidth available via cellular modems.
- Budget is a constraint. Should unexpected design developments result in budget shortfall, there is no additional Federal budget and design would either be reduced, or additional local funding partners developed.
- Schedule is constrained by Grant guidelines and includes multiple, interdependent staged deliverables.
- Florida Law and FDOT policy on traffic control devices being on pre-approved product list constrain the ability to make rapid changes in infrastructure – mitigated by advance coordination with FDOT Test Evaluation and Research lab (TERL).

1.5 Risks

The risks are documented and maintained in the Risk Register.

- Inadequate bandwidth to transfer data from the OBUs via DSRC

- Inadequate bandwidth to transfer data from Personal Information Devices (PID) via WiFi to RSUs.

- Inadequate bandwidth to transfer data from the RSUs via Wi-Fi or Fiber to the Master Server.
- Inadequate bandwidth to update OBUs apps from the RSU via DSRC.
- The traditional detection devices such as radars are inadequate to provide the additional vehicle detection for the Intelligent Signal System (I-SIG) work as designed.
- The commercial SCMS POC will not be delivered on schedule
- The commercial SCMS POC will not be able to provide as promised features.
- The 5.9 DSRC spectrum does not remain fully available for implementation as designed without limitation by changing regulations/rules.
- The Public Data Hub will not facilitate a demark connection point that is internet based.

2 System Description

2.1 Physical System Overview

The Pilot system is divided into four major subsystems:
- Backend servers (i.e., Master Server)
- RSUs
- OBUs
- PIDs

These subsystems have both independent modules and integrated modules. Independent modules are those modules that execute functions specifically for that subsystem. Integrated modules are those modules which communicate with other subsystems in order to complete its function (e.g., ERDW).

Figure 1 below depicts the physical breakdown of the subsystems and applications of the Pilot system.
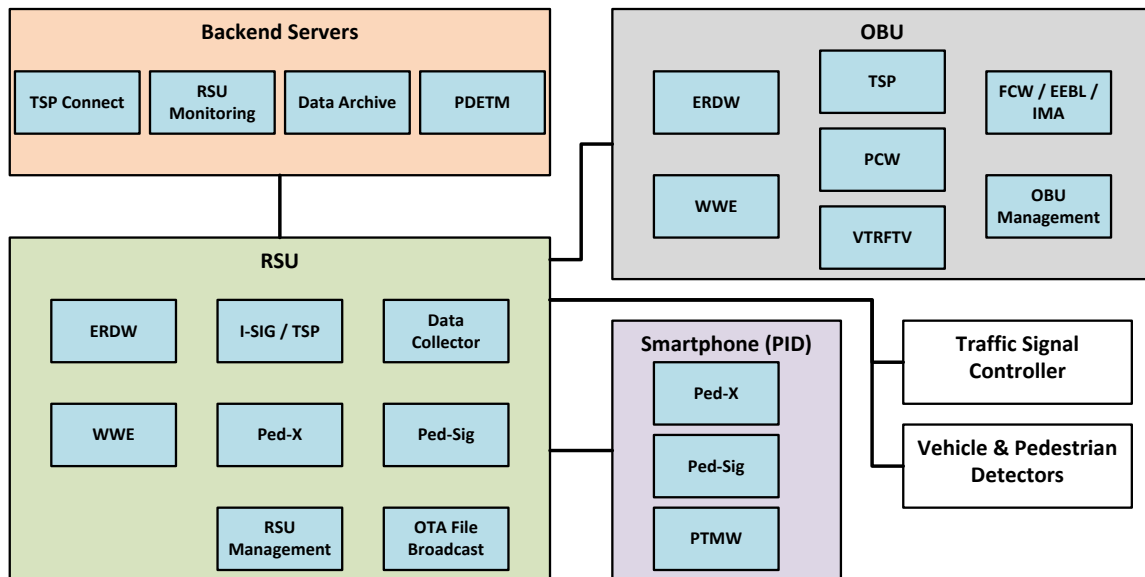
Figure 1: Pilot System/Subsystem Physical Overview

The THEA CV System has functionality distributed across backend servers, roadside units (RSUs), onboard units (OBUs), and smartphones (PIDs). RSUs interface with Traffic Signal Controllers as well as Vehicle & Pedestrian Detectors. (Source: Siemens). For the "soft launch", CUTR logs into the Master Server through VPN to manually retrieve data, such as records of BSMs. Once the data is examined for proper content and format, the manual data collection process is automated through command scripts executed by the master server. System functionality in the tables below references sections of the System Design Document or is COTS per 8.1 of the Comprehensive Acquisition Plan.

Table 1: Backend Server Functions

Functionality	Description
TSP Connect	Siemens application granting or denying priority service requests from buses (COTS)
RSU Monitoring	Siemens application monitoring connected RSUs for basic operation and health (COTS)
Data Archive	Siemens application storing log data received from RSUs (COTS)
PDETM	See application description 2.1.11

Table 2: RSU Functions

Functionality	Description
ERDW	See the application description in Section 2.1.1
WWE	See the application description in Section 2.1.2
I-SIG / TSP	See the application description in Sections 2.1.10 and 2.1.6
Ped-X / Ped-Sig	See the application description in Section 2.1.4
Data Collector	Application responsible for collection of log data (e.g. BSMs, TIMs, alerts, etc.) and forwarding of that data to the backend server (COTS)
RSU Management	Support functions for managing basic RSU operations such as broadcast of MAP and SPaT messages. Functions for application lifecycle management, health monitoring, and browser-based user access. Functions for configuration of core RSU services such as Message Forwarder. Functions for log collection and software update management. (COTS)

Table 3: OBU Functions

Functionality	Description
ERDW	See the application description in Section 2.1.1
WWE	See the application description in Section 2.1.2
TSP	See the application description in Section 2.1.6
VTRFTV	See the application description in Section 2.1.5
FCW / EEBL / IMA	See the application description in Sections 2.1.7, 2.1.8, 2.1.9
PCW	See application description in Section 2.1.12
OBU Management	Support functionality for managing basic OBU operations such as broadcast of BSM messages. Functions for application lifecycle management, health monitoring, and human machine interface. Functions for log collection and software update management. (COTS)

Table 4: Smartphone Functions

Functionality	Description
Ped-X	See the application description in Section 2.1.4
Ped-Sig	See application description in Sections 2.1.3
PTMW	See application description in Section 2.1.13

The following sections are functional views of the CV Pilot applications.

2.1.1 End of Ramp Deceleration Warning

This app computes a geo location of stopped traffic / vehicle queue based on the longest lane queue length computed by I-SIG. In this case, overlapping I-SIG app estimates the queue length from the

end of the Reversible Express Lane (REL). An Infrastructure Sensor Message (ISM) is generated for the end of the longest lane queue and provided to I-SIG only. The REL is divided into multiple speed zones extending from Twiggs to the Selmon main lanes. Based on the end of the longest queue, the RSU sends a TIM that describes the recommended speed for each zone based on the safe stopping distance from the Florida Driver's License Handbook. As the driver approaches the end of queue, the recommended speed TIM drops to within the safe stopping distance or the posted speed, whichever is lower for that zone.

There is a complementary OBU app that receives the recommended safe speeds as TIMs. The OBU app adjusts the recommended safe speed based on the vehicle's type and sends a message to the HMI for display to the driver.

2.1.2 Wrong Way Entry

The RSU app broadcasts the MAP and Signal and Phasing Timing (SPaT) message. According to J2735_201603, each MAP zone includes an allowed direction of vehicle travel, plus a revocable indication for each zone. In this case, seven lanes are present at the end of the REL. Four are always inbound with a fixed direction and not revocable, therefore the MAP message will always indicate inbound. The reversible lanes will indicate a direction of outbound and indication that each of the three reversible lanes is revocable. The RSU sends the seven MAP locations to the OBU each of which includes the direction, plus an indication of whether each lane is active or revoked as described in SAE J2735_201603. The RSU sends SPaT message for each Revocable zone representing the direction of the Revocable zone by time of day. The OBU issues an alert to a driver approaching the inbound lanes from the wrong direction. A secondary, non CV detection point is used as confirmation of continued counter-flow entry and generates a warning to the TMC. The RSU app provides an alert to the TMC that a vehicle is going the wrong way and provides a warning to upstream RSUs that a vehicle is approaching going the wrong way. The RSUs' app begins broadcasting wrong way vehicle ahead. OBU equipped vehicles receive the wrong way vehicle ahead message and HMI warns the driver of the approaching wrong way vehicle. The HMI issues an alert to a driver approaching a lane that has been revoked at that time of day according to the SPaT message.

2.1.3 Mobile Accessible Pedestrian Signal

PED-SIG is composed of two software objects; one on the pedestrian information device (PID) and the second on the RSU. The pedestrian points the PID in the direction they want to cross the intersection and presses the Cross button. The PID app generates a request to the RSU for a pedestrian call. The RSU app interprets the PID app request, sends the command to the signal controller, receives concurrence from the Signal controller, and sends a confirmation to the PID app.

2.1.4 Pedestrian in a Signalized Crosswalk

Ped-X is an application that receives Pedestrian Safety Messages (PSMs) from LIDAR and sends them via DSRC to warn vehicles when pedestrians, within the crosswalk, are in the intended path of the car. The complementary Personal Information Device (PID) application receives BSMs from the RSU via WiFi that a vehicle is approaching a crosswalk. As the PID GPS is unpredictable, the feasibility of warning the pedestrian that they may collide with a vehicle will be analyzed. Equipped vehicles HMI using the PCW app warn the driver of a potential crash course with pedestrian in the crosswalk. There is no detection of unequipped vehicles as defined by the scope of the project.

2.1.5 Vehicle Turning Right in Front of Transit Vehicle

VTRFTV HMI warns the streetcar operator of an equipped vehicle turning right at the intersection the streetcar is approaching and warns the equipped vehicle driver, they are on a potential crash course with the streetcar. VTRFTV uses the BSMs sent and received from the equipped vehicle and equipped streetcar to determine if the vehicle/streetcar are on a potential collision trajectory.

2.1.6 Transit Signal Priority

TSP is part of a larger suite of applications called Multimodal Intelligent Transportation Systems Signal (MMITSS) available on the Open Source Application Development Portal (OSADP). As part of this application suite, TSP must be used in conjunction with I-SIG. TSP provides signal priority to transit at intersections and along arterial corridors. The OBU sends a Signal Request Message (SRM) to the RSU. The RSU forwards that to the Transit Server (i.e., housed on the Master Server) at the TMC. The Transit Server determines if the bus is behind schedule. If the bus is behind schedule, the SRM is returned from the Transit Server to the RSU. The RSU determines priority of all SRMs received from all approaching vehicles, and then selects the controller phase via NTCIP objects to extend the green, allowing the bus to proceed through the intersection. At the same time, RSU sends the Signal Status Message (SSM) to the approaching vehicles to inform which has received priority to extend the green and which vehicles have been denied priority.

2.1.7 Forward Collision Warning

Forward Collision Warning (FCW) is an application where alerts are presented to the trailing driver in order to help avoid or mitigate the severity of potential crashes into the rear end of other vehicles on the road. Forward crash warning responds to a direct and imminent threat ahead of the host vehicle. FCW works lane by lane.

When two equipped vehicles interact, FCW provides a driver alert by calculating potential crash trajectories, if the right conditions occur as follows: one vehicle following the other; the lead vehicle brakes causing the closing distances to decrease (as calculated) to warrant an alert of a potential collision.

2.1.8 Emergency Electronic Brake Light Warning

Emergency Electronic Brake Light (EEBL) warning is an application where the driver is alerted to vehicle exceeding preset deceleration in the traffic stream ahead. This alert is received from one or more vehicles in the same lane ahead but not the immediate vehicle ahead. This provides the driver with additional time to look for, and assess situations developing ahead

2.1.9 Intersection Movement Assist

Intersection Movement Assist (IMA) is an application that uses the HMI to warn the driver of a potential collision when two or more vehicles are approaching one another using the relative position, speed and heading of those vehicles. IMA receives BSMs from approaching vehicles adjacent to the vehicle equipped with IMA. If IMA determines there is a high probability of a collision, the HMI warns the driver.

2.1.10 Intelligent Signal System (I-SIG)

I-SIG is part of a larger suite of applications called MMITSS available in the OSADP. I-SIG receives BSMs from vehicles approaching the intersection and local ITS traffic detection devices (e.g., radar or video) to estimate the length of the queue at the intersection. I-SIG determines green times allocated to phases based on the queue lengths estimated.

2.1.11 Probe Data Enable Traffic Monitoring (PDETM)

PDETM receives BSMs, speeds, and traffic counts (traffic volume) from RSUs along a corridor. These RSUs receive BSMs from vehicles traveling along the corridor. PDETM uses these BSMs to calculate travel times along the corridor. PDETM stores the travel times for use in measuring performance of the corridor. PDETM resides on the Master Server.

2.1.12 Pedestrian Collision Warning (PCW)

PCW receives PSMs to calculate potential crashes with pedestrians entering and in the crosswalk at the courthouse. When PCW detects a potential crash, PCW sends an alert to the driver.

2.1.13 Pedestrian Transit Movement Warning (PTMW)

PTMW receives starting/stopping information from equipped buses and streetcars. If a pedestrian equipped with the PTMW app is within a geo-fenced area around the intersection/transit stop, PTMW will provide an informational message to the pedestrian that the vehicle is approaching within the geo-fence, or is departing within the geo-fence based on incremental forward movement of BSM location.

2.2 List of Subsystems and Components

The following table lists the subsystems and components defined in Section 3.

Figure 2: Subsystems and Components

Systems	Subsystem/Component
Master Server	TSP Connect
	RSU Monitoring (Concert)
	Log Data Archive
	PDETM
RSU	ERDW
	WWE
	MMITSS (I-SIG/TSP)
	PED-X
	PED-SIG
	Log Data Collector
	RSU Management
	Over the Air (OTA) Update
OBU	ERDW
	WWE
	TSP
	VTRFTV
	PCW

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Systems	Subsystem/Component
	FCW
	EEBL
	IMA
	Log Data Collection
	OTA Update
	OBU Management
Smartphone (PID)	PED-X
	PED-SIG
	PTMW

The existing traffic controllers and traffic management system are not part of the system design, but rather used to collect portions of the research data, such as stops on green, vehicle counts, research signal plans and others.

3 Subsystems and Components

3.1 Master Server

The Master Server will be based on the Siemens Sitraffic Concert software which consists of an application server, a NextConnect server, a database server, and at least one workstation. Concert has a modular system design with various application modules. These application modules communicate with each other and subsystem interface via a proprietary middleware. Status information and configuration data is stored in a central data storage. External 3rd party systems can be connected via OCIT-C, OCPI, or NTCIP/TMDD interfaces. Custom business logic can be added to the NextConnect server which is part of Concert.

Concert communicates with connected RSUs via its OCIT-C interface for health monitoring and detector data collection as well as traveler information. NextConnect implements interfaces for the "RSU Log Data Archive" and the "TSP Request Interface".

3.1.1 Hardware Design
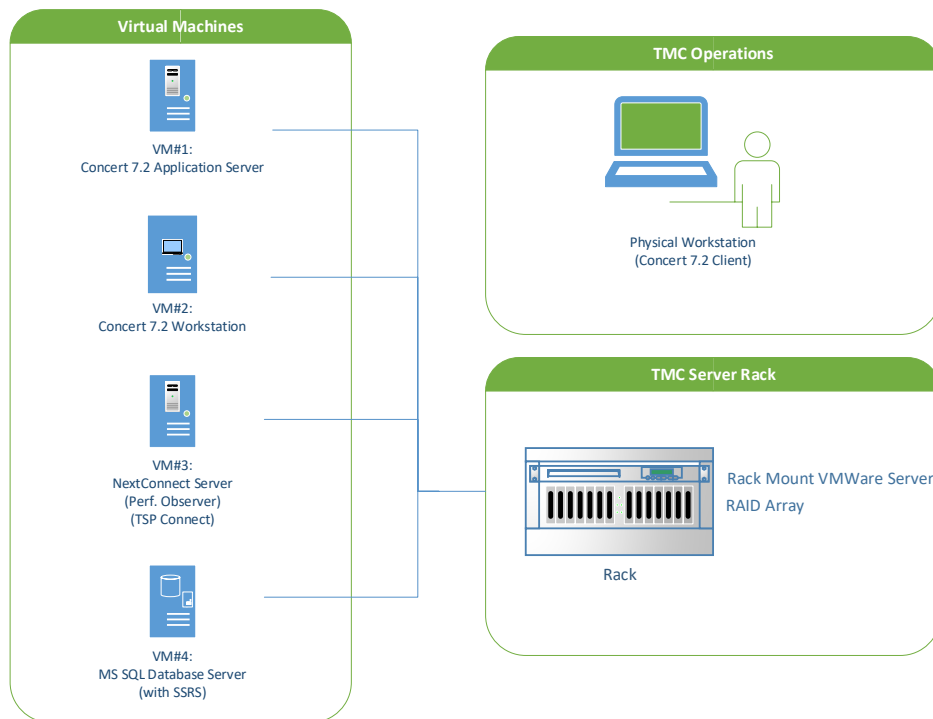
Figure 3: Virtual Machines and Physical Hardware at the TMC

The above diagram shows the virtual machines hosted on a rack mount VMWare server with RAID hard disk array. The detailed specifications for each are as follows:

Figure 4: Key Specifications of Hardware and Virtual Machines

Hardware / Virtual Machine	Specification
Physical VMWare Rack Server Host	CPU Cores: 12 CPUs x 1.9 GHz Sockets: 2 Cores per Socket: 2 Number of NICs: 4 Memory: 20 GB Storage: 200 GB SSD; 10 TB HDD; <u>Note: This host will be part of VMWare HA</u> <u>Cluster of vCenter[1]</u>
VM#1: Concert App. Server	Guest OS: Microsoft Windows Server 2012 (x64) CPU: 4 vCPU Memory: 4 GB Storage: 100 GB
VM#2: Concert Workstation	Guest OS: Microsoft Windows 7 (x64) CPU: 4 vCPU Memory: 2 GB Storage: 100 GB
VM#3: NextConnect Server (Data Log Archive + TSP)	Guest OS: Microsoft Windows Server 2012 (x64) CPU: 4 vCPU Memory: 8 GB Storage: 100 GB + 200 GB SSD + 7 TB HDD
VM#4: MS SQL Database Server (with SSRS)	Guest OS: Microsoft Windows Server 2012 (x64) CPU: 4 vCPU Memory: 6 GB Storage: 2 TB
Physical Workstation	Microsoft Windows 7 (x64) CPU: Core i5-6400 Memory: 4 GB Storage: 100 GB

The VMWare Host server has a RAID hard disk array which will ensure data availability. Also, it will use VMWare HA in order to provide failover of virtual machines. Failover is an automatic restart of virtual machines on redundant hardware in the event of failure.

All of the above VMs and physical machines are considered part of the Master Server. In addition, VM#3 also takes on the role of the Transit Server via the NextConnect TSP component (see also section 3.1.2.2).

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[1] VMWare HA Cluster is an available feature of the VMWare vSphere product line. It supports high availability of virtual machines.

3.1.2 Software Design

3.1.2.1   Concert
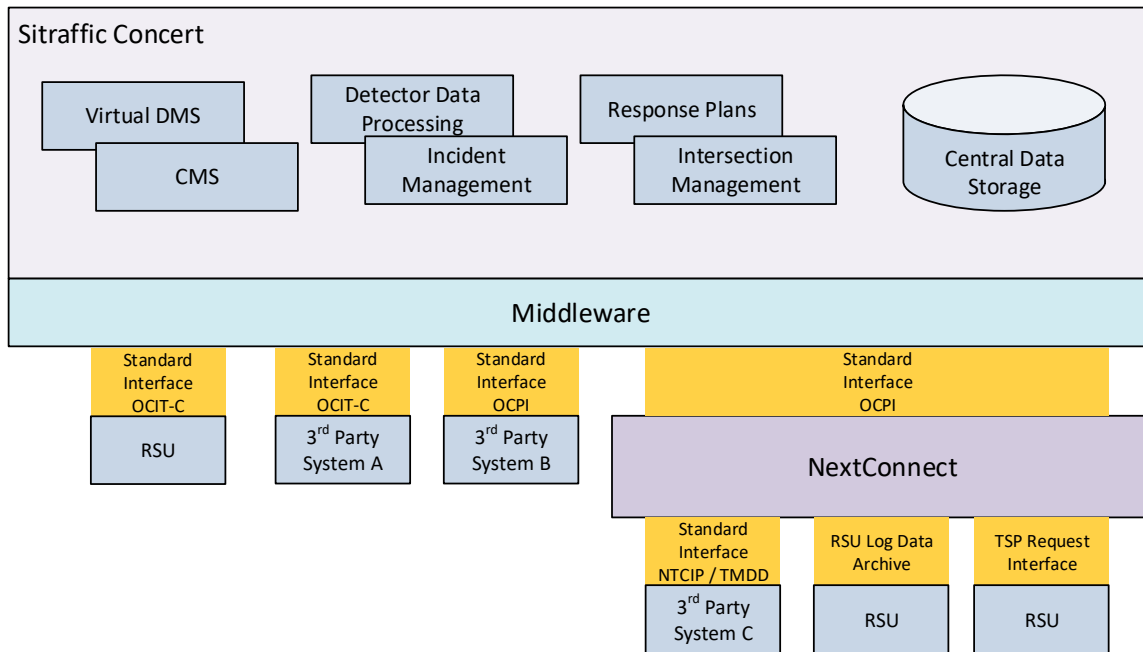
Figure 5: Siemens Concert System Architecture

The above figure depicts the Siemens Sitraffic Concert architecture as it applies to the THEA CV pilot project. Since Sitraffic Concert is an existing Siemens product with a vast number of features and interfaces, not all details can be shown here. Sitraffic Concert is in use in the United States and Europe. The product will be integrated and tested as part of the THEA CV Pilot.

Concert has modular system architecture with various application modules. These application modules communicate with each other and subsystem interface via a proprietary middleware. Status information and configuration data is stored in central data storage. External 3rd party systems can be connected via OCIT-C, OCPI, or NTCIP/TMDD interfaces.

Concert communicates with connected RSUs via its OCIT-C interface for health monitoring and detector data collection. It is via this interface that Concert receives point speed data and equipped vehicle counts from RSUs. See ICD: interface 23014 "Traffic Situation Data".

The OCIT-C interface receives application status information from connected RSUs. See ICD: interface 23018 "RSU Application Status". The OCIT-C interface is also used to send RSU firmware updates to connected RSUs. See ICD: interface 23019 "Application Install / Upgrade".

Project-specific add-on interfaces are typically implemented using the NextConnect subsystem of Concert. In the case of the THEA CV Pilot these interfaces are the "RSU Log Data Archive" and the "TSP Request Interface".

"RSU Log Data Archive" implements the "RSU Data Logs" flows from the RSUs in order to support CV data archiving. See ICD: interface 23030 "RSU Data Logs". This functionality is described in more detail in section 3.1.2.3 of this document.

The "TSP Request Interface" implements the "priority service request/response" flow from the RSU. This flow requests permission to grant an approaching bus priority service at a specific intersection. The response contains the "grant" or "reject" decision made by NextConnect. See ICD: interface 23013 "Signal Priority Service Request". This functionality is described in more detail in section 3.1.2.2 of this document.

3.1.2.2   NextConnect TSP (Transit Server)
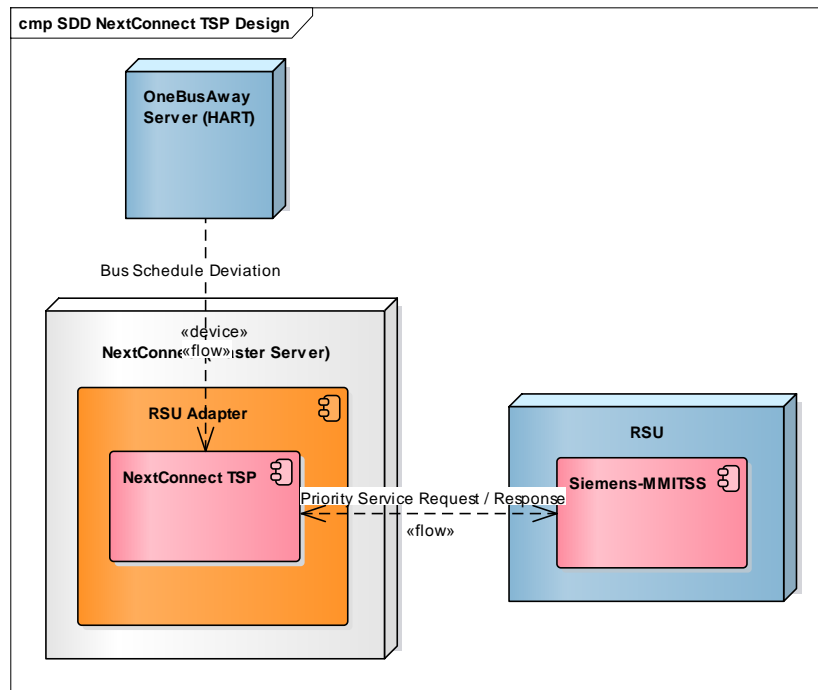
Figure 6: NextConnect TSP Software Design

NextConnect is a modular Siemens software platform. A module in NextConnect is called an "adapter". The Siemens RSU Adapter is responsible for handling communication and business logic related to connected RSUs.

The NextConnect TSP component is part of the RSU Adapter and implements the decision logic for determining if a bus requesting priority service at an intersection is behind schedule. As such it incorporates the role of the Transit Server. It implements the "Priority Service Request / Response" flow. See ICD: interface 23013 "Signal Priority Service Request".

NextConnect TSP receives current bus schedule deviation from HART's OneBusAway server. It polls the server for updated information at regular intervals and caches the result. NextConnect TSP

receives a priority service request from Siemens-MMITSS which includes the bus ID, estimated time of arrival (ETA) and intersection ID. Using this information, it looks up the current schedule deviation of the bus received from the OneBusAway server. If the bus is behind schedule the priority service request is granted. A configurable threshold value (behindScheduleSeconds) ensures that small schedule deviations due to normal fluctuations in traffic don't immediately result in a granted priority service request. See ICD: interface 23033 "Transit Vehicle Status".

3.1.2.3 Data Log Archive
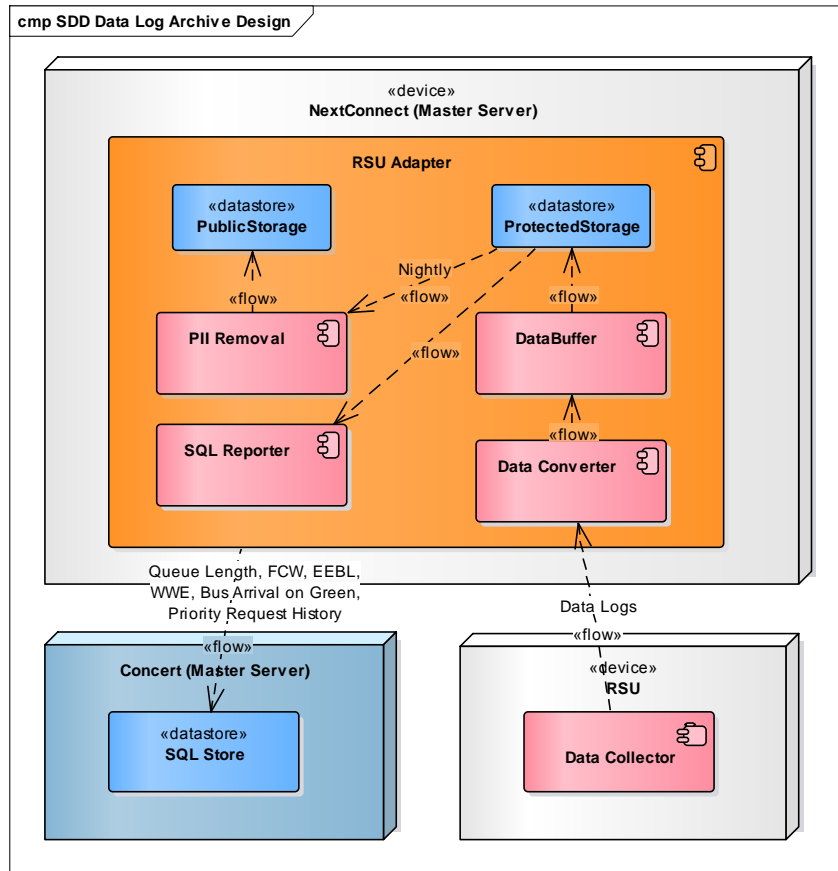
Figure 7: Log Data Archive Software Design

The Data Converter receives the Data Logs from the RSUs. It maintains the connection with connected RSUs and controls the flow of incoming Data Logs. See ICD: interface 23030 "RSU Data Logs".

Data Converter passes the Data Logs on to the DataBuffer component. DataBuffer will combine the data logs into batches and save them to protected storage. Batching is done in order to reduce stress on the storage system. Separate batches are created for each source device where data logs originated from. This will result in data logs coming from the same OBU to be stored next to each other even if they were received via different RSUs. Similarly, data logs originating from the same PID

will be stored together. DataBuffer will also perform deduplication of identical OBU / PID data logs received from multiple RSUs.

ProtectedStorage

The ProtectedStorage is a directory structure on an encrypted file system. Only authorized users will have read access to the protected storage. The directory structure follows this schema: */<protected_storage_path>/<year>/<month>/<day>/<hour>/*.

Table 5: Protected Storage

<protected_storage_path>	Root directory of the protected storage
<year>	4 digit year when data log was received (e.g. 2017)
<month>	2 digit month when data log was received, 01-12 (e.g. 12)
<day>	2 digit day of the month when data log was received, 01-31 (e.g. 09)
<hour>	2 digit hour of the day when data log was received, 00-23 (e.g. 13)

Within each directory a GZIP file is created for each source device from where data logs were received during that hour. Files are named according to this schema: *<year>_<month>_<day>_<hour>_<ID>.csv.gz*

<ID> is one of RSU_<id>, OBU_<id>, PID_<id> depending on type of the source device. <id> is the unique identifier of the corresponding device.

Each GZIP file contains a single CSV file named according to this schema: *<year>_<month>_<day>_<hour>_<ID>.csv*

The CSV file has the following structure:

```
timestamp,kind,psid,DSRCmsgID,payload
timestamp,kind,psid,DSRCmsgID,payload
timestamp,kind,psid,DSRCmsgID,payload
```

With fields meaning:
- timestamp – UNIX timestamp in milliseconds since the unix epoch
- kind – type of message (in, out, log, pedx::psm, pedx::collisionAlert, obu::data, mmitss::data)
- psid – PSID of message (kind equals "in" or "out") or 0 (all other kinds)
- DSRCmsgID – DSRCmsgID (kind equals "in" or "out) or 0 (all other kinds)
- payload – plain text human readable data (XER encoded WSM message, XML, JSON or any other plain text data format without newline characters)

See also ICD: interface 23030 "RSU Data Logs" for more details on the definition of these fields.

PII Removal

This component removes Personally Identifiable Information (PII) in a nightly batch job. Data of the last 24 hours is read from the Protected Storage and transferred over to the Public Storage.

Of particular concern during this process is any information part of BSMs which can be used as a unique identifier for a particular vehicle. For purpose of the study the BSM of all vehicles will contain a

unique ID in the "id" field of the BSM coreData data frame. This field will be randomized in the public copy by PII Removal.

PII Removal will also reorganize the GZIP file content stored in the public storage area. The protected storage area has data originating from the same OBU collocated inside the same file. PII Removal will combine all data received from any OBU into a single GZIP file. Similarly, all data originating from individual PIDs will be combined into a single GZIP file.

PublicStorage
The PublicStorage is a directory structure in the file system. The directory structure follows this schema: /*<public_storage_path>*/*<year>*/*<month>*/*<day>*/*<hour>*/.

Within each directory a GZIP file is created for each source device from where data logs were received during that hour. Files are named according to this schema:
<year>_<month>_<day>_<hour>_<ID>.csv.gz

<ID> is one of RSU_<id>, OBU, PID depending on type of the source device. <id> is the unique identifier of the corresponding RSU. Data from all OBUs and all PIDs will be stored in a single GZIP file.

SQL Reporter
The SQL Reporter extracts information from the data logs in the ProtectedStorage and saves it into a SQL database for reporting purposes. The data stored in SQL is anonymous. It includes the following:
- Queue Length estimate as computed by MMITSS
- FCW, EEBL events logged by OBUs (stripped of OBU identifier)
- Wrong Way Entry events detected by traditional vehicle detector
- Bus Arrival on Green / Red events as computed by MMITSS
- Priority Request / Response Events as computed by MMITSS

3.1.2.4   Performance Measure Collection
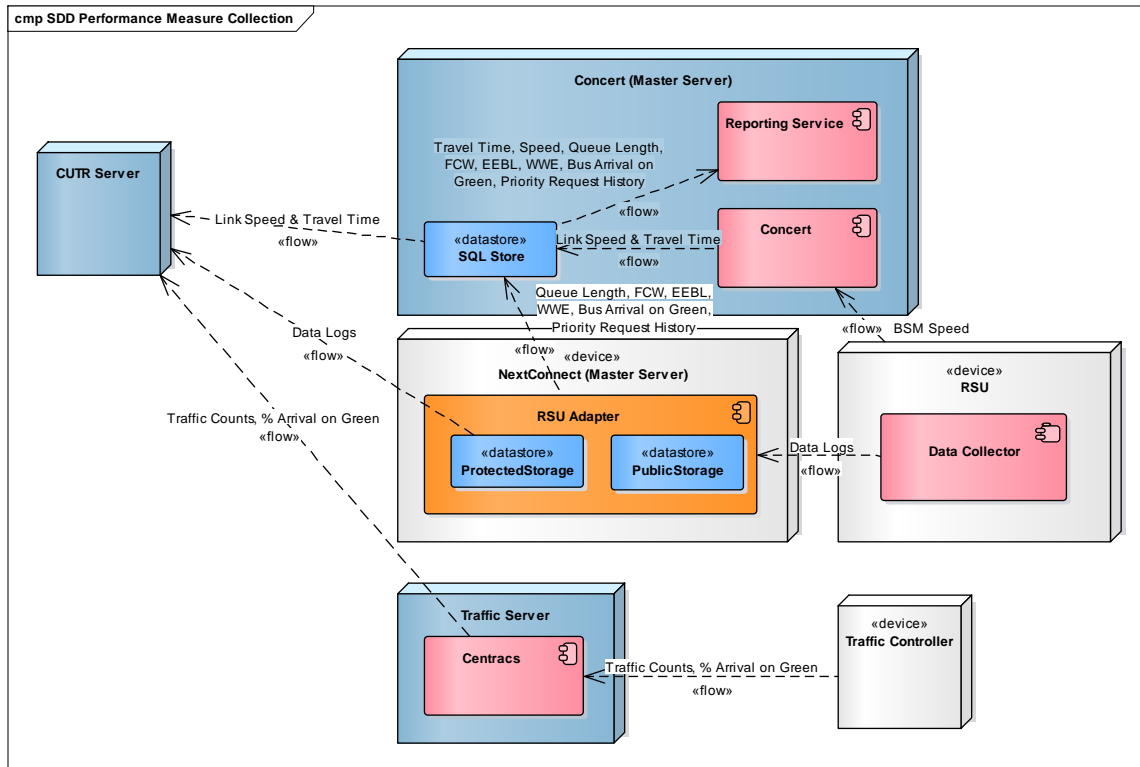
Figure 8: Performance Measure Collection Software Design

The above diagram illustrates how the system collects various performance measures. Ultimately all data used as basis for performance measures is concentrated at the CUTR Server. As described in section 3.1.2.3 of this document NextConnect collects the data logs coming from the RSUs. The CUTR Server accesses to the protected storage area in order to obtain those data logs.

Additional information comes from the Concert Server which hosts a SQL database (Microsoft SQL Server) and Reporting Service (SQL Server Reporting Services). RSUs measure average vehicle speed based on observed BSMs and send this information to Concert. See ICD: interface 23014 "Traffic Situation Data". Concert associated this data with traffic links and calculates link speed and travel time metrics. It saves those in the SQL database from where the data can be access by the CUTR server, which shares data per the Performance Measurement and Evaluation Support Plan.

The Reporting Service allows a user to run a report and specify certain report-specific parameters (e.g. time period). It also allows the user to schedule reports to be created in regular intervals (daily, weekly, or monthly) automatically. Such reporting jobs can also be configured to send the report to a provided email address. Please see further below for a list of supported reports (**Error! Reference source not found.**).

Finally, the existing Centracs traffic control system at the City of Tampa TMC collects traffic counts and percent arrival on green from connected traffic controllers. The CUTR server can access this information from the Centracs system used to manage the traffic signal controllers via NTCIP.

The following table lists all the performance measures defined in the requirements along with the source of the data:

Table 6: Performance Measures and their Data Source

Metric	Source	Comment
delay time	MMITSS Performance Measures inside Data Logs	MMITSS measures delay of equipped vehicles queuing at intersections
queue length	MMITSS Performance Measures inside Data Logs	MMITSS estimates queue lengths based on a configured CV penetration rate and BSMs.
crashes, conflicts, or near misses	EEBL, FCW, WWE, VTRFTV, PCW ev ents from OBU Data Logs	These events are recorded by OBUs in their Data Log. CUTR server analyzes these events and derives the performance measure
approaching speed on REL	Point speed from BSMs from Concert	Speed measurement of equipped vehicles passing through a virtual detection zone (geo-fence).
travel times	Link travel time from Concert	Point speed measurements from BSMs are used by Concert to compute travel time along a road link
travel time reliability indices	Link travel time from Concert	CUTR server uses Concert-provided travel times to compute reliability indices
percent arrival on green	Centracs report based on traffic controller data	The Econolite Centracs TMC collects available detector calls and phase status from intersections. Centracs supports generation of a report for percent arrival on green.
wrong way violation	Incident Log from Concert	Wrong way violation is recorded in Concert's incident archive
travel time delay on REL	Link travel time from Concert	CUTR server uses Concert-provided travel times to compute delay
travel time delay on adjacent arterial	Link travel time from Concert	CUTR server uses Concert-provided travel times to compute delay
approaching speed on Twiggs street toward the REL	Point speed from BSMs from Concert	See "approaching speed on REL" metric

Metric	Source	Comment
vehicle delay time at the crosswalk	Point speed from BSMs from Concert	CUTR server uses Concert-provided travel times to compute delay
pedestrian delay time at the crosswalk	PSMs from RSU Data Log	CUTR server computes pedestrian delay at courthouse crosswalk from analysis of PSMs
vehicle's speed approaching the crosswalk	Point speed from BSMs from Concert	See "approaching speed on REL" metric
bus travel time through the deployment region	SRMs from RSU Data Log	CUTR server analyzes SRMs which are received by RSUs at intersections along the bus route and computes bus travel time between intersections
bus percent arrival on schedule	SRMs, SSMs from RSU Data Log	CUTR server analyzes SRMs received and corresponding SSMs sent out. SSMs contain granted/rejected status of priority request. Requests are only granted when the bus was behind schedule.
bus percent arrival on green	MMITSS performance measure from SRM, bus BSM, signal phase status	MMITSS monitors the bus BSMs and tracks the bus as it travels through the intersection. Bus arrived on green if it didn't stop due to a red light travelling through the intersection.

Table 7: Reports Supported by the Master Server

Report	Interval	Description
Travel Time	Daily	Average travel time for 15 minute and 1 hour time periods during a selected day.
	Weekly	Average travel time for 1 hour time periods averaged across the workweek (Mo – Fr) and the weekend (Sa – Su).
	Monthly	Average travel time for 1 hour time periods averaged across the workdays (Mo – Fr) and the weekends (Sa – Su) of the month.

Approaching Speed	Daily	Average approaching speed for 15 minute and 1 hour time periods during a selected day.
	Weekly	Average approaching speed for 1 hour time periods averaged across the workweek (Mo – Fr) and the weekend (Sa – Su).
	Monthly	Average approaching speed for 1 hour time periods averaged across the workdays (Mo – Fr) and the weekends (Sa – Su) of the month.
Queue Length Estimate	Daily	Average queue length for 15 minute and 1 hour time periods during a selected day for each intersection approach.
	Weekly	Average queue length for 1 hour time periods averaged across the workweek (Mo – Fr) and the weekend (Sa – Su) for each intersection approach.
	Monthly	Average queue length for 1 hour time periods averaged across the workdays (Mo – Fr) and the weekends (Sa – Su) of the month for each intersection approach.
CV Safety	Daily	Count of FCW, EEBL, WWE, PCW, and VTRFTV alerts per location within each 1 hour period of a selected day.
	Weekly	Count of FCW, EEBL, WWE, PCW, and VTRFTV alerts per location within each 1 hour period for the workweek (Mo – Fr) and the weekend (Sa – Su).
	Monthly	Count of FCW, EEBL, WWE, PCW, and VTRFTV alerts per location within each 1 hour period for the workdays (Mo – Fr) and the weekends (Sa – Su) of the month.
Bus Priority	Daily	Bus % arrival on green (B%AoG)

		Number of times priority is requested and granted (Pg) Number of times priority is requested and denied (Pd) Number of times priority is requested, granted, and then denied due to a higher priority (Pgd) B%AoG, as well as count of Pg, Pd, Pgd for each of the 15 minute and 1 hour time periods of a selected day for each intersection.
	Weekly	Average B%AoG, Pg, Pd, Pgd for each of the 1 hour time periods averaged across the workweek (Mo – Fr) and the weekend (Sa – Su) for each intersection.
	Monthly	Average B%AoG, Pg, Pd, Pgd for each of the 1 hour time periods averaged across the workdays (Mo – Fr) and the weekends (Sa – Su) of the month for each intersection.

3.1.3 Interfaces

Table 8: Interface triple references used by the Master Server

Triple ID	Triple Name	Used By
23013	Signal Priority Service Request	3.1.2.2 NextConnect TSP
23014	Traffic Situation Data	3.1.2.1 Concert
23018	RSU Application Status	3.1.2.1 Concert
23019	Application Install/Upgrade	3.1.2.1 Concert
23030	RSU Data Logs	3.1.2.3 Data Log Archive

3.2 Roadside Unit (RSU)

3.2.1 Hardware Design

The roadside unit selected for this CV pilot is a Sitraffic ESCoS (Ecosystem for Cooperative Systems) by Siemens. It is a commercial off-the-shelf (COTS) product which is compliant to the USDOT RSU Specification and fulfills the specific requirements of the pilot.
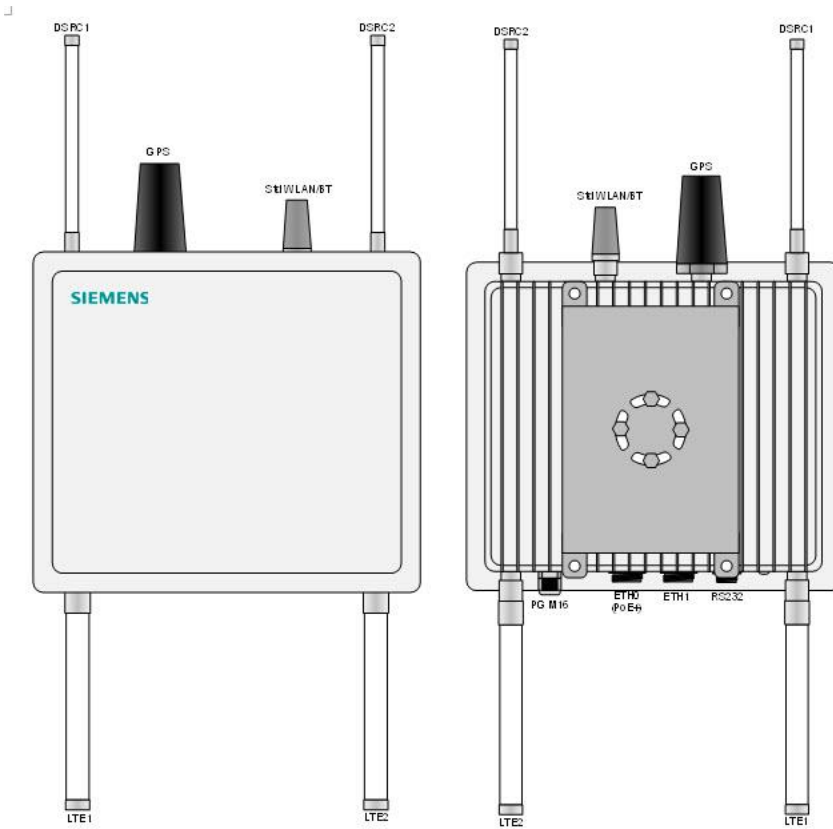
Figure 9: Sitraffic ESCoS Roadside Unit

Table 9: Sitraffic ESCoS Data sheet

Output power (802.11p)	-10 to +23 dBm (CFR 90.210 Emission Mask C)
Receiver Sensitivity (802.11p)	-97 dBm
Frequency Band (802.11p)	5.9 GHz
Operating Modes (802.11p)	Single- and multi-channel operating mode
Security	HSM for signing of WAVE messages and secure storage of private keys
GNSS	GPS/GLONASS/Galileo/BeiDou 2.0 m CEP position accuracy
Connectivity	2 x 802.11p 5.9GHz 2 x 10/100 MBit Ethernet 1 x RS232 1 x 802.11 a/b/g/n WLAN 1 x Bluetooth 4.0 1 x LTE
Operating System	Linux 4.x
CPU	Dual-Core ARM-Cortex A9 @800MHz
Memory	1 GB RAM
Operating Temperature	-40°C to +74°C
Storage Temperature	-40°C to +85°C
IP rating	IP67
Power Supply	PoE+ (802.3at)
Power Consumption	Typ. 12W
Mounting	Mounting kit for wall or pole mounting
Dimensions	270 x 308 x 80 mm
Weight	4.1 kg (with default antenna set)
V2x Standards Conformance	ETSI EN 302 571, V2.1.1 ETSI EN 302 636-4-1, V1.2.1 ETSI TS 103097, V1.2.1 ETSI EN 302 636-5-1, V1.2.1 ETSI TS 102 894-2, V1.2.1 ETSI EN 302 637-2, V1.3.2 ETSI EN 302 637-3, V1.2.2 ETSI ITS 103 301, V1.1.1 SAE J2735, MAR 2016 ISO TS 19091, OCT2016 ISO TS 19321, SEP2014
Communications Security	RSU supports Wi-Fi WPA2 plus TLS encryption via Wi-Fi. RSU supports OpenVPN encryption via LTE.

3.2.2 Software Design

The following sections describe the software components deployed on the ESCoS RSU.

3.2.2.1   ERDW

3.2.2.1.1   Conceptual Design

The ERDW (end of ramp deceleration warning) application shall provide advance warning to vehicles on the REL driving inbound. The HMI warning shall recommend a safe speed which will allow the vehicle to stop before it reaches the end of the queue / stopped traffic. The following graphic shows 2 examples to illustrate the concept.
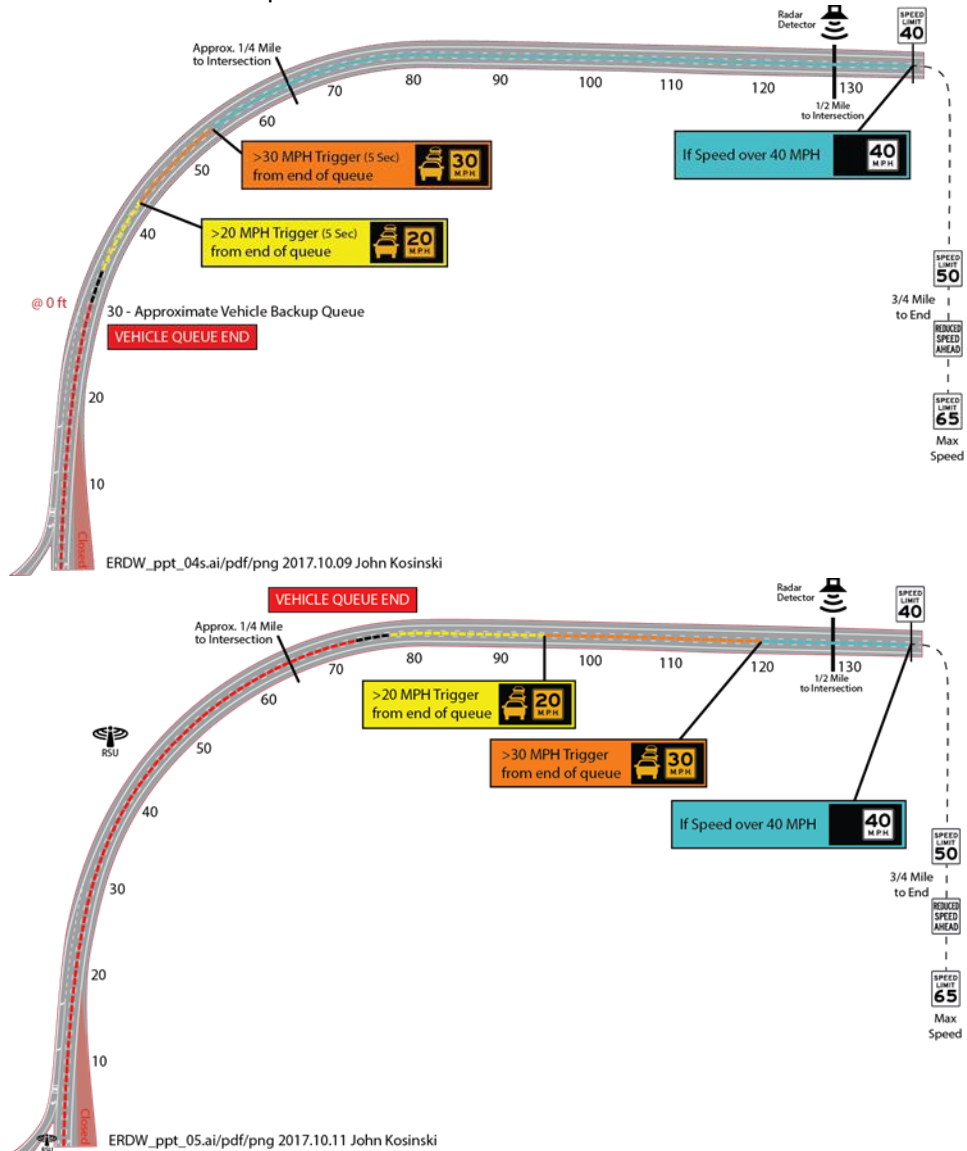
Figure 10: ERDW concept of speed recommendation zones for 2 traffic situations

The top example shows a situation with a short queue of vehicles waiting for green at the intersection of Twiggs & Meridian. In this situation the RSU would broadcast a series of recommended speed zones which apply to road segments of the REL. Each zone has a recommended speed and speeds decrease along the path of a vehicle from one zone to the next until the final zone is reached.

The system will use 3 speed zones. The 40 MPH speed zone represents the point along the REL from where the 40 MPH speed limit is posted until the end of the ramp at the intersection. The other 2 speed zones are overlaid and represent recommended speeds of 30 MPH and 20 MPH. Speed zone length and location are configurable on the RSU by defining the content of the TIM being broadcast for this queue length.

The second situation in above figure shows a longer queue. The speed zones are shifted back / upstream accordingly. The locations of the speed zones for this second situation are defined as part of the TIM associated with the queue length. The RSU is configured to select the speed zone TIM appropriate for a particular queue length from the ERDW application configuration.

In order to have the greatest amount of flexibility it was decided that the ERDW application will allow configuration of arbitrary TIM messages. Each TIM describes the series of speed recommendation zones that ERDW shall broadcast for a specific traffic situation, i.e. when the current queue length is within a certain range. ERDW will pick the appropriate TIM to broadcast based on the current queue length and its configuration.

ERDW supports configuration of queue length ranges (min and max) and their associated TIM to broadcast when the current queue length is within the range. Min and max values for each TIM can be configured such that the values overlap with the next TIM for the next traffic situation. This creates a hysteresis which will prevent the broadcast TIM from changing too frequently in case the current queue length is just above the min value for the next traffic situation but still below the max of the current traffic situation.

The current queue length is determined as the maximum queue length across all 4 lanes of the REL (including the right turn lane) as estimated by I-SIG (MMITSS). The speed recommendation zone inside the TIM will apply to all lanes on the REL, irrespective of whether a particular lane has a vehicle queue. This is to safeguard against vehicles suddenly cutting in and out of the queue from and into free flowing traffic, respectively.

For a complete ERDW configuration on the REL the following items will be defined:
- For a particular traffic situation (x), i.e. queue length range (min and max), the location and length of each of the 3 speed zones shall be defined. The speed zones shall be encoded in a TIM for that traffic situation referred to as TIM(x)
- Traffic situation TIM(x) shall be defined for a sufficient number of situations up to a queue length of 500 meters[2].

Location and length of a speed zone will follow MUTCD recommendations for advance placement of warning signs (see MUTCD table 2C-4). As an additional constraint, speed zones shall have a

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[2] THEA observes morning peak hour queue lengths of less than 500 meters xxx % of the time

minimum length such that a vehicle travelling at that speed will be within the speed zone for at least 10 seconds.

A total of 6 traffic situations will be configured for queue lengths from 0-100 meters, 100-200meters, …, 500 or greater. For each traffic situation the corresponding maximum queue length shall be considered for design of the speed zone location and length.

3.2.2.1.2 Detailed Design
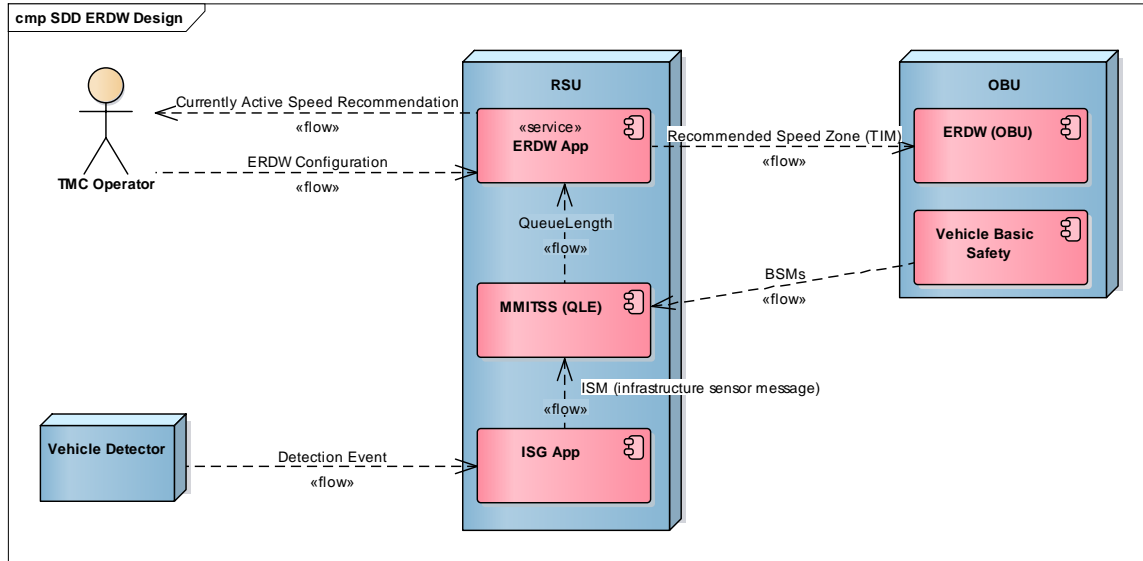
Figure 11: ERDW Software Design

The ERDW application runs as a service on the RSU. The application is implemented using the facilities of the ESCoS software stack. The application consists of a user interface (UI) which supports display of the current queue length as well as the currently selected TIM for broadcast. The UI also enables an authorized user to edit the configuration (see Figure 12).
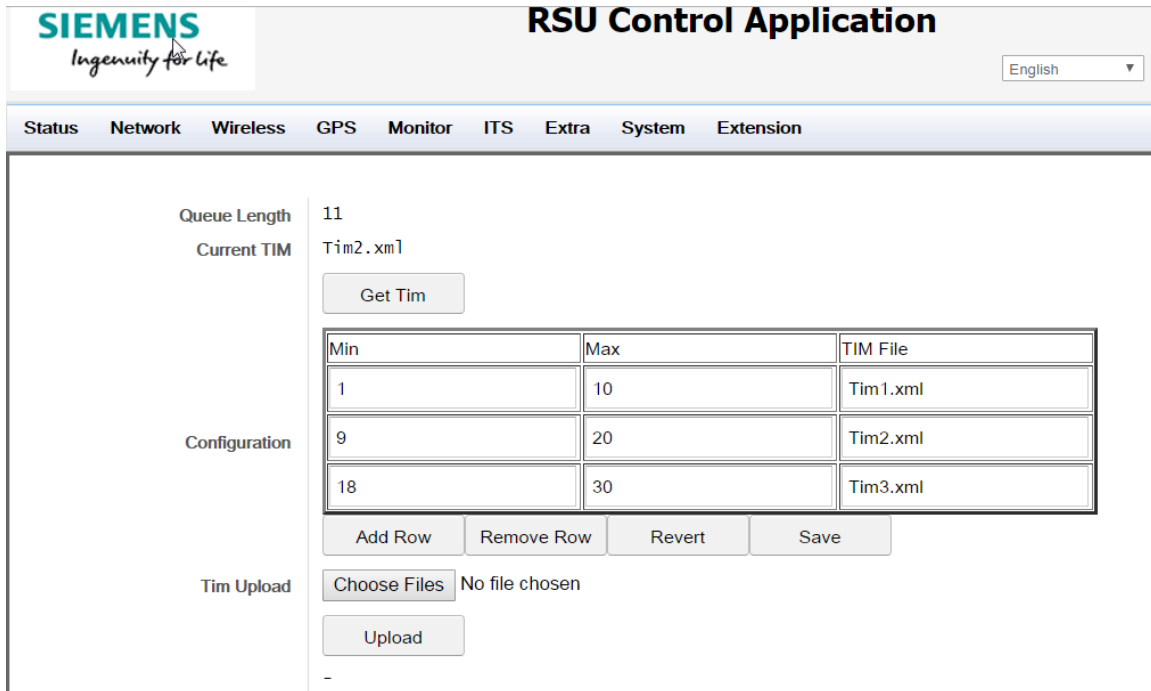
Figure 12: ERDW application configuration and status UI

The ERDW configuration UI allows a user to set a TIM(x) to be broadcast for a particular traffic situation defined by min and max value of the vehicle queue. The user can add a row to the table for each traffic situation.

The ERDW application receives the currently estimated queue length (QLE) for the REL from MMITSS (I-SIG) through a local inter-process communication (IPC) interface provided by the ESCoS stack. MMITSS estimates queue lengths on intersection approaches monitoring BSMs of vehicles approaching the intersection. See ICD interface 20004, "Vehicle Location and Motion".

In addition to BSM monitoring the Tampa CV pilot will install one Wavetronix SmartSensor HD radar detector on the REL at a location upstream to capture free flow vehicle data. The detector will be installed in a location along with an RSU[3]. This information is received by MMITSS in the form of an infrastructure sensor message (ISM) coming from the Infrastructure Sensor Gateway (ISG). The ISM contains the timestamp, location and speed of a single detected vehicle. The ISMs are used along with the BSMs as input for the MMITSS queue length estimation algorithm.

The ISG interfaces with the Wavetronix radar sensor and receives vehicle detection events in real-time. See ICD interface 23016, "Vehicle Entries and Exits" for the corresponding interface specification.

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[3] The exact location depends on where RSUs will be deployed along the REL which in turn depends on pole locations and availability of power and communication.

The ERDW application uses the received queue length estimation to select a TIM to broadcast based on its configuration. See ICD interface 20014, "I2V Situational Awareness TIM (I2V)".

3.2.2.2 WWE

3.2.2.2.1 Conceptual Design
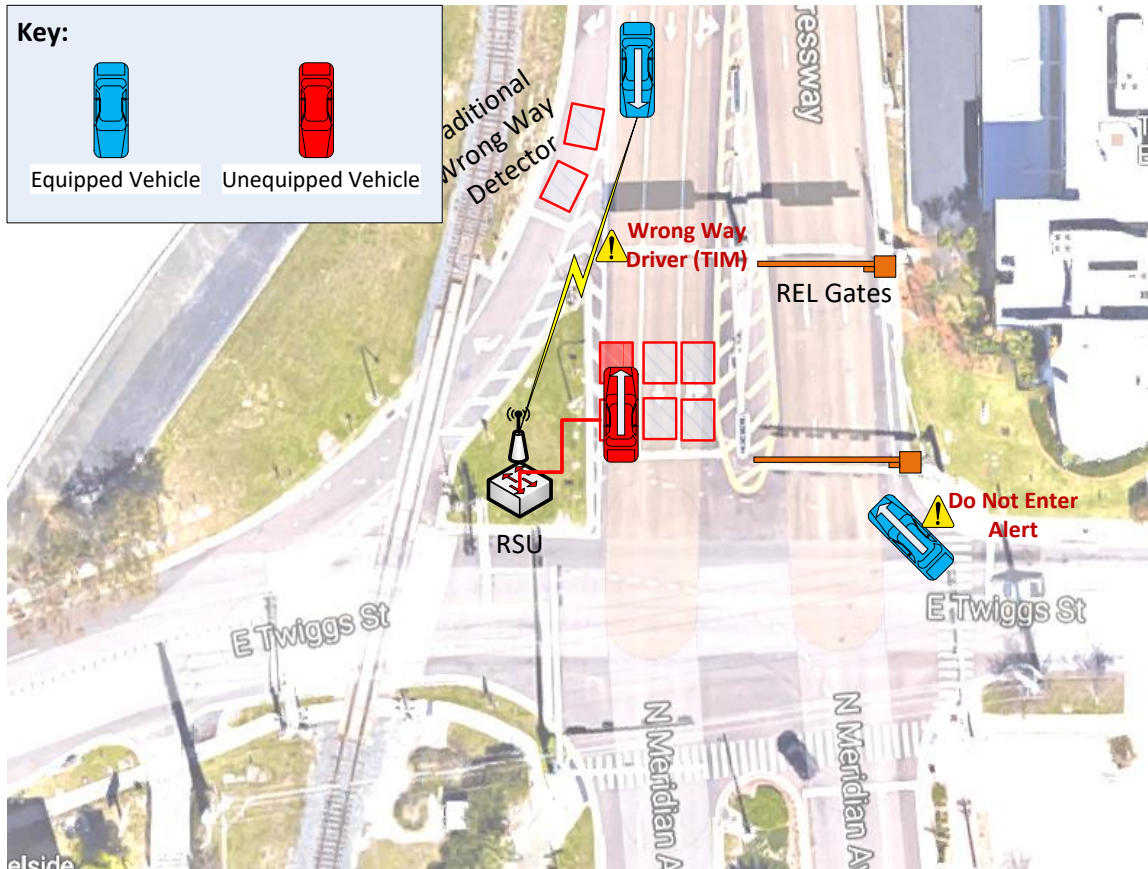
Figure 13: Traditional wrong way driver detection with equipped and unequipped vehicles

Unequipped vehicles going the wrong way would be detected by a radar system (Temple) that covers the 4 possible lanes to drive onto the REL with detection zones. Detection zones on the outbound access lanes aren't needed since the gates are closed when these lanes are closed for traffic.

Detection zones for unequipped vehicles would be located per the "As Built" engineering records such that when a vehicle is detected going the wrong way it is an actual violation with a very high certainty and not a false positive. The red vehicle represents a wrong-way driver entering the REL illegally. The WWE application on the RSU receives the corresponding detection and broadcasts a TIM with a wrong way driver alert. Equipped vehicles driving inbound on the REL receive the alert and warn their driver via the HMI. This is illustrated by the blue vehicle driving southbound on the REL. The TIM would be broadcast continuously for a configurable amount of time.

The OBU of an equipped vehicle will be able to determine that a wrong way violation is imminent or highly likely based on the vehicle's current trajectory. This is illustrated in above figure by the blue vehicle making an illegal right turn when the gates are closed. When the OBU determines that the vehicle is on a trajectory to turn into a closed lane the HMI will warn the driver (see also section 3.3.2.2).

An equipped vehicle detects the wrong way violation based on the MAP message broadcast for the intersection. The OBU detects that the vehicle is approaching an ingress lane going the wrong direction when it rather should be using an egress lane. Likewise, the OBU detects that the vehicle is attempting to use a closed lane.

3.2.2.2.2   Detailed Design
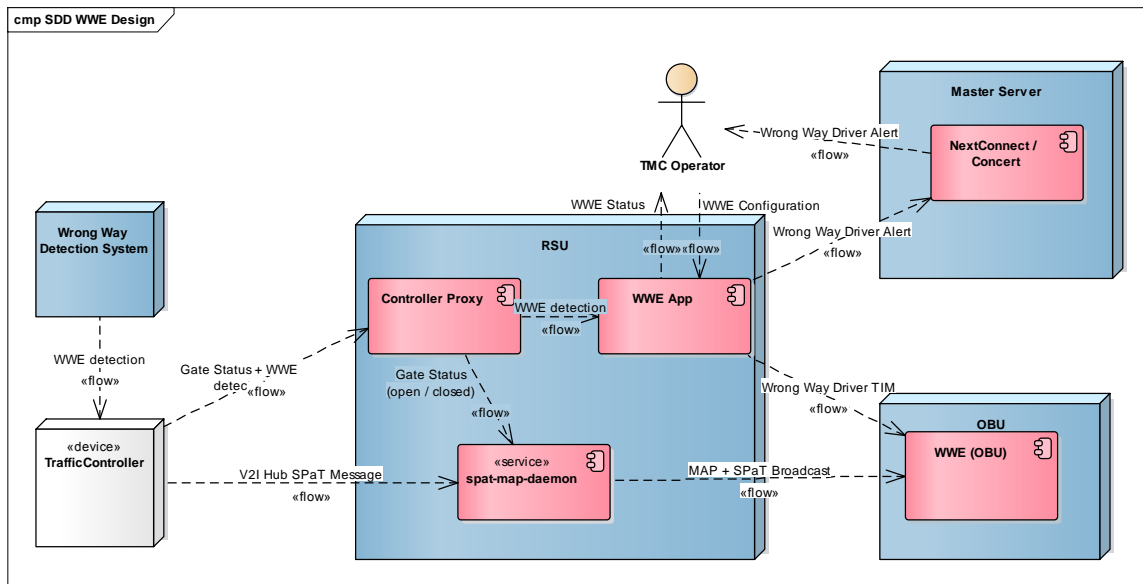
Figure 14: WWE Software Design

The WWE application on the RSU receives a wrong way detection event via the local NTCIP traffic controller to which the wrong way detection system is connected to. The interface used to query for the detection event is defined in ICD: interface 23006 "Phase and Detector Status". This interface also defines the SPaT message sent from the traffic controller to the RSU.

The Controller Proxy component serves as a gateway to isolate other components from the details of the traffic controller interface. It is used by the WWE app to receive detection events from the wrong way detection system. It is also used by the SPaT-MAP-Daemon in order to receive the current open/closed status of the gates. The SPaT-MAP-Daemon uses the gate status in order to set the enabled Lanes in the broadcast SPaT message. See ICD: interface 23007 "reversible lane status".

The WWE application sends out a configured TIM message when a wrong way driver is detected by the wrong way detection system. See ICD: interface 20014, "I2V Situational Awareness TIM (I2V)".

The WWE application also notifies the Concert system of the wrong way incident which is displayed to the TMC operator. See ICD: interface 23018 "RSU Application Status".

Figure 15: Active Wrong Way Incident on the Concert UI
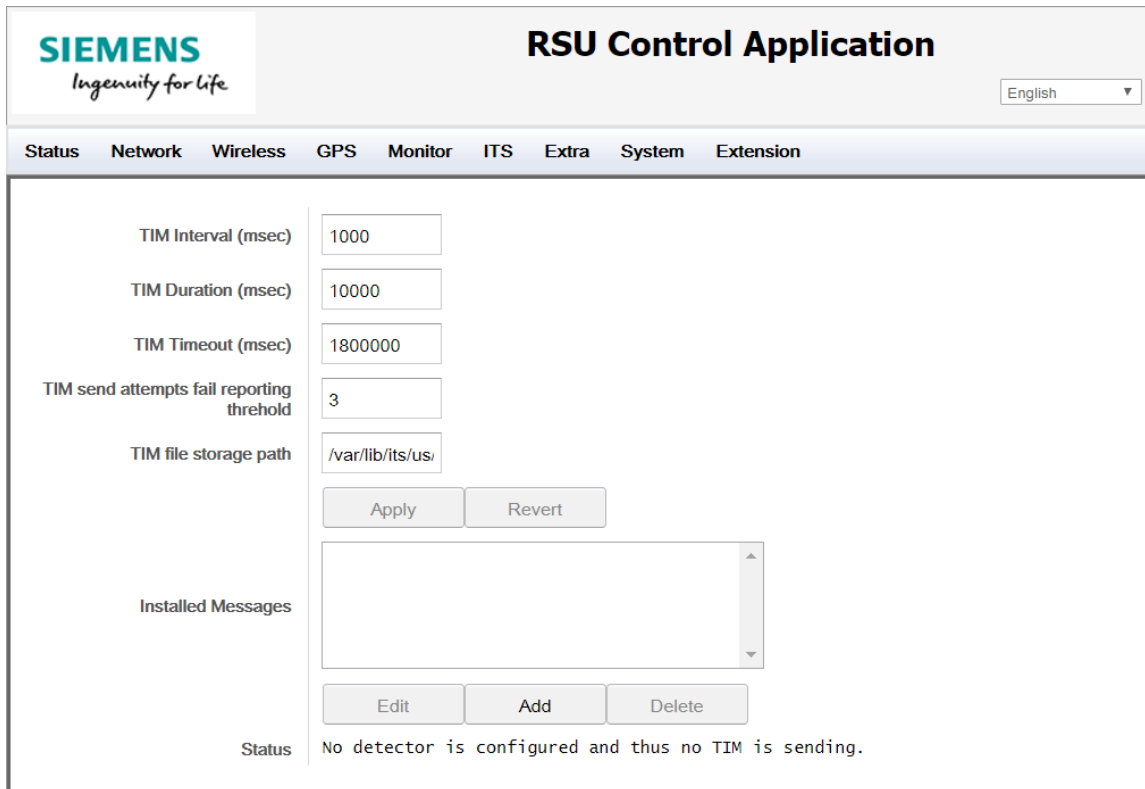
Figure 16: WWE Application Configuration and Status

The above figure shows the WWE application UI screen which supports configuration of WWE and displays the current application status. The Interval configures the time interval between repeated broadcasts of a TIM (e.g. 1 second). The Expiration field configures the amount of time that a wrong-way TIM will be broadcast after the wrong-way driver detection occurred (e.g. 60 seconds). Installed Messages shows the TIMs configured to be broadcast in the event of wrong-way detection.

The SPaT-MAP-Daemon is a Siemens core application which processes the V2I Hub SPaT message received from the traffic controller. See ICD: interface 23006 "Phase and Detector Status". The SPaT-MAP-Daemon broadcasts MAP and SPaT messages. See ICD: interface 20008 "Intersection Geometry" and interface 43013 "Intersection Status", respectively.

See section 3.3.2.2 in this document for a discussion on how the WWE (OBU) application uses the TIM, MAP, and SPaT messages received to warn the driver using the HMI.

3.2.2.3 MMITSS

3.2.2.3.1 Conceptual Design
The Multi-Modal Intelligent Traffic Signal System (MMITSS) is innovative traffic control software developed by the University of Arizona within the department of Systems & Industrial Engineering under the supervision of Professor Dr. Larry Head. The software has been funded by the Connected

Vehicle Pooled Fund Study (CV PFS) and has been published on the Open Source Application Development Portal (OSADP[4]).

The conceptual design of MMITSS as used in this CV pilot is described in [5], specifically in section 4.5 of that document.

The Tampa CV pilot uses the MMITSS applications I-SIG (Intelligent Traffic Signal Control), TSP (Transit Signal Priority), and PED-SIG (Pedestrian Mobility) as defined in the Arizona MMITSS architecture. Usage of PED-SIG is further described in sections 3.2.2.4 and 3.4.2.1. I-SIG and TSP usage is further described in the next section.

3.2.2.3.2   Detailed Design
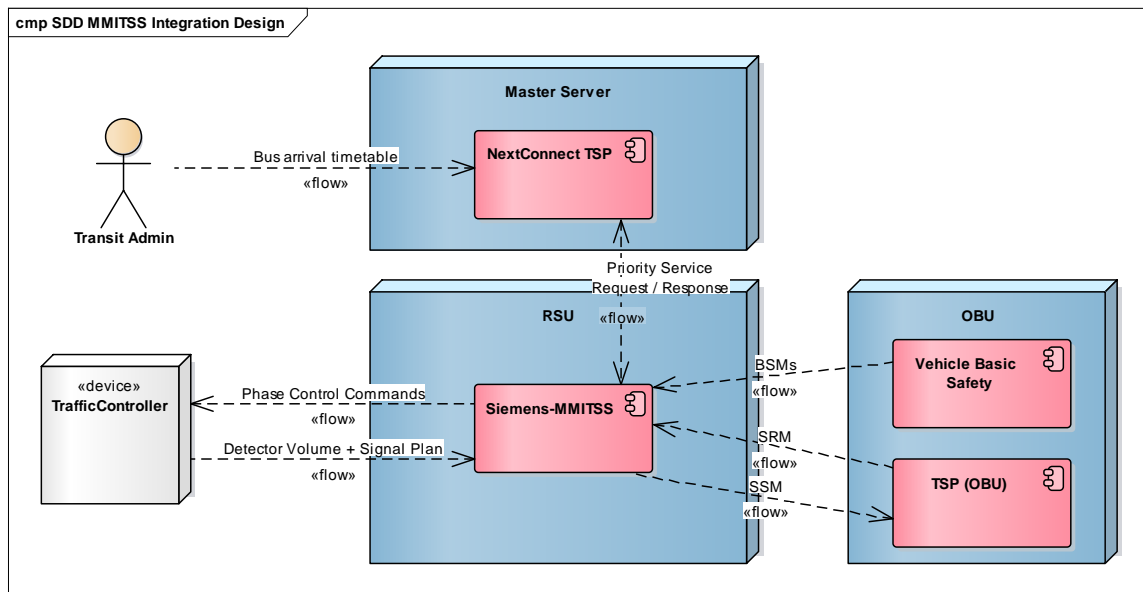
Figure 17: Software Design of MMITSS Integration into ESCoS RSU

MMITSS is existing software and as such comes with an existing software design. See [6] for details on the MMITSS software design.

MMITSS v1.1 was written to run on standard Ubuntu Linux. Prior versions run on Savari RSUs (and OBUs). For the CV Pilot it is necessary to port this software to run on a Siemens ESCoS RSU. Furthermore, MMITSS has to be updated to use SAE J2735_201603 instead of the 2009 revision of the standard. This creates a derivative work tentatively called "Siemens-MMITSS".

Siemens-MMITSS includes all of the following processes defined in the MMITTS Detailed Design document [6]:
- MRP_EquippedVehicleTrajectoryAware

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[4] https://itsforge.net/

- MRP_PerformanceObserver
- MRP_PriorityRequestServer
- MRP_Priority_Solver
- MRP_TrafficControl
- MRP_TrafficControllerInterface

Siemens-MMITSS interfaces with the traffic controller via NTCIP in order to receive information about the controller configuration, current signal plan, and vehicle calls and volume from detectors. It then uses phase control commands (i.e. phase calls, holds, omits, and force offs) to control the phase execution. See ICD: interface 23006 "Phase and Detector Status" and interface 23013 "Signal Priority Service Request".

Siemens-MMITSS receives BSMs from OBUs and estimates queue lengths based on monitoring each vehicle's speed and location as it approaches the intersection. This queue length is used as input to I-SIG for optimizing the phase time allocation. See ICD: interface 20004 "Vehicle Location and Motion".

Siemens-MMITSS also receives priority service requests via SRMs (signal request messages) from OBUs of equipped buses. See ICD: interface 20009 "Local Signal Priority Request".

Priority service requests are sent to the transit server first. At the master server the NextConnect TSP component determines if the bus is behind schedule based on the current bus schedule adherence. If the bus is behind schedule the request is granted and otherwise rejected. See ICD: interface 23013 "Signal Priority Service Request". The design of NextConnect TSP is further described in section 3.1.2.2 of this document.

If the priority service request is granted by the NextConnect TSP then Siemens-MMITSS processes it along with other granted requests in the TSP component. For all received SRMs Siemens-MMITSS adds a corresponding entry to the SSM (signal status message) and informs the TSP (OBU) application the priority response status. See ICD: interface 20009 "Local Signal Priority Request".

The design of the TSP (OBU) application is further described in section 3.3.2.3 of this document.

3.2.2.4   PED-SIG

3.2.2.4.1   Conceptual Design
The CV pilot PED-SIG application is based on the MMITSS PedApp. See [6] section 5.5.4 "Nomadic MMITSS Application (MMITSS PedApp)" for details.

3.2.2.4.2 Detailed Design
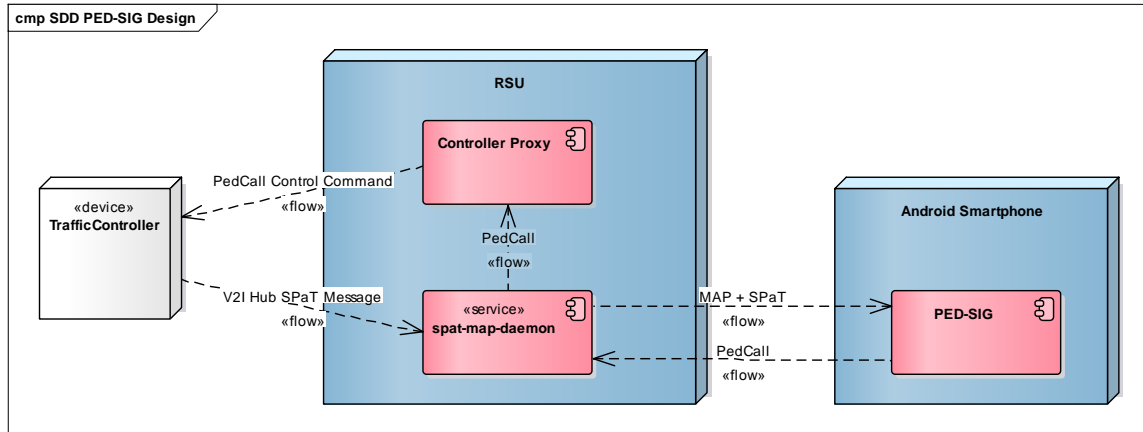
Figure 18: PED-SIG Software Design

The MMITSS PedApp uses a custom format for representing the crosswalk geometry. See [6] section 5.3.8 "MRP_Ped_MAP_Broadcast" for details. The CV pilot improves this design by sending a J2735 MAP message containing crosswalk geometry to PED-SIG. PED-SIG processes the MAP message and extracts relevant crosswalk geometry and signal group IDs. Crosswalks are represented in the MAP message in accordance to [7].

The MMITSS PedApp uses a custom format for representing the pedestrian signal phase and timing status. The CV pilot improves this design by sending the same J2735 SPaT message which I broadcast to vehicles also to PED-SIG. PED-SIG processes the SPaT message and extracts relevant pedestrian signal status and timing information.

PED-SIG receives the MAP and SPaT messages from the SPaT-MAP-Daemon. See ICD: interface 23026 "Intersection Geometry" and 23027 "Intersection Status". PED-SIG allows a user to request walk (pedestrian call) via the smartphone when it is near the crosswalk very much like pushing a button on a pole. PED-SIG sends the pedestrian call to the spat-map-daemon which uses the Controller Proxy component to forward the call to the NTCIP traffic controller. See ICD: interface 23028 "Pedestrian Call" and interface 23013 "Phase Control and Detector Status".

See also section 3.4.2.1 PED-SIG in this document for a more detailed description of the PED-SIG smartphone application.

3.2.2.5   PCW / PED-X / PTMW

3.2.2.5.1   Conceptual Design of PCW
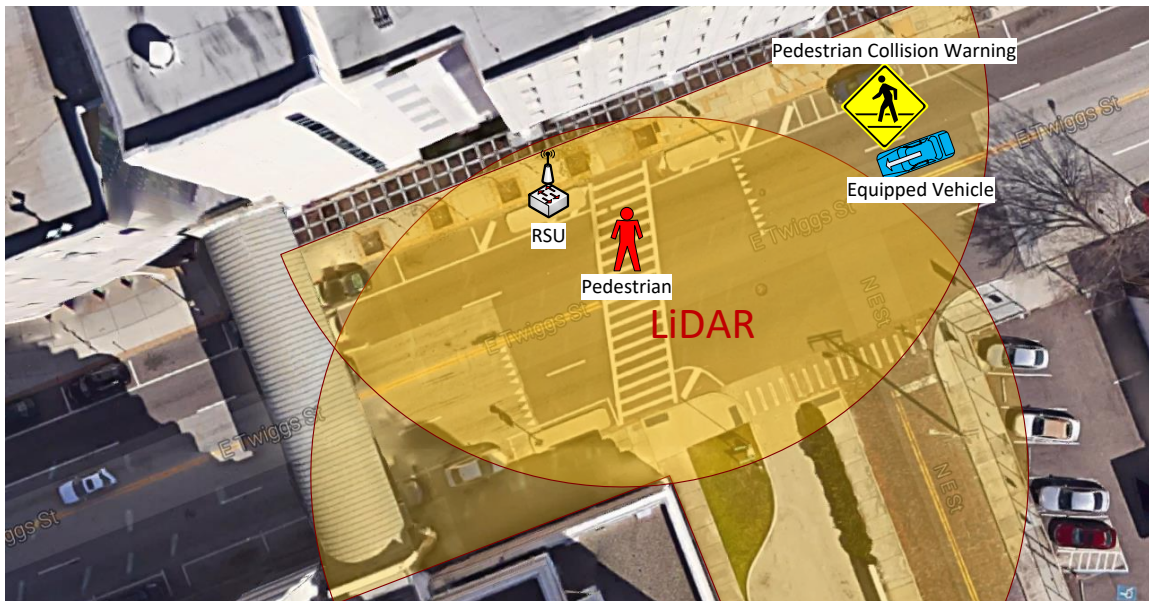
Figure 19: LiDAR Pedestrian Detection triggers a Pedestrian Collision Warning (PCW)

The PED-X application on the RSU is connected with a Pedestrian Detection System which is based on LiDAR. The system is going to be deployed at the unsignalized crosswalk across Twiggs Street near the courthouse. 2 LiDAR sensors scan the cross walk and adjacent sidewalk area from 2 opposite locations.

The LiDAR system is able to accurately measure a pedestrian's location and track their movements. The LiDAR system converts this information into Personal Safety Messages (PSMs) for each tracked pedestrian and sends them out to equipped vehicles via the RSU.

The pedestrian collision warning (PCW) app on the OBU receives the PSMs and uses the vehicle's location and trajectory to calculate a pedestrian collision threat. The HMI warns the driver with a pedestrian collision warning. See section 3.3.2.4 in this document for more details on the OBU PCW application.

The conceptual design of PED-X and PTMW is covered in section 3.4.2.2.

3.2.2.5.2 Detailed Design
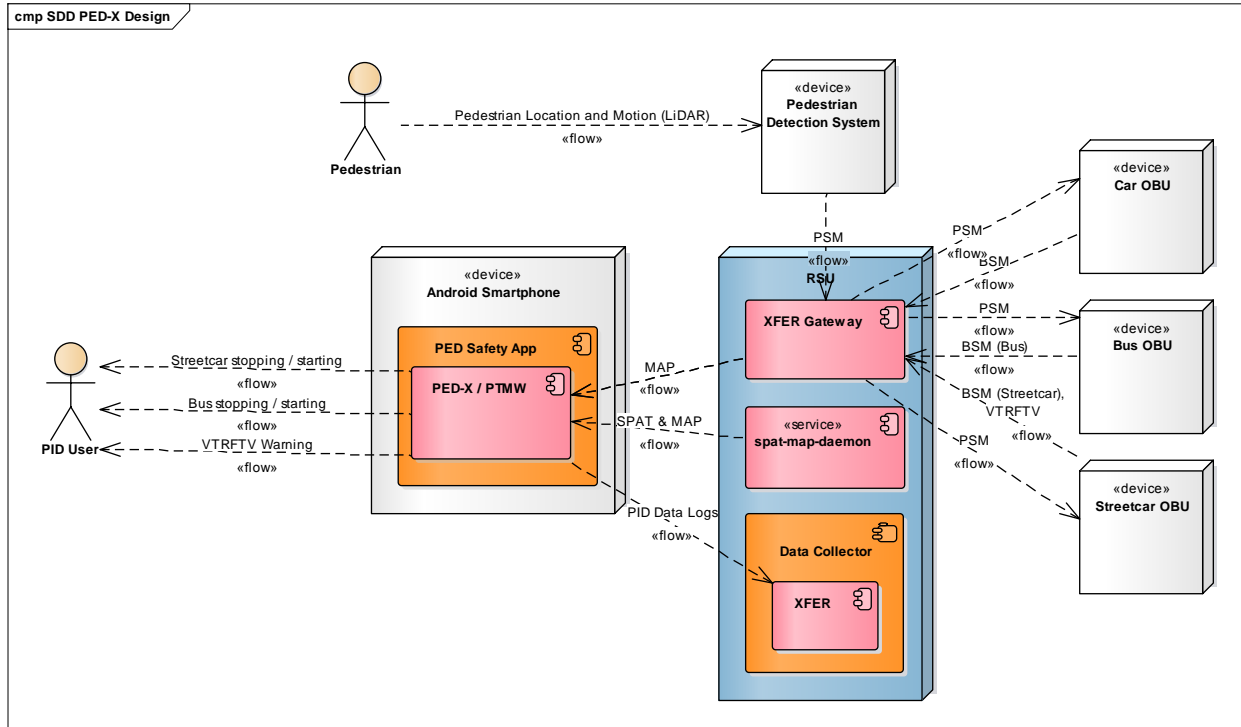
Figure 20: PED-X Software Design

The LiDAR Pedestrian Detection System uses the XFER interface on the RSU to send PSMs. See ICD: interface 23008 "Personal Location". The RSU component XFER Gateway receives the PSMs and sends them out via WAVE to nearby OBUs. See ICD: interface 20012 "Proxy Personal Location".

The XFER Gateway also receives BSMs from nearby OBUs via WAVE. See ICD: interface 20004 "Vehicle Location and Motion". It forwards those BSMs to the pedestrian safety app on nearby smartphones connected via WiFi to the RSU. See ICD: interface 23012 "Proxy Vehicle Location and Motion for PID". The spat-map daemon on the RSU sends SPAT and MAP messages to the smartphone as well. See ICD: interface 23026 "Intersection Geometry" and 23027 "Intersection Status".

PED-X / PTMW app is included in Figure 20 in order to illustrate the RSU side of those PID applications. For a detailed discussion of the PED-X / PTMW app interfaces with the PID User see section 3.4.2.2 of this document. For a detailed discussion of the PID data log flow see section 3.2.2.6.

3.2.2.6   Data Log Collector

3.2.2.6.1   Conceptual Design
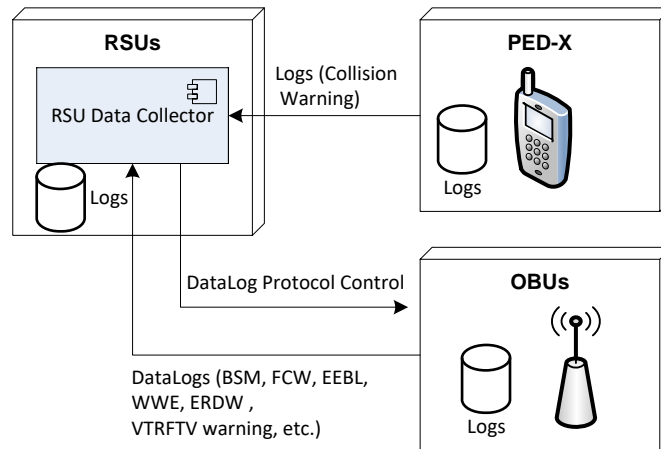
Figure 21: Data Log Collector Concept

OBUs collect log data. The data collected is specified in appendix 7.1 in this document. OBUs will send the collected data via WAVE to RSUs. Due to the fact that OBUs aren't always in radio range of an RSU the log data is stored on the OBU until it can be sent. This also addresses the problem that the communication bandwidth available to a single OBU will depend on at least a few factors such as:

- Other RSUs and OBUs using the same channel
- Signal strength

It is anticipated that data collection rate and transfer rate will vary such that at times data will be collected at a higher rate than it can be transferred to a nearby RSU. There may also be times when data collection rate is lower than the data transfer rate which will allow the OBU to "catch up".

Available bandwidth for data transfer from OBUs to RSUs is a big concern. The total bandwidth will have to be shared among all OBUs within radio range possibly bringing the bandwidth down to a trickle. The design anticipates this situation and allows the RSUs to change certain protocol parameters (e.g. minimum time between data log messages) used by OBUs via log data control messages.

The PED-X smartphone application also collects logs which contain the smartphone location and collision warnings which were computed by PED-X based on that location. These warnings are only computed but not displayed to the smartphone user for safety reasons as well as because the smartphone location is inherently very inaccurate. Additionally, PED-X also collects logs whenever the "bus (streetcar) is stopping / starting warning" is issued and when the VTRFTV warning is displayed.

The RSU collects all the received data logs in a local persistent log buffer. This addresses the issue that most RSUs in the CV pilot are connected to the master server via LTE cellular connection which is considered an unreliable communication link. If the LTE connection is temporarily down data logs aren't lost. They will be transmitted later when the LTE connection is back up again.

3.2.2.6.2 Detailed Design
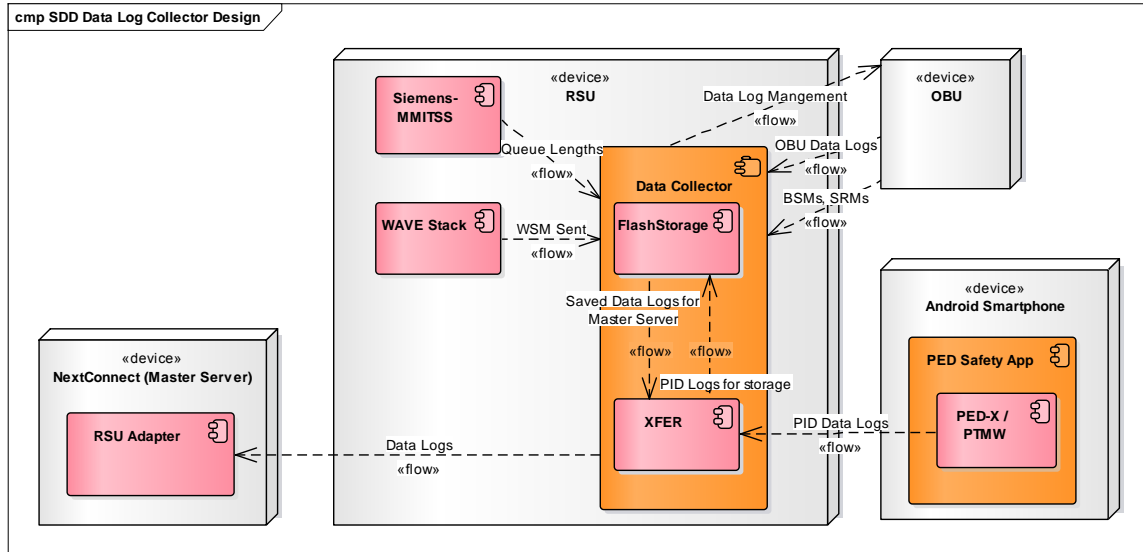
Figure 22: Data Log Collector Software Design

The OBU receives DataLogManagement information via the broadcast WSA containing the DataLog PSID. The OBU will send its data logs to the RSU via an encrypted WAVE connection. See ICD: interface 23015 "OBU Data Logs".

PED-X sends PID data logs to the Data Collector containing the smartphone location and any collision warnings which were computed but not displayed to the user via XFER. See ICD: interface 23029 "PID Data Logs".

The Data Collector receives estimated Queue Lengths from Siemens-MMITSS through a local inter-process communication (IPC) interface provided by the ESCoS stack.

The Data Collector also stores BSMs and SRMs received from OBUs as well as certain WSMs (WAVE Short Messages) sent by the RSU (i.e. MAP, SPAT, TIM, PSM, SSM). The Data Collector stores the WSMs, the Queue Lengths, and the received data logs in local Flash Storage.

The Data Collector creates batches of data logs from Flash Storage and sends them to the master server via XFER. See ICD: interface 23030 "RSU Data Logs".

3.2.2.7 OTA Update

3.2.2.7.1 Conceptual Design

3.2.2.7.1.1 Overview

The OTA File Broadcast leverages RSUs which are distributed through downtown and along the REL[5] in order to distribute the firmware images and other files to OBUs. Each RSU will continuously broadcast all configured files in a round-robin fashion[6]. The RSUs should ideally use a dedicated DSRC channel which isn't used for anything else but file updates. Also, the RSUs should be located such that their respective radio range doesn't overlap significantly. This should minimize the number of channel access collisions and maximize the available bandwidth for file update broadcast.

The radio range of a dedicated file broadcast RSU (FBR) will overlap with that of regular RSUs providing messages for the CV applications. Since OBUs are equipped with 2 DSRC radios with one radio dedicated to the safety channel, a channel access prioritization scheme is needed in order to define how OBUs are expected to handle contention for available DSRC radio timeslots. See section 3.2.2.7.1.7 for details.

Because of the typically large size of firmware files (100 MB) they will have to be broken up into packets which fit into the size limit of a DSRC / WAVE message frame (1400 bytes). Each FBR will then continuously broadcast those packets using a special encoding scheme. An FBR also broadcasts a corresponding WAVE Service Advertisement (WSA) message which lets OBUs know which files are being broadcast and which channel to tune to.

As OBUs travel through the study area they will be able to collect packets from the dedicated file broadcast RSUs (FBR). However, OBUs will also experience packet loss for various reasons such as:
- The OBU went out of radio range or experienced noise on the channel.
- The OBU got turned off along with the vehicle.

With a naïve implementation approach of sending out sequential packets for each file, it is estimated that it would take 9 – 11 minutes for an FBR to broadcast 100 MB worth of data via the dedicated channel. With 3 such files (e.g. firmware images) going round-robin with packets interleaved, it would take at least 33 minutes for an OBU to receive the full 100 MB file which it too long. This calculation also does not yet include any encoded data overhead and is therefore too optimistic.

It would be unlikely for an OBU to be within radio range continuously for that amount of time. Moreover, each OBU would have to receive all packets without missing a single one in order to be able to reconstruct the entire firmware image sent. Especially the latter is a highly unlikely assumption. Therefore, a special encoding scheme is needed for the packet broadcast which allows a single OBU to reconstruct the entire file as long as it receives enough file packets.

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[5] It would also be possible to use RSUs which already serve other purposes. However, dedicated RSUs would be able to leverage normally unused DSRC channels and should provide for better bandwidth.

[6] Round robin scheduling is a method of allocating time slices for broadcasting a given number of files and going in circular order through the files.

The encoding problem to solve here is addressed by the family of erasure codes (Wikipedia https://en.wikipedia.org/wiki/Erasure_code). Among others the following are erasure codes: Tornado Code, Fountain Code, Raptor Code, Reed-Solomon Code, Random Linear Network Code (RLNC).

The erasure code selected for this specification is Wirehair (https://github.com/catid/wirehair). Wirehair belongs to the family of fountain codes, a rateless erasure code. This means it can produce a potentially unlimited number of unique encoded blocks.
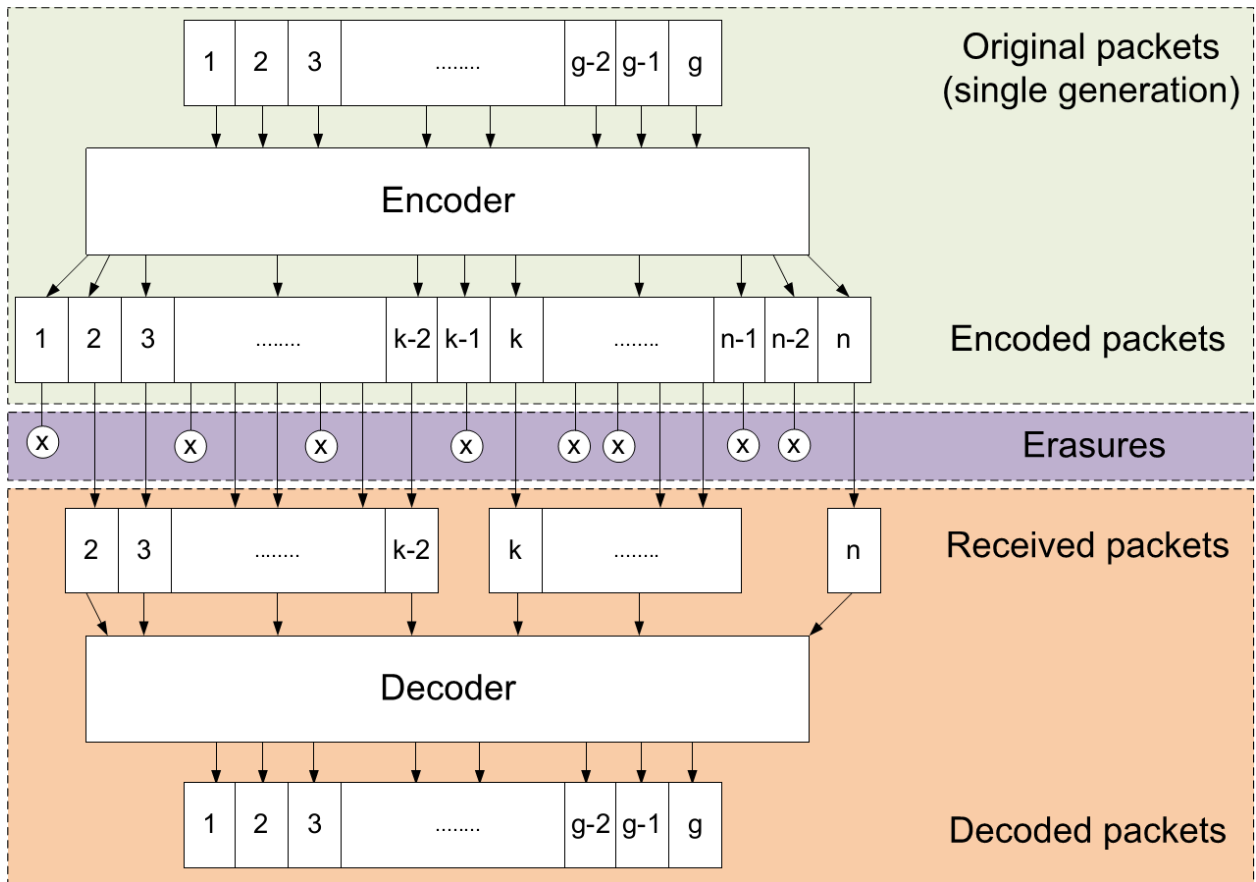
(Source: Steinwurf Projects, http://docs.steinwurf.com/nc_intro.html)

Figure 23: Working Principle of Random Linear Network Coding

The above figure illustrates how encoding and decoding with a fountain code works (the figure is actually from an RLNC implementation which is similar). The encoder takes as input a so-called generation which has a maximum size. It then breaks up the generation into packets and encodes each one, producing encoded blocks. The block size is typically set to match the maximum transfer unit (MTU) size of the underlying transport. However, there are ways to increase the block size with little drawbacks as per discussion below.

RLNC (like fountain codes) is a rateless erasure code. That means the encoder can produce an unlimited number of encoded blocks. Any one of these blocks can be used by the decoder for decoding the originally encoded generation. The decoder just needs to receive enough unique blocks. The total number of bytes of received encoded blocks usually only needs to be ~3% higher than the generation size. So, in the case of a 100 MB file being broadcast any receiver only needs to receive 103 MB worth of unique encoded blocks in order to be able to decode and reconstruct the original file.

With a rateless code like Wirehair the RSU will continuously generate and broadcast new encoded blocks instead of repeating previously sent blocks. That way it wouldn't matter during which time an OBU receives blocks. It would only matter how many it receives. The alternative would be to have the RSU send a limited number of previously encoded blocks in an endless loop. With such an approach an OBU may see more blocks which it already received, and it might take longer for an OBU to receive enough unique blocks in order to decode the entire file. Choosing between these 2 alternatives will have to be part of the RSU implementation and should be based on considering the computational overhead of continuously creating new encoded blocks vs. the expected delay in decoding the whole file. On the decoding side there is no difference in implementation between the 2 alternatives.

3.2.2.7.1.2   Block Size vs. Block Count

The computational load of encoding/decoding a generation file grows non-linearly with the block size and block count that is produced by the encoder. Block count has a larger impact than block size, so a larger block size with fewer blocks is better than a smaller block size with more blocks.

From experience a 4-8 Kilobyte block size is a good sweet spot. This is larger than the targeted packet data unit (PDU) of 1300 bytes. However, it is possible to send a block of size 5200 bytes in 4 consecutive UDP packets containing 1300 bytes encoded block data each. Packets belonging to the same encoded block are identified by having the same blockID. The 1st packet of a block has the packetID == 0, the next packet has the packetID == 1 and so forth. The packet count for an encoded block shall be configurable. For purpose of further discussion in this specification it shall be assumed to be 4.

The drawback of this approach is that, if an OBU doesn't receive all 4 UDP packets of a block, then the data in the packets already received is useless. On average 1.5 UDP packets would be thrown out when the OBU comes in radio range of the RSU and 1.5 UDP packets would be thrown out when the OBU leaves the RSU radio range.[7] If the OBU is in range of the RSU for 32 seconds[8], the OBU will see ~3600[9] UDP packets of which 1/3 (~1200 packets) will be for Vendor-A OBU (assuming 3 vendors). Hence dropping 3 packets per "session" amounts to less than 0.3% loss.

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[7] If an OBU only receives 1-3 packets of a block it has to discard the entire block. The assumption is that this will happen randomly for a single block when the OBU just gets within radio range as well as when it leaves the radio range. Hence on average 1.5 packets are wasted / discarded.

[8] 32 seconds is the time it takes a vehicle travelling at 70 MPH to pass through a radio range of 1000 meters. This is realistic for unobstructed deployments for example along the REL. Within the Tampa downtown area vehicle speeds are less than 25 MPH and pass-through radio range is estimated to average at least 350 meters resulting in a similar time window.

[9] At 1.35 Mbps MAC level transfer rate we can expect to broadcast up to 5662310 bytes within 32 seconds or roughly 3700 packets of 1500 bytes each. For argument sake we're reducing that amount

3.2.2.7.1.3   1 BIG FILE vs MANY FILE FRAGMENTS

Another computational load saver is to break up the large firmware image file into many smaller fragments (called generations in the context of RLNC, see above). All else being equal, it is significantly less computationally expensive to decode 100 1-megabyte encoded fragments than it is to decode one 100-megabyte encoded file.

It is estimated that it would take ~450x the computation power to reconstruct a single 100-megabyte file than it would take to reconstruct one-hundred 1-megabyte fragments and then concatenate them. To allow for breaking the files into fragments, an 8-bit fragment ID field (fragID) and an 8-bit fragment count field (frag) is added to the UDP packets.

Choosing an upper limit on the number of fragments is usually based on the duration of a typical "session". It is desirable that the OBU to receives at least 1 block of data for every fragment during a typical "session" with an RSU.

At 32-seconds per "session", each vendor's OBU will receive ~1200 packets or ~300 encoded blocks. If a 100 MB firmware image file is broken into 100 fragments, the OBU will receive ~3 encoded blocks per fragment per "session". This indicates that 1 MB fragments are acceptable but also shouldn't be much smaller. Fragment size shall be a configurable parameter.

3.2.2.7.1.4   Example Estimated Delivery Time

When using GF(256) and a 100 megabyte file is broken into one hundred 1-megabyte fragments, you can safely say that the firmware image could be reconstructed by receiving 205 blocks of each fragment[10].

At 3 blocks per fragment per "session", a vendor OBU would need ~69 sessions to receive the entire file. Assuming that we deploy 5 non-overlapping RSUs along the commute and the OBU sees these once in the morning commute and once in the evening commute, it would get 10 sessions per "commuter-day".

With the above assumptions, it would take 7 "commuter days" to get the update file (30 blocks per day out of 205).

3.2.2.7.1.5   Packet Broadcast Pattern

The RSU will broadcast file update blocks from multiple vendors interleaved for fairness. In order to allow a recipient OBU for easy filtering of only packets relevant to a particular vendor the RSU will send out each vendor's packets to a unique UDP port (unique to the vendor). The port number used for each vendor will be announced as part of the OTA WSA service info.

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to 3600 UDP packets of 1400 bytes which is ~90% of 1.35 Mbps. An RSU will need to broadcast a new packet every 8.8 ms in order to achieve this data rate.

[10] 1 MB divided up into 5200 byte long encoded blocks requires 202 blocks. With assumed 3 additional blocks required due to encoding overhead the total is 205 blocks.
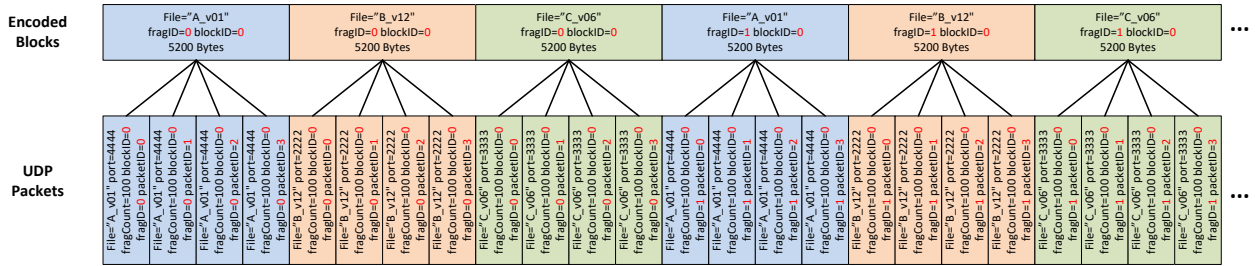
Figure 24: Example Sequence of Packets Broadcast for Firmware Images from 3 Vendors

The above figure illustrates the interleaving of packets from multiple vendors (3 in this example) of the following firmware image files:

- Vendor A, FileName = "A_v01", Port = 4444
- Vendor B, FileName = "B_v12", Port = 2222
- Vendor C, FileName = "C_v06", Port = 3333

Each file is assumed to be 100 MB in total size and has been broken into 100 fragments of 1 MB each.

The diagram shows how blocks from the 3 vendors are interleaved. Each 5200 byte encoded block is broadcast using 4 consecutive UDP packets. It further illustrates that after sending block 0 for fragment 0 of vendor A the RSU will send block 0 of fragment 1. This would continue until block 0 of fragment 99 is sent. At that point the RSU will send block 1 for fragment 0, then block 1 of fragment 1, and so on.

3.2.2.7.1.6   Broadcasting Multiple File Types of Different Size

As discussed in section 3.2.2.7.1.4, successful reception of a large 100 MB file will take roughly 70 sessions. In many cases it isn't necessary to replace the existing firmware of an OBU with a whole new software version, though. Instead it will be sufficient to update certain predefined configuration parameters. Therefore, the OTA file broadcast also needs to support broadcast of small files which could be received by OBUs within only a few sessions.

Assuming a config file of 10 KB size, it would require an OBU to receive at least 2 encoded blocks (5.2 KB each) in order to decode the file. In the packet broadcast pattern discussed above each vendor gets an equal fraction of 1/3 out of all packets broadcast. For each vendor the RSU will broadcast ~300 encoded blocks per 32 second session. Or 3 blocks for each of the 100 fragments. If for example 1 fragment block out of the 100 would be used to broadcast the config file then it would take 1 session for an OBU to receive 3 blocks of the config file which is enough to it.

The firmware file of 100 MB is roughly 10000 times larger than the 10 KB config file. However, the config file would be allocated to be broadcast for 3 out of 300 encoded blocks instead of only 1 out of 10000 blocks. So, the config file gets broadcast disproportionally more often (100 times) which leads to the desired outcome of an OBU receiving the entire file in only one session.

The impact on the delivery time of the 100 MB firmware image is as follows. With 297 encoded blocks per session broadcast for the firmware image file, on average 2.97 encoded blocks per fragment per

session will be received by an OBU. With 205 blocks needed in order to decode all fragments it'll still take roughly 69 sessions until all fragments can be decoded.
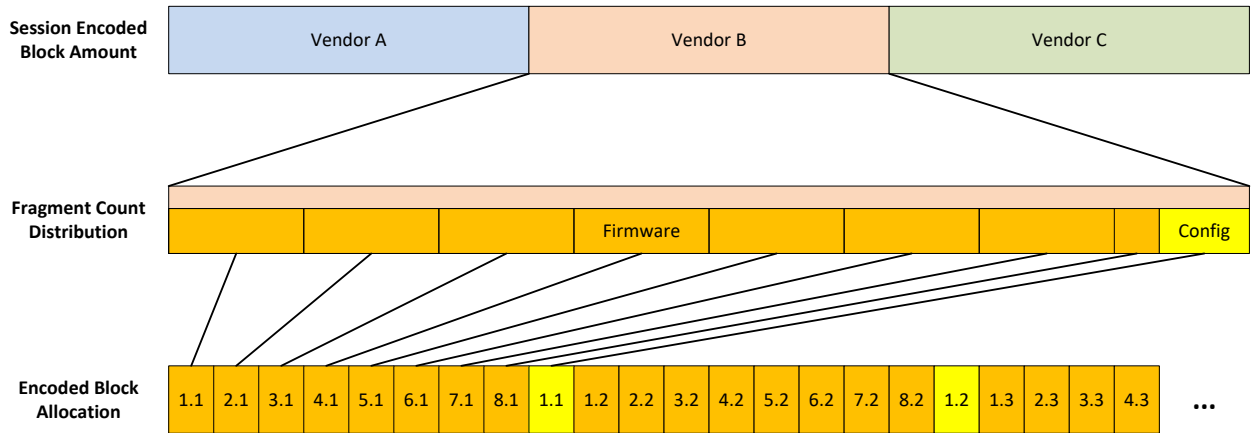
Figure 25: Encoded block allocation with 2 files of different size

Each vendor has the option to broadcast many different file types. The diagram depicts the broadcast of 2 different files by vendor B. The broadcast of encoded blocks for each file is allocated based on the fragment count. With a maximum fragment size of 1 MB the config file (10 KB) will use one fragment while the firmware file (100 MB) uses 100 fragments. Encoded blocks for vendor B are broadcast sending the 1st encoded block for each fragment, then sending the 2nd encoded block, then the 3rd and so on. The block numbers in the diagram are using the nomenclature <FragmentID>.<BlockID>. The block color indicates the file type.

3.2.2.7.1.7   Channel Access Schedule

OBUs are equipped with 2 DSRC radios will dedicate one radio for safety messages (BSMs, MAP, SPaT) on channel 172. The second radio would be able to listen to the control channel (178) for WSAs and TIMs during timeslot 0. That leaves timeslot 1 for tuning to other channels for other services. The following table lists the available services deployed in Tampa in descending priority order. OBUs shall tune to the highest priority service currently advertised by the nearest RSU.

Table 10: Channel Access Priority Schedule for OBUs

WSA	OBU Behavior
PSM (0p27 Ch 176)	Listen for PSMs and calculate PCW. This would have to take precedence over everything else. Other messages broadcast on the same channel would also be received and could be processed. PSM sending will only be deployed on one RSU at the courthouse crosswalk.
SRM / SSM (0p80-82 Ch 176)	For bus OBUs with the TSP app running, the app should monitor MAPs received via 172. As the TSP app determines that it needs to send out SRMs it tunes to 176. SSM status is broadcast once per second at the top of the second. The OBU looking for SSMs would tune to 176 at that time.

WSA	OBU Behavior
SCMS (0pEF-FF-FF-FE Ch 176)	Note: There is ongoing discussion on whether SRM and SSM will have their own PSID. If so, then this could be used to trigger the OBU to tune to 176 in timeslot 1 right after an SSM PSID was received in the WSA.
	If the OBU needs to download new certificates it should react to the IPv6 routing PSID by tuning to 176 and connecting to the commercial SCMS.
OTA (0pTBD Ch 182)	If the OBU determines from the OTA WSA that a newer firmware revision is available, then it should tune to 182 whenever it can and receive as many encoded blocks as possible.
Data Log (0pTBD Ch 176)	If the OBU needs to transfer new data logs it should tune to 176 and send the logs.

3.2.2.7.2 Detailed Design
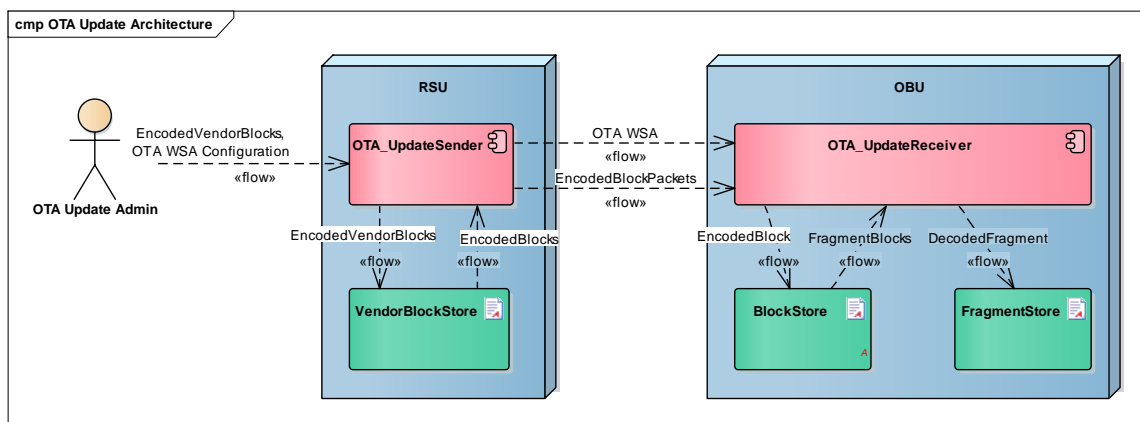
Figure 26: OTA Update Software Design

The RSU implements the OTA_UpdateSender component which is responsible for broadcasting the corresponding WSA service info and the encoded block packets to OBUs. See ICD: interface 23031 "OTA Update".

The OTA_UpdateSender takes configuration information via its browser UI. The configuration includes the encoded firmware image blocks as well as the vendor ID, firmware revision, and UDP port to use. It is intended that vendors perform the fragmentation and encoding of their firmware and provide a ZIP file containing all the fragments and encoded blocks. The OTA Update Admin downloads the ZIP file to the RSU and sets the corresponding vendor, firmware revision and UDP port parameters. The ZIP file is stored in the VendorBlockStore, a storage location on the RSU's Flash Media.

The OTA_UpdateSender continuously sends encoded blocks from the VendorBlockStore to OBUs by dividing each block into 4 packets and interleaving packets from multiple vendors as described above.

The OTA_UpdateReceiver on the OBU receives the packets and concatenates 4 consecutively received packets to an encoded block. It is anticipated that the OTA_UpdateReceiver will store each unique encoded block in a BlockStore. Once enough encoded blocks have been received to decode a fragment the OTA_UpdateReceiver decodes the fragment and puts it in the FragmentStore. When all fragments of a file have been received and decoded the OBU can perform the firmware upgrade.

3.2.2.7.3   OTA Deployment Locations

THEA will deploy additional RSUs not previously considered in the deployment plan along the REL. These RSUs are dedicated to OTA file broadcast and data log transfer. Some downtown RSUs will also broadcast firmware updates to cover buses and streetcars.

3.2.2.8   RSU Management
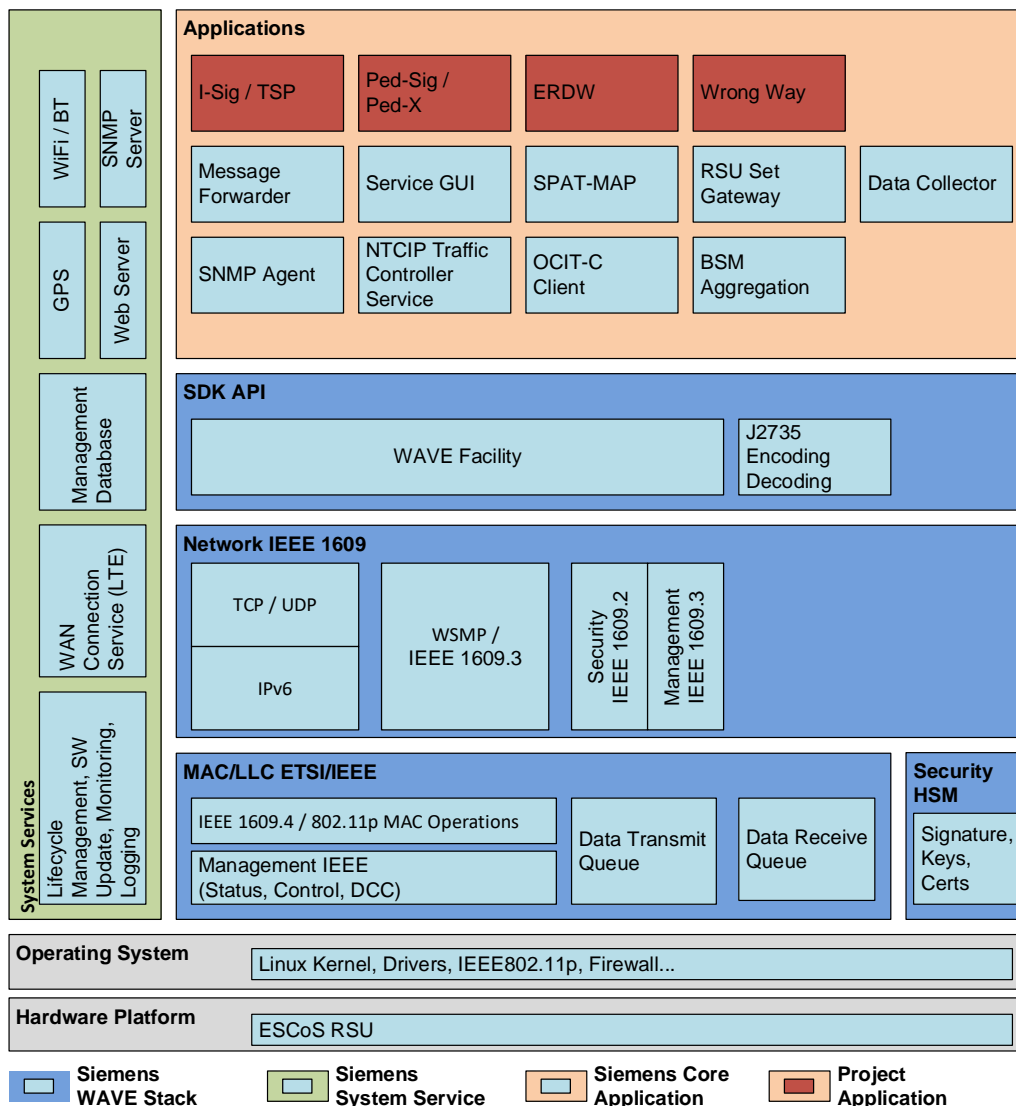
Figure 27: Siemens ESCoS RSU Software Architecture

Siemens Roadside Unit software architecture follows a layered architecture approach. Applications like for example ERDW sit on top of the software stack and are able to leverage the facilities provided in order to implement their functionality. For a description of the individual components of the stack please refer to the "System Architecture Document (SAD) - Tampa (THEA)" [4].

3.2.3 Interfaces

Table 11: Interface triple references used by the RSU

Triple ID	Triple Name	Used By
20004	Vehicle Location and Motion	3.2.2.1 ERDW 3.2.2.3 MMITSS 3.2.2.5 PCW / PED-X
20008	Intersection Geometry	3.2.2.2 WWE
20009	Local Signal Priority Request	3.2.2.3 MMITSS
20012	Proxy Personal Location	3.2.2.5 PCW / PED-X
43013	Intersection Status	3.2.2.2 WWE
20014	I2V Situational Awareness TIM (I2V)	3.2.2.1 ERDW 3.2.2.2 WWE
23006	Phase and Detector Status	3.2.2.2 WWE 3.2.2.3 MMITSS
23008	Personal Location	3.2.2.5 PCW / PED-X
23012	Proxy Vehicle Location and Motion for PID	3.2.2.5 PCW / PED-X
23013	Signal Priority Service Request	3.2.2.3 MMITSS
23013	Phase Control and Detector Status	3.2.2.4 PED-SIG
23015	OBU Data Logs	3.2.2.6 Data Log Collector
23016	Vehicle Entries and Exits	3.2.2.1 ERDW
23018	RSU Application Status	3.2.2.2 WWE
23026	Intersection Geometry	3.2.2.4 PED-SIG 3.2.2.5 PCW / PED-X
23027	Intersection Status	3.2.2.4 PED-SIG 3.2.2.5 PCW / PED-X
23028	Pedestrian Call	3.2.2.4 PED-SIG
23029	PID Data Logs	3.2.2.6 Data Log Collector
23030	RSU Data Logs	3.2.2.6 Data Log Collector
23031	OTA Update	3.2.2.7 OTA Update

3.3 Vehicle Subsystem

The following graphic describes the Vehicle subsystem components consisting of the OBU, rear view mirror as the HMI (display/audio), GNSS/DSRC antenna(s), wiring harnesses and associated installation services.
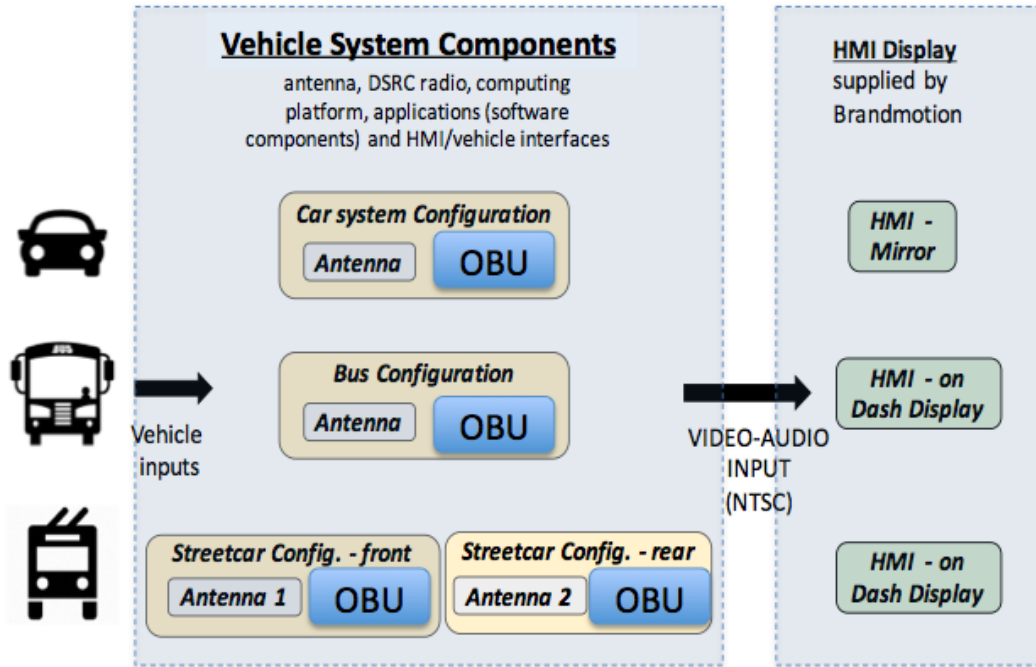
Figure 28: Vehicle System and Components

The following vehicle system diagram and interfaces from the SAD identifies the key system design elements for cars (e.g. light duty vehicles), buses and streetcars.
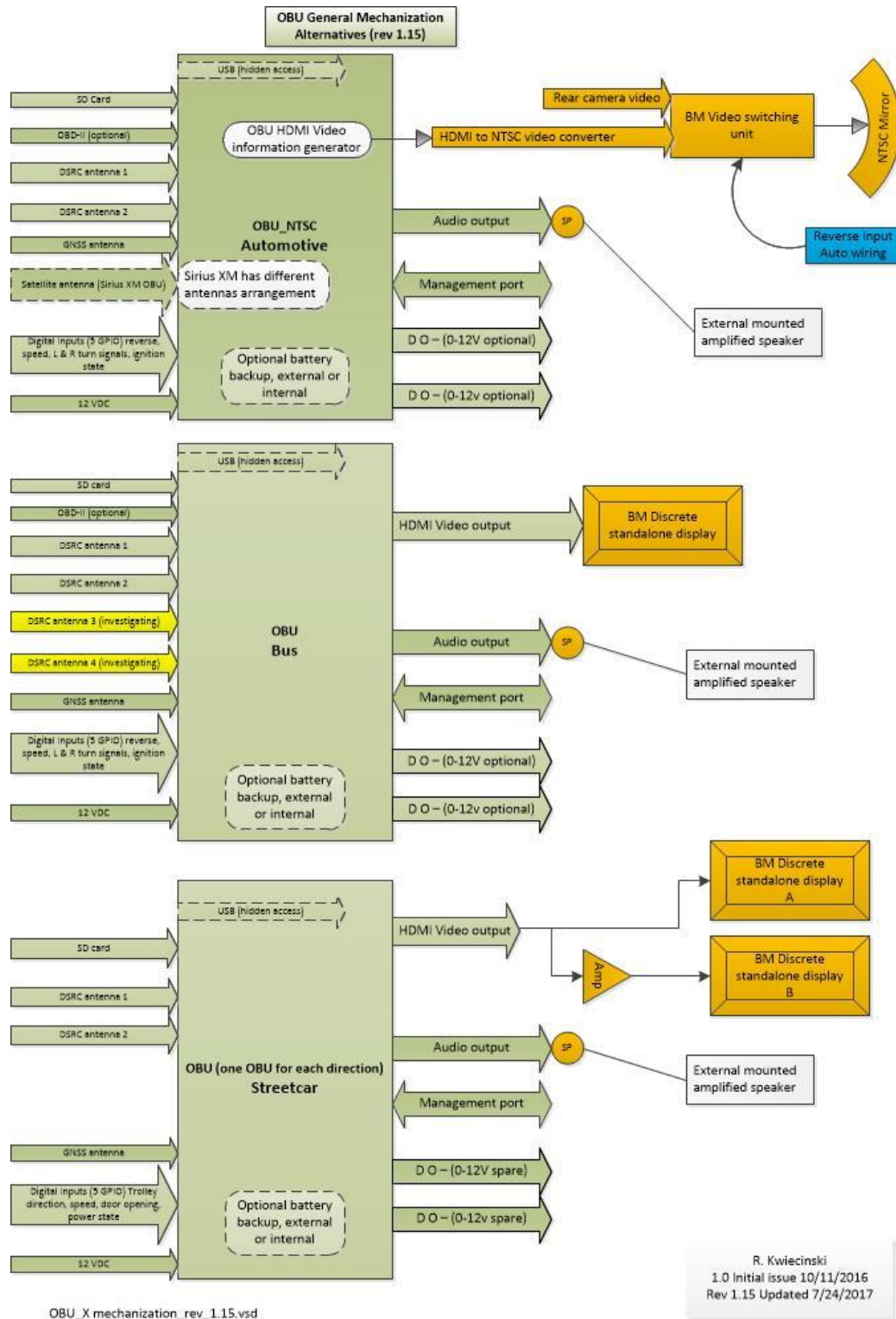
Figure 29: OBU Subsystems and Input/Output – Car, bus and Streetcars

The following is a description of the hardware/software elements:

The Human Machine Interface (HMI) will display all video alerts generated by the OBU. For the CV Pilot program, the HMI components, displays and speakers, will be:

- **Private passenger automobiles and light duty trucks** – Each respective OEM rear view mirror will be replaced with a compatible rear-view mirror, that is maintaining all original mirror functions, that will have a 3.5" LCD video display imbedded with an interface conforming to the National Television System Committee (NTSC), or composite video standard. In the case of a rear camera video equipped mirror, the reverse signal will override any alerts generated by the OBU. A commercially available two channel video switching device is used to switch from rear camera video (if the vehicle is equipped with a rear viewing/back up camera) to the video signal from the video (to display alerts to the driver). Shown below a commercially available mirror that provides this functionality.

- Auto display reverse camera;
- Detecting distance is 30cm, 50cm or 70cm, to calculate spare wheel or bike in the backside into the distance.
- Screen: 4.3" TFT-LCD monitor
- Resolution: 480*272
- Video input: 2 ways
- Signal format: PAL/AUTO/NTSC
- Storage temperature: −40℃~85℃
- Working temperature:−20℃~70℃
- Contrast : 16: 9

Figure 30 Example Mirror

Buses and Streetcars – Each bus and streetcar will have an LCD video display box that will be packaged directly in the driver's field of view. In the case of a streetcar there will be two displays, that is one on each end due to the streetcar reversing driving direction. *(note streetcars do not drive in reverse, rather the driver moves to the opposite side of the streetcar to drive in the other direction).*

- **Display Monitor**: A commercially available 4.3-inch monitor (viewing display area) with a VGA or NTSC input with a temperature specification as follows: operating 0-60°C degrees and a storage of -20 to 80°C.

- **Speaker (s)** – will sound an audible alert generated by the OBU. Locations for the speakers in automobiles, light duty trucks, buses and streetcars will be determined and optimized by HMI and safety experts. A speaker integrated with the rearview mirror is being proposed to reduce wiring.

DSRC Antennas – Each vehicle will have two dedicated DSRC antennas connected to two OBU internal radios. The DSRC antennas will be designed according to the following specifications:
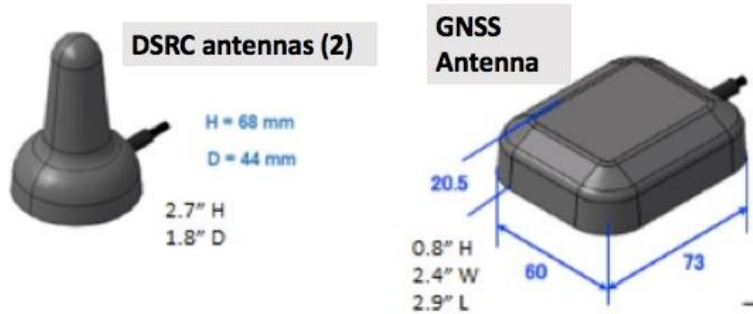
Figure 31: Vehicle Antenna

Brandmotion is sourcing commercially available antennas from Harada Industries as follows:

Table 12: Harada Antenna Part Numbers

Harada Industries Part Numbers
Single DSRC mag mount antenna (DEN-HA-001-002-GEN2)
Single DSRC adhesive mount antenna (DEN-HA-003-002-GEN2) as an alternative design
Dual Band mag mount antenna, Single DSRC and GNSS (COM-HA-001-002-GEN2)
GNSS mag mount antenna (DEN-GN-001-002-GEN2)

Private passenger automobiles and light duty trucks – Each vehicle will have two DSRC antennas with each respective antenna supporting a DSRC radio channel. Antenna locations will be determined by in-vehicle testing.

- **Buses** – Will have 2 DSRC antennas located on the roof. Locations will be determined by in-vehicle testing.
- **Streetcars** – Will have 2 to 4 DSRC antennas located on the roof at both ends of the streetcar. Locations will be determined by in-vehicle testing. *(note streetcars have a wooden roof and will require a metal ground plane under each antenna)*
- **Antennas** - Each vehicle will have one GPS antenna and two DSRC antennas as previously described.

Wiring harnesses and associated installation services – Each vehicle will require unique wiring and associated installation to accommodate different vehicle types (CV Participants), as identified by Global 5, and OBU suppliers (Commsignia, SiriusXM and Savari). The THEA team members, as lead by Global-5, will assess the potential participant's vehicles, those drivers in the THEA community. This information drives the design and installation of the vehicle system, that is what is the type of vehicle, and therefore the best approach to safely and seamlessly integrate the vehicle system into the participant vehicle. The Hillsborough Community College automotive training facilities and personnel will install the vehicle systems.

The following information is being assembled to design and fabricate the specific vehicle and vehicle system designs:

Table 13 - Vehicle System Signal Descriptions

Signal Description	Vehicle Source	OBU Destination	Electrical Characteristics: Voltage,Current, Impedance, Power Description	Used on
Power 12V (Vbatt) (key off)	Unswltched Vbatt	OBU Power (Pwr) (key off)	fused 5A, I = < 50ma	All
Ground (Gnd) *all grounds common	12 V Grd	OBU 12 V Gnd	Common Gnd	All
Power 12V (Ign)	Ign On 12V	OBU Ign On 12V	fused 5A I = @1A	All
Ground (Gnd) *all grounds common	12 V Gnd	OBU 12 V Gnd	Common Gnd	All
Trolley Speed (Vs) *NOT CONNECTED	Axle mounted sensor (NC)	OBU GPIO pin#	Hall Effect (proposed)	Trolley
Bus Door Status switc h (Ds)	Bus door switch	OBU GPIO pin #	0V = closed, 12V = open I = 20 ma	Bus
Trolley Door Status switch (Ds)	Trolley door switch	OBU GPIO pin #	0V = closed, 12V = open I = 20 ma	Trolley
Car Left Turn Signal (LTs)	Left turn signal switch	OBU GPIO pin#	0v • 12V blinking I = 20 ma	Car
Car Right Turn Signal (RTs)	Right turn signal switch	OBU GPIO pin#	0v • 12V blinking I = 20 ma	Car
Bus LeFt Turn Signal (LTs)	Left turn signal switch	OBU GPIO pin#	0v • 12V blinking I = 20 ma	Bus
Bus Right Turn Signal (RTs)	Right turn signal switch	OBU GPIO pin#	0v • 12V blinking I = 20 ma	Bus
Speaker (Sp)	Speaker, +-	OBU Speaker,+-	I = 160 ma 2 watt	All

Signal Description	Vehicle Source	OBU Destination	Electrical Characteristics: Voltage,Current, Impedance, Power Description	Used on
Reverse (Rvs)	Reverse lamp	OBU GPIO pin#	OV = Off, 12V = ON	Car, Bus
Brake light (Brk)	Brakelight	OBU GPIO pin #	OV = Off, 12V = ON	Car, Bus
Rear VIew Mirror (Rvm) Video	Rear View Mirror	OBU video out	HDMI (NTSC input conversion)	Car
LCD Display (LCD)	LCD Display	OBU video out	HDMI	Bus,Trolley
SD Card	OBU	SD Card	SD Card	all
GPS Antenna	GPS	GPS	GPS in	all
DSRC Antenna (2)	DSRC ANT (2)	DSRC (2)	DSRC in	all
Ethernet	Internal development only	OBU ethernet	ethernet	all

Abbreviations used:

- pwr – power,
- Grd or Gnd – signal ground,
- CAN – Controller Area Network,
- GPIO – General Purpose Input/Output,
- HDMI - High-Definition Multimedia Interface,
- Ign – ignition signal,
- OV – over voltage,
- z – Impedance,
- Lt – Left turn and
- Rt – Right Turn

3.3.1 Hardware Design – On Board Unit (OBU)

On-Board Unit (OBU) design shown in figure, provides the vehicle-based processing, storage, and communications functions. Dedicated Short Range Communications, the "radios" supporting V2V, V2P, and V2I communications are a key component of the Vehicle OBU. This communication platform is augmented with processing and data storage capability that supports the connected vehicle applications. The hardware platform is typical of current OBU designs as follows:

- Processor 1 GHz iMX6 Dual Core
- Memory 1 GB DDR3 DRAM
- Storage Up to 8GB Flash
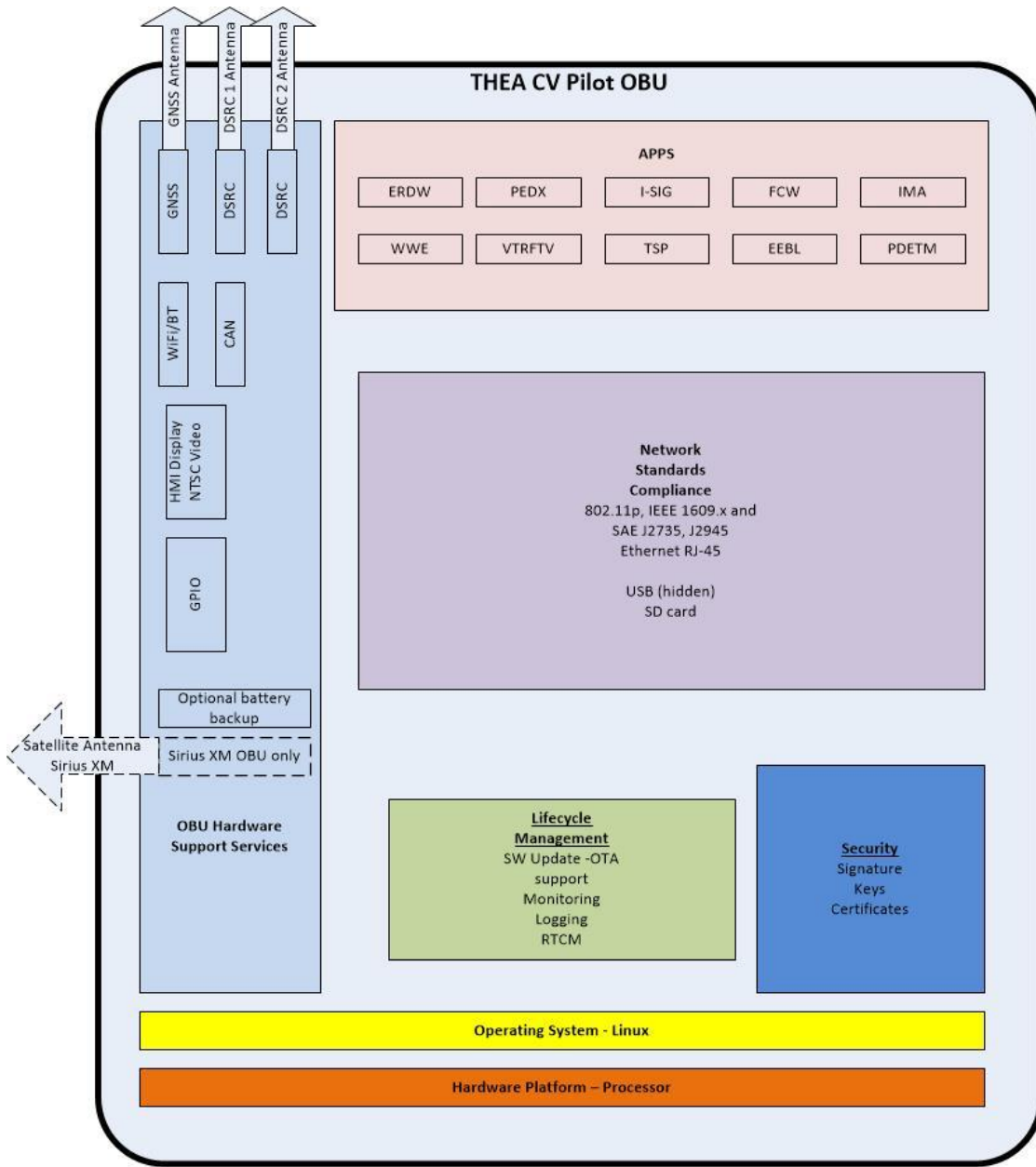
Figure 32: OBU Hardware Design

The following is a description of the OBU hardware and associated functions:

Table 14: OBU Hardware Description

OBU Function	Description
Operating System	LINUX is the OBU OS for development, pre-mass production systems of this type
GPIO	General Purpose Input Output (GPIO) re used for ignition state, reverse, wheel ticks (depending on chipset used), turn signals, brake, door open (buses), and direction (streetcars). Discrete inputs shall be used to provide zero to twelve-volt (0-12v) vehicle inputs to the OBU. For example, vehicles equipped with "*Rear Camera Video Mirrors,*" the OBU will monitor the "*Reverse Signal*" so the OBU will switch the mirror display from rear camera video to OBU App driven alerts. There is spare digital output available for future use.
HMI Display/NTSC Video	All current rear view camera mirrors are NTSC driven. The OBU will decide which video to display, rear view camera video or OBU App alerts. The vehicle mirror displays are NTSC driven.
CAN	Vehicle electrical communication Bus information is available via the vehicle On-Board Diagnostics connector (OBD). Many vehicle signals are available that could enhance future App alerts algorithms and also enhance the GPS while in a *"Dead Reckoning Mode."* Another example is utilizing the vehicle "steering wheel angle" signal.
DSRC	Dedicated Short Range Communications (DSRC), this is the radio communications protocol and frequencies allocated for the CV project. Intelligent Transportation Systems (ITS) Radio Service in the 5.850-5.925 GHz band (5.9 GHz band).
GNSS	Location/[positioning services for location tracking
Optional Battery Backup	Battery backup can be supported for future applications, if warranted, i.e. the situation of an unexpected vehicle power interruption or electrical shutdown.
SiriusXM Antenna Input	Satellite antenna to be used for security certificate and CRL distribution on SiriusXM supplied OBUs.

The following is a description of the standards that the hardware must meet:

Table 15: Industry Standards applicable to OBU Design

Component	Description
IEEE802.11p	Dedicated short-range communication (DSRC) and wireless access vehicular environments (WAVE) are the communication standards on which these transportation services are provided. These communication standards are based on IEEE **802.11p** PHY/MAC and DSRC wireless communication and messaging protocols.
IEEE 1609.x	• The IEEE 1609 Family of Standards for Wireless Access in Vehicular Environments (WAVE) defines: – the architecture, – communications model, – management structure, – security mechanisms and – physical access for high speed (up to 27 Mb/s) short range (up to 1000m) low latency
SAE J2735	Basic Safety Message (BSM) Set definitions Standard
SAE J2945	This standard specifies the system requirements for an on-board vehicle-to-vehicle (V2V) safety communications system for light vehicles, including standards profiles, functional requirements, and performance requirements. The system is capable of transmitting and receiving the Society of Automotive Engineers (SAE) J2735-defined Basic Safety Message (BSM) [1] over a Dedicated Short-Range Communications (DSRC) wireless communications link as defined in the Institute of Electrical and Electronics Engineers (IEEE) 1609 suite and IEEE 802.11 standards [2] – [6].
SCMS	Commercial SCMS specific requirements for access and interoperability
Ethernet RJ-45	Ethernet Communications and connector standardized as the 8P8C modular connector used with CAT5 cables
USB (hidden)	Universal Serial Bus (USB) will be used for software and firmware updates. Port will be hidden and encrypted to prevent malicious data entry.
SD Card	Secure Digital (SD) card port/reader, encrypted, will be used to provide software and firmware updates.

3.3.2 Software Design

Industry best practices for software design, application of standards and application of existing OBU design practices drive the THEA OBU designs and software design:
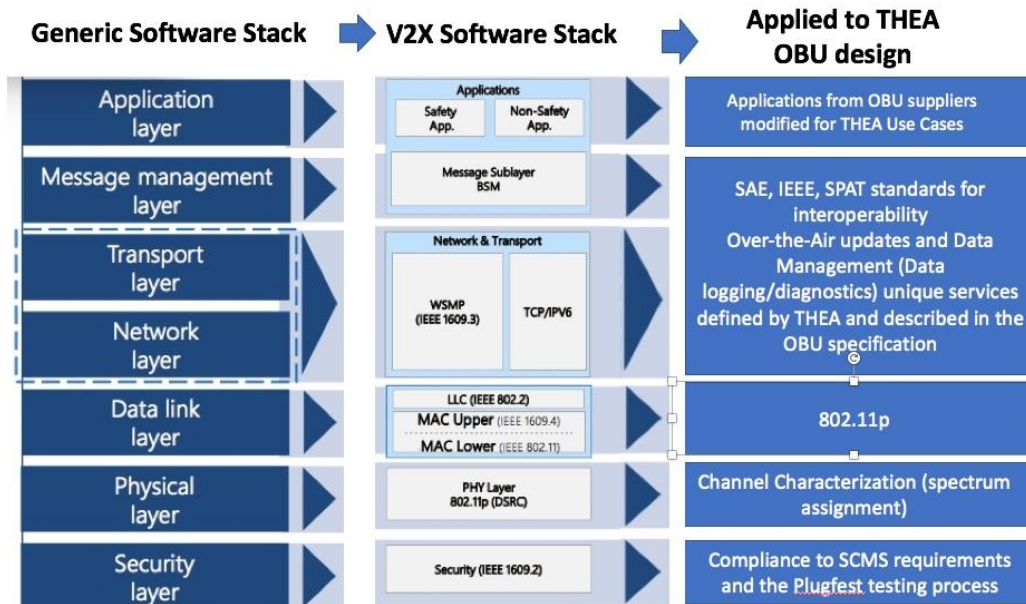
Figure 33: Software Design, Application of Standards and Application of Existing OBU Design Practices

The following table describes key software components as referenced by the software stack.

Table 16 - Software Component Description

Software Component	Description
Application layer	OBU suppliers developed (V2V and V2I) applications modified to implement THEA use cases and specific applications as described by the SAD. Brandmotion as described by the SAD. Brandmotion will supply the OBU suppliers with user interface graphics (JPEG files) and audio alert files (standard WAV files).
OTA as software update	Software update support for secure remote software maintenance. Will be securely inputted via OTA or OBU mounted encrypted SD Card input.
Data Management/Logging	OBU through DSRC supports centralized logging of system and application events
Security	OBU suppliers are compliant to the commercial SCMS process and have participated in various forums and Plug fest testing.

3.3.2.1   ERDW

As mentioned in section 3.2.2.1 of this document, the ERDW application is designed to audible tone warning drivers incoming on the REL of a queue that has formed at the intersection of Twiggs St and Meridian Ave. The warning shall recommend a safe speed which will allow the vehicle to safely stop before it reaches the end of the queue / stopped traffic.

The estimated end of the queue would be transmitted to the vehicle OBUs using a TIM from the RSU that would then be interpreted by the OBUs to display the recommended speed to the driver. As the driver makes their way closer to the end of the queue, the recommended speed would lower so that they have ample time to safely stop their vehicle before reaching the end of the queue. The recommended speeds are based on safe stopping distances for a vehicle class based on the Florida Driver License Handbook. Once the OBU receives the TIM, it would display a recommended speed zone Figure below shows the ERDW functional flow.
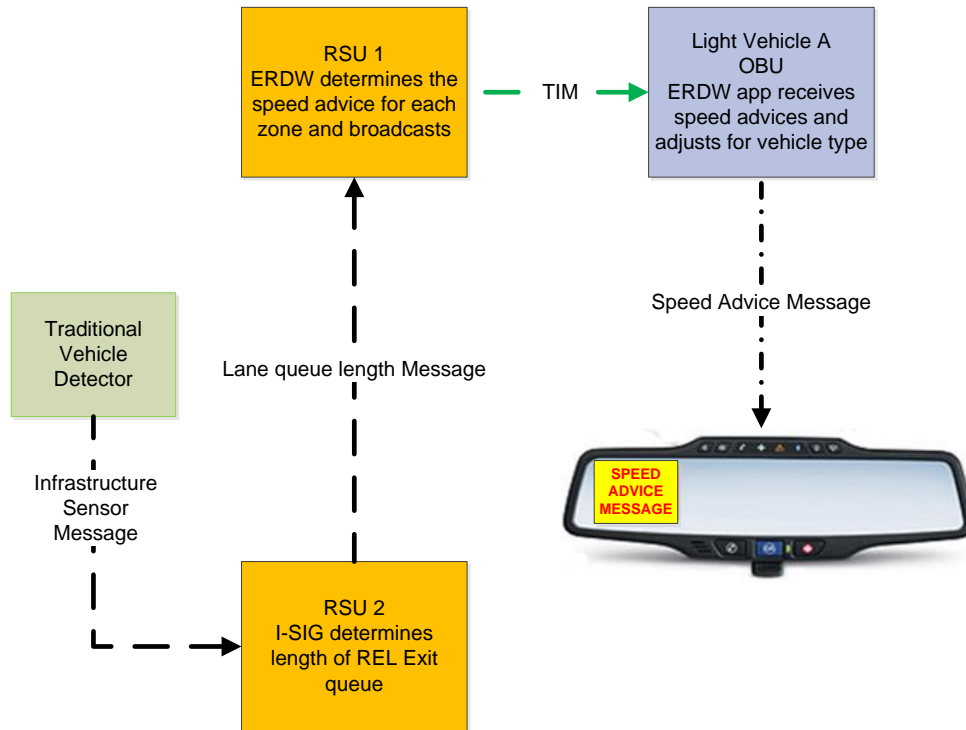
Figure 34: ERDW Functional Flow

Below, two different examples of queue lengths are presented along with the recommended speed zones based on the TIM received by the OBU from the RSU. The figures also show the estimated number of cars in the queue on the section of the REL. Approximately 130 car single lane queue can form within the half mile section of the REL starting at the Twiggs and Meridian intersection.
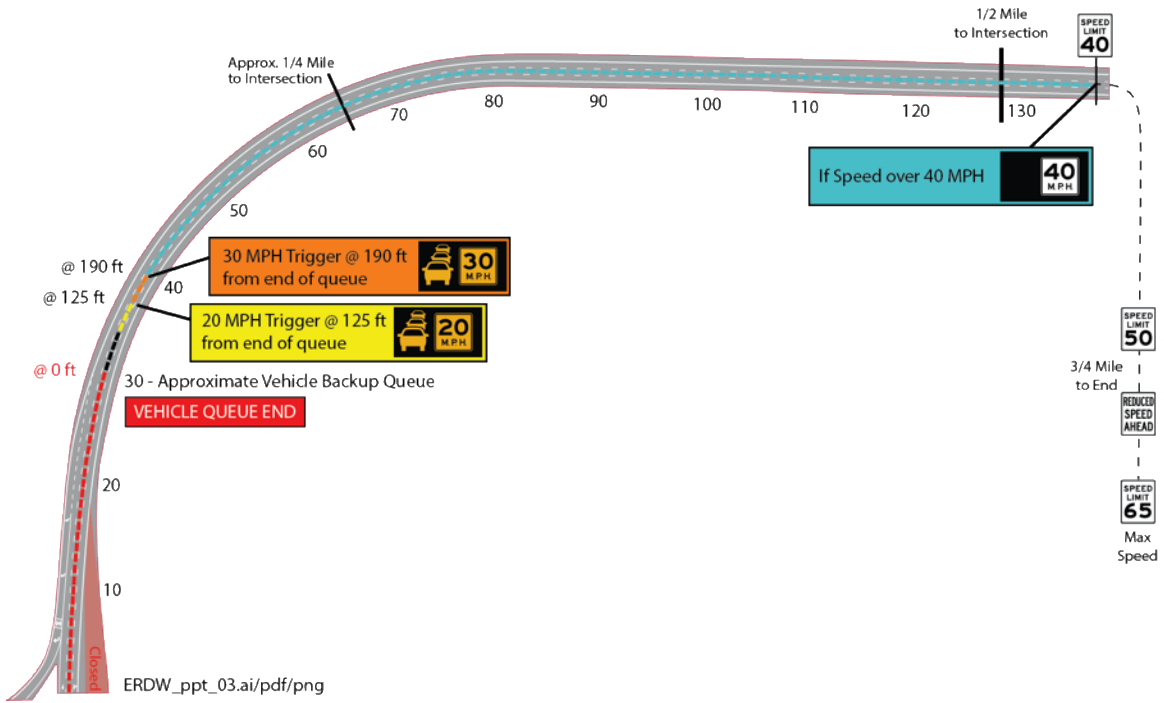
Figure 35: Thirty Car Queue Example
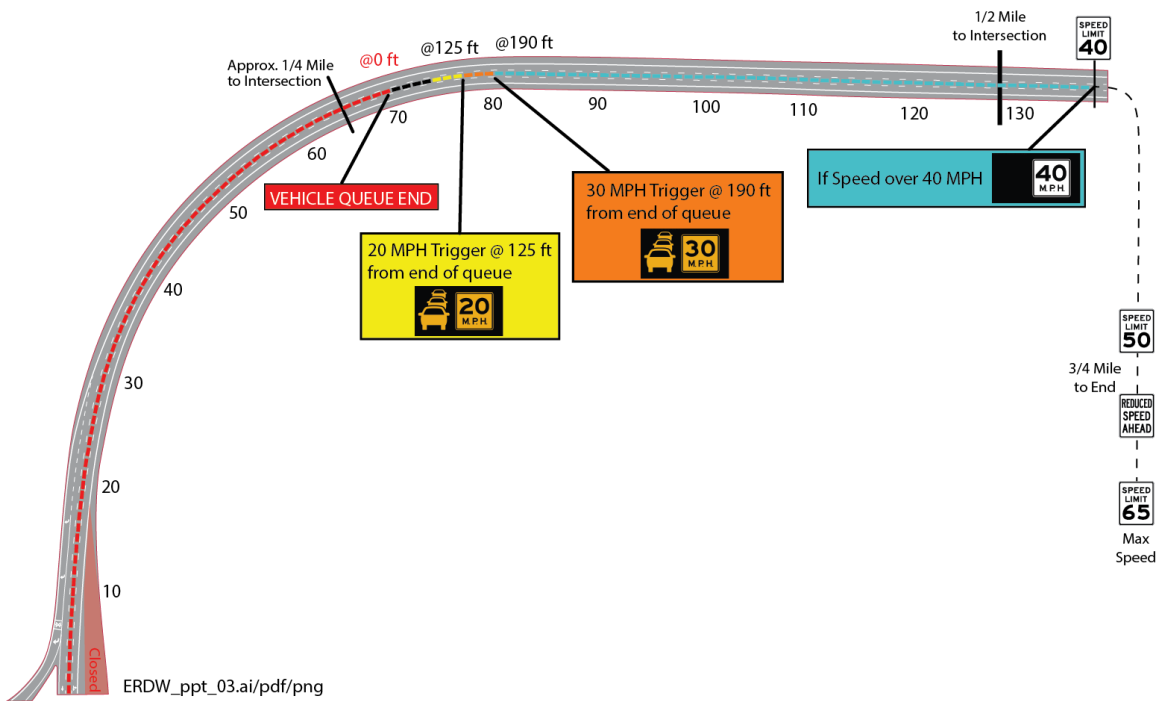
Figure 36: Seventy Car Queue Example

The speed limit on the REL starting at half mile before Meridian and Twiggs is 40MPH. If there is a vehicle queue, based on the Florida Driver License Handbook, the 20MPH speed zone (colored in yellow in Figure 35 and Figure 36) would start at 70 feet away from the last car in queue, and end at 125 feet away from the last car. The 30MPH recommended zone (colored in orange in Figure 35 and Figure 36) would start right were the last zone ended and extend to 190 feet away from the last car. At 190 feet, the 40MPH recommended/posted speed zone (colored in blue in Figure 35 and Figure 36) would start and end where the posted speed zone starts a little over a half mile away from the Twiggs and Meridian intersection. The OBU would display these recommended speeds as they pass through the speed zones while going over the recommended speed. For example, if the driver is going 45MPH in the 40MPH speed zone, they would get a warning message. The time out of the warning messages will depend on three factors: the warning will time out after a certain configurable amount of time, the driver corrects their speed to be within the recommended speed, or another higher priority warning comes on (FCW for example). The warnings are not lane specific therefore even if there is a queue in one lane and not the others, the warnings will be based on backed up lane and displayed for all drivers passing through the speed zones no matter what lane they are in. This will help prevent accidents where cars from the queue might try to get out into an open lane.

3.3.2.2   WWE

As mentioned in section 3.2.2.2 of this document, WWE app is designed to warn OBU equipped vehicles trying to wrong way enter an RSU equipped intersection which provides the MAP and SPaT messages through DSRC. The specific intersection used for this study is at Twiggs St. and Meridian Ave. A radar detector covering the REL entrance is used to detect unequipped wrong-way vehicles.
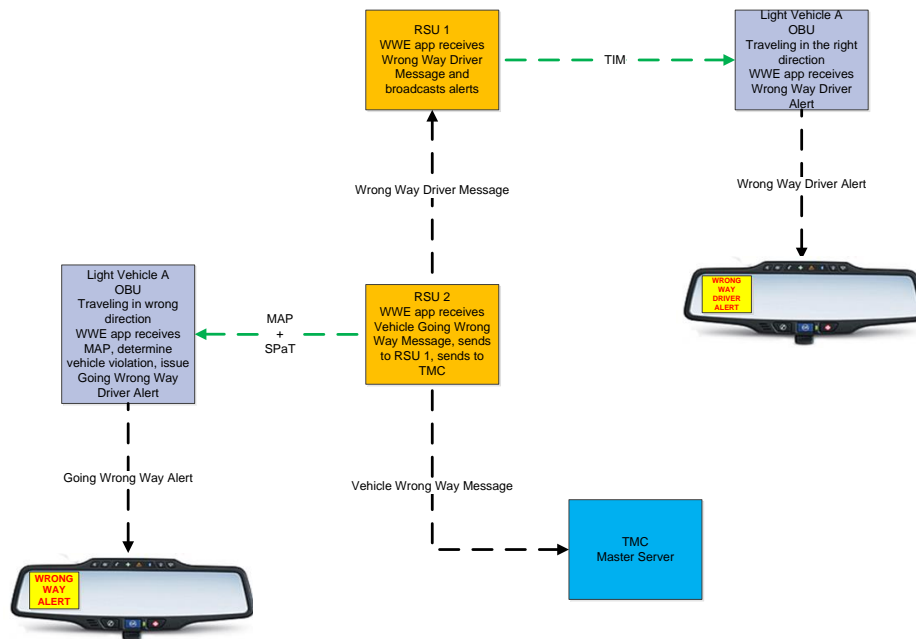
Figure 37: WWE Functional Flow

The app has multiple levels of warning. The driver would receive a first level warning when their OBU equipped vehicle is on a path that is projected to enter a part of the intersection that would make them go the wrong way based on their trajectory and speed (labeled with 1 in Figure 38 and Figure 39). If the vehicle continues to go up a road in the wrong way manner, the driver of the vehicle would receive a secondary warning letting them know that they are already going the wrong way (labeled with 2 in Figure 38 and Figure 39). There is also another warning message displayed to the driver using this app where the equipped vehicle finds itself in an area where no traffic is allowed which is specific to the REL exit (labeled with 3 in Figure 38 and Figure 39). Another feature of the app is that it will warn the drivers of equipped vehicles of a wrong way driver approaching them on the REL based on a TIM that would be broadcast by the RSU.
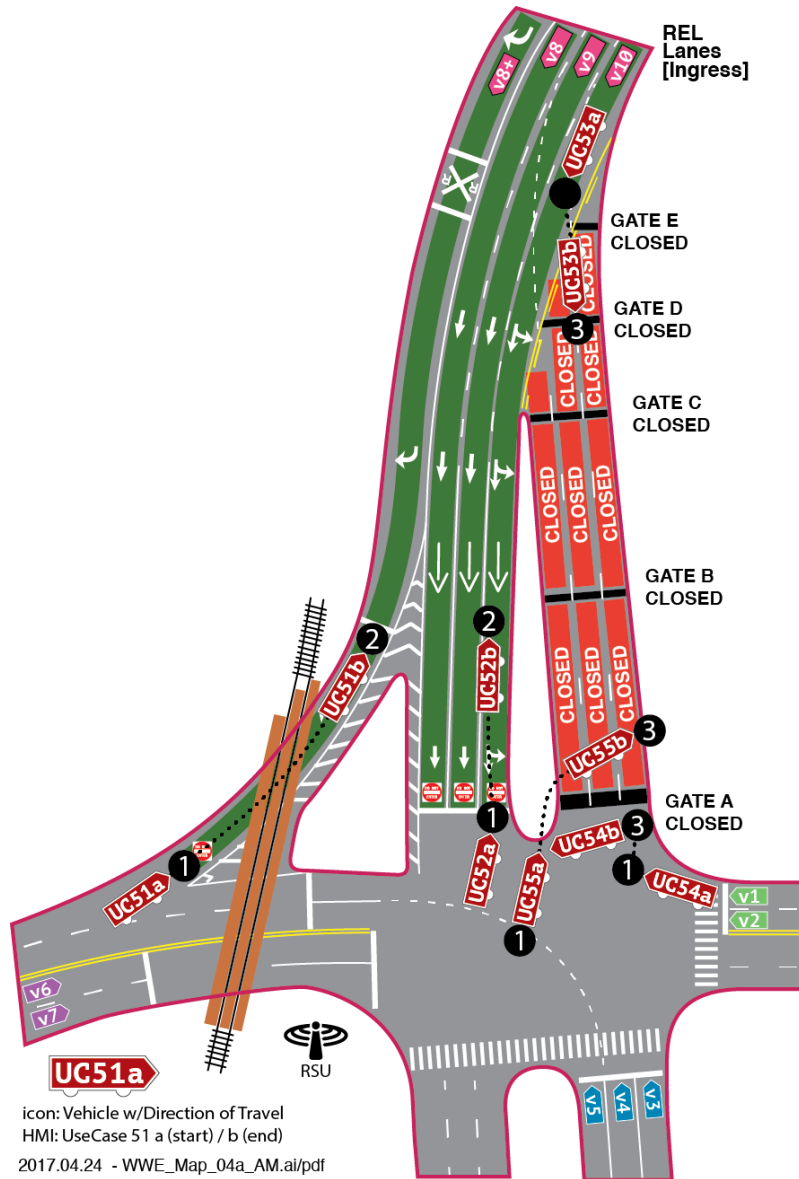
Figure 38: Morning REL
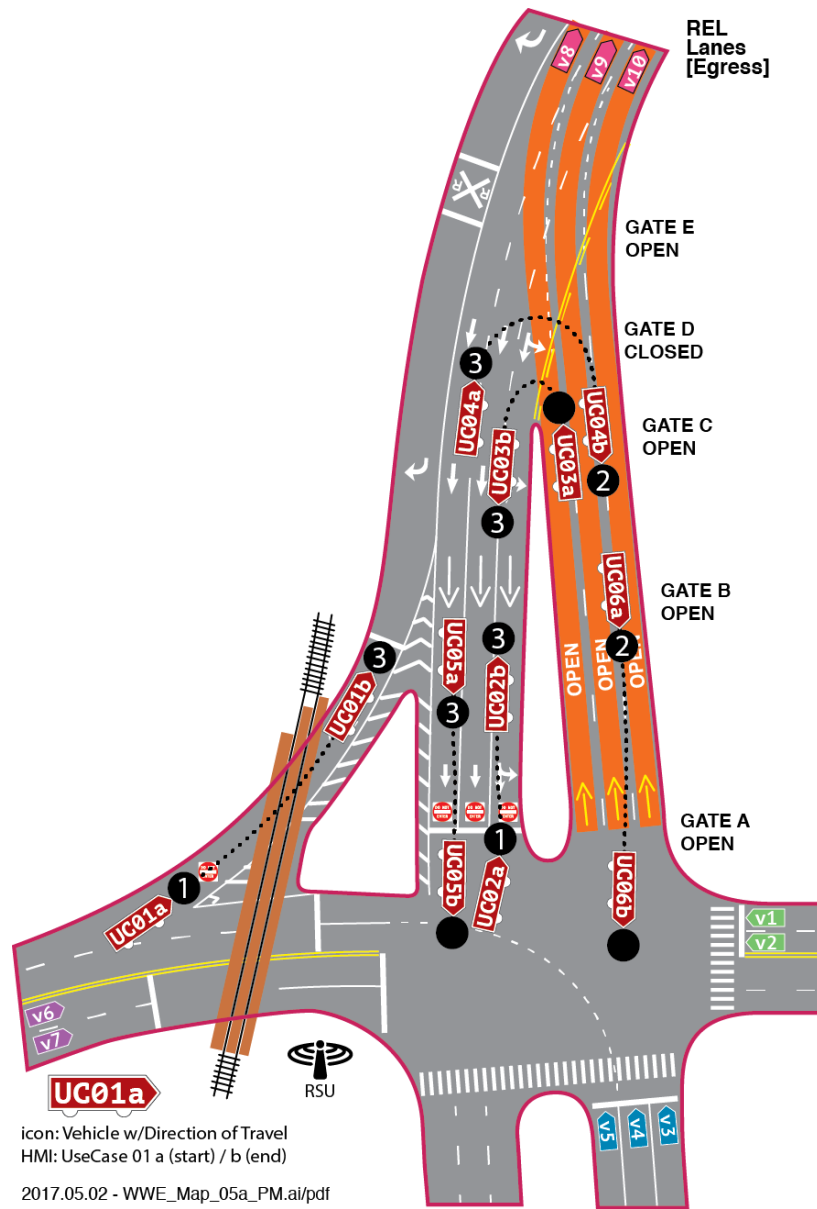
Figure 39: Afternoon REL

As previously mentioned, this app is not specific to the intersection shown in figures above and should function in any intersection that can provide the MAP and SPaT messages to the vehicle OBU.

3.3.2.3 MMITS-TSP

TSP is an application that provides signal priority (green) to transit vehicles at intersections and along arterial corridors only if the bus is behind schedule.

If the bus is behind schedule priority will be granted for the bus. The OBU sends an SRM to the RSU. The RSU forwards that to the Transit Server at the TMC. The Transit Server determines if the bus is behind schedule. If the bus is behind schedule, the SRM is returned from the Transit Server to the RSU. The RSU determines priority of all SRMs received from all approaching vehicles, and then selects the controller phase via NTCIP objects to extend the green, allowing the bus to proceed through the intersection.

At the same time, RSU sends the SSM to the approaching equipped transit vehicles to inform which has received priority to extend the green and which vehicles have been denied priority. If signal priority has been granted, the driver of the transit vehicle is notified. If the bus that is approaching the intersection stops at its stop, TSP app on the OBU would cancel its pending priority request to the next intersection as soon as the door opens (door open/close is one of the GPIO inputs). It will pick up the request again once the door closes and the bus starts moving. Using the MMITSS components for this app is suggested.

The OBU shall continuously estimate the vehicle's arrival time at the intersection stop bar based on the current vehicle speed and distance from the stop bar. In case of a change in estimated time of arrival (ETA) of a second or more the OBU shall send an updated SRM with the new ETA to the RSU. In case the bus stops in traffic without opening the door the OBU shall continue to update the ETA in the SRM to the RSU. This will allow vehicles in front of the bus to move through the intersection and in turn allow the bus to proceed. The TSP application running on the RSU will continue to extend the green phase up to the maximum green time configured in the traffic controller. If the bus does not pass through the intersection the priority request times out and the driver display changes accordingly.

The variables and timing of when the priority granted/denied message is displayed to the driver and how long it will stay on must be configurable.
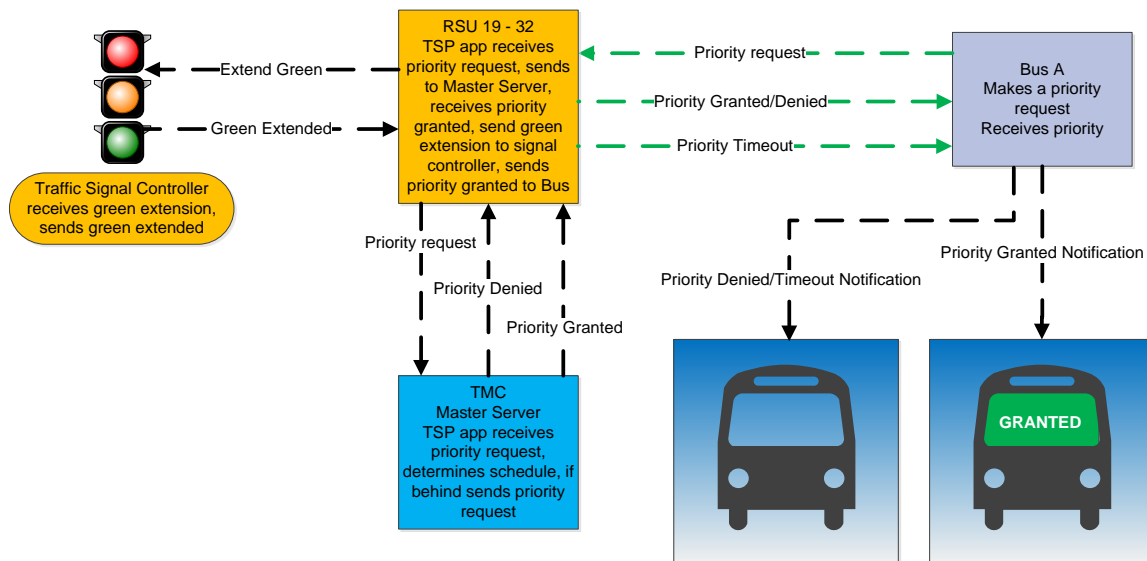
Figure 40: TSP Functional Flow

3.3.2.4 PCW

The PCW (Pedestrian Collision Warning) application is designed to work at the midblock crosswalk on East Twiggs Street at the Hillsborough County Courthouse to improve pedestrian safety. A LiDAR installed at the crosswalk will locate the pedestrians in the area and translate the information to PSMs and send them over DSRC for the HMI to warn drivers when pedestrians, within the crosswalk, are projected to be in the intended path of the vehicle. OBU equipped vehicles, using the PCW app, warn the drivers that are on a collision course with pedestrian in the roadway. The variables and timing of when the message is displayed to the driver and how long it will stay on will be configurable, which is required by the OBU procurement specification and verified by Test Cases.
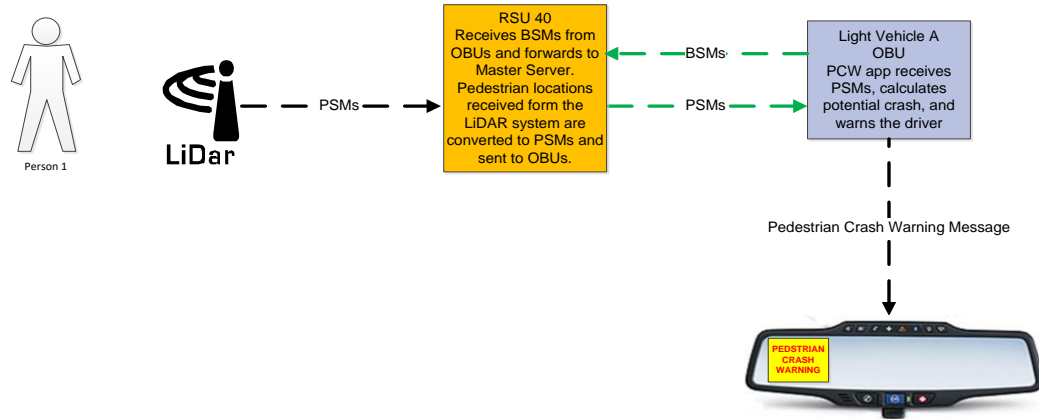
Figure 41: PCW Functional Flow

3.3.2.5 VTRFTV

The VTRFTV app HMI warns the streetcar operator of an equipped vehicle turning right at the intersection the streetcar is approaching, using the BSMs that are being sent and received, if the app determines the vehicles are on a potential collision trajectory. Once a blinker of the equipped vehicle that is approaching the intersection is engaged while passing the streetcar as well as the trajectory and speed determined by the OBU matches that of the potential collision, the streetcar OBU will give the streetcar driver a warning. The equipped vehicle receives a warning that they are on a collision course with streetcar as well. The Streetcar OBU would also put a special ITIS code to SpecialVehicleExtensions.description.typeEvent and SpecialVehicleExtensions.description.description in the BSM once noticing that the blinker in the vehicle was engaged which would then be received by the RSU at the intersection and sent out as a warning message to nearby pedestrians equipped with a PID. Refer to section 3.4.2.2 for a description of the pedestrian interface. The variables and timing of when the message is displayed to the driver and how long it will stay on must be configurable.
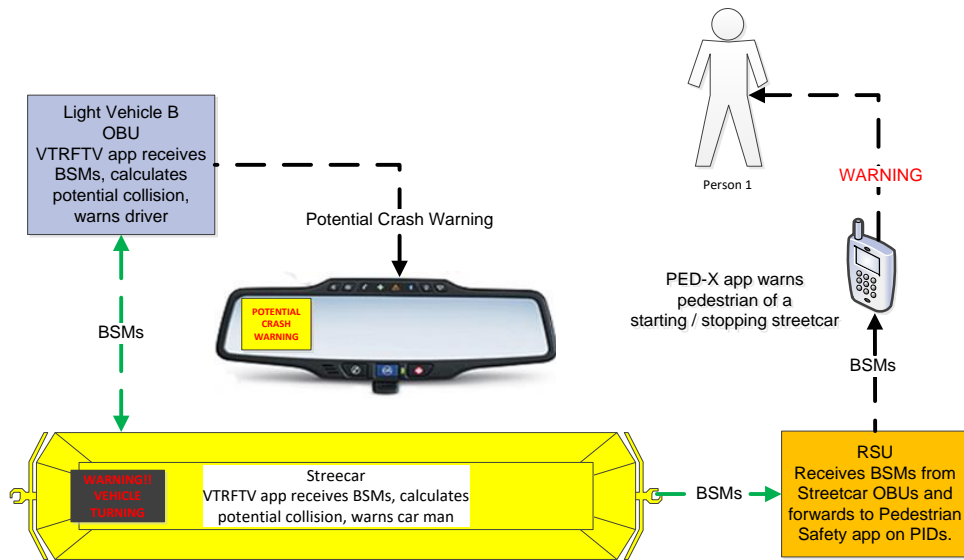
Figure 42: VTRFTV Functional Flow

Because it is a V2V app, it will be operational everywhere where the streetcar travels. The figure below shows an example of an intersection where VTRFTV app would be operational.
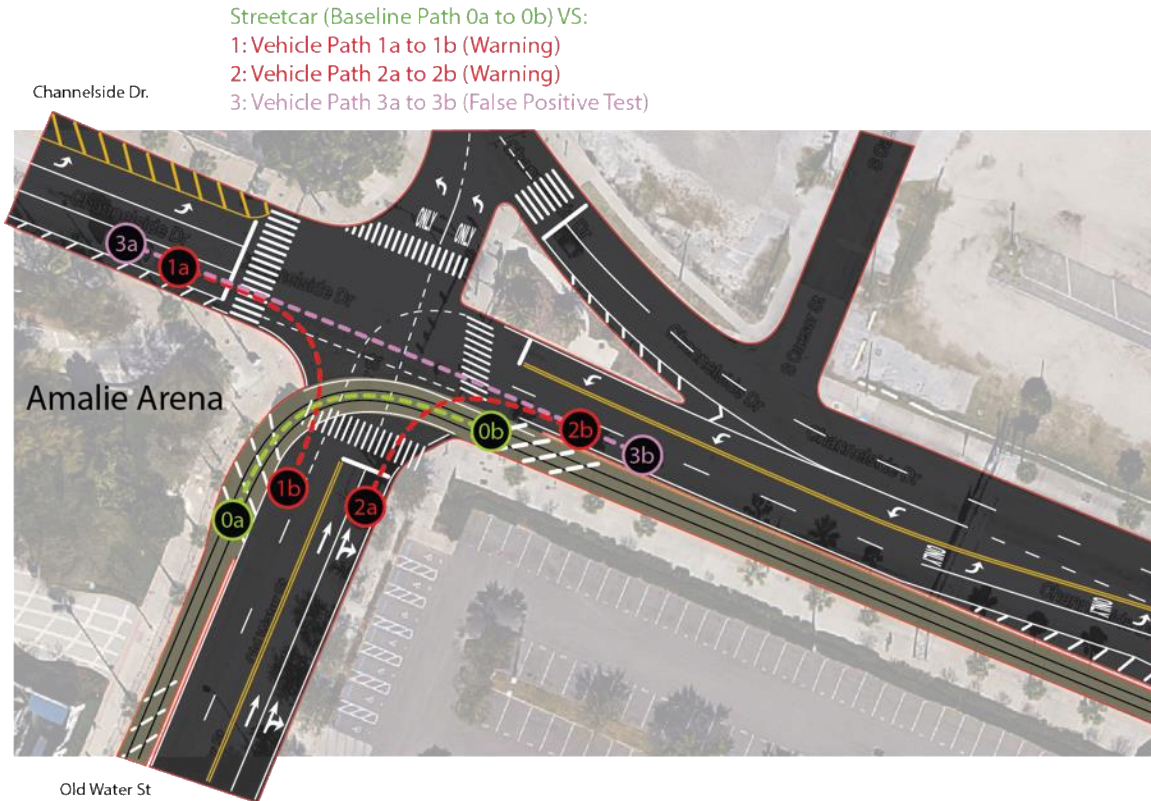
Figure 43: VTRFTV Case Example

As can be seen in **Error! Reference source not found.**, when the streetcar travels from point 0a to 0b, multiple potential situations can happen that can cause accidents which the VTRFTV app will help prevent. If the OBU equipped vehicle approaches the intersection at point 1a and tries to make a right turn in front of the streetcar proceeding to point 0b, the driver of the vehicle as well as the streetcar will receive a warning based on the turn signal engagement, speed and trajectory. Same warning would be issued if the car approaches the intersection at point 2a and tries to make a right turn to 2b in front of the streetcar. It is also important that the app does not give false positive warnings as is shown in the case of the vehicle proceeding from point 3a to 3b and never cutting in front of the streetcar.

3.3.2.6   FCW

The FCW application is intended to alert the driver in case of impending potential rear-end collision with an equipped vehicle ahead in traffic. FCW is intended to help avoid or mitigate the severity of crashes into the rear end of other equipped vehicles in the same lane and direction of travel on the road. Forward crash warning responds to a direct and imminent threat ahead of the host vehicle. The FCW app receives BSMs from the lead vehicle OBU. Using the lead vehicle's BSM data, FCW calculates crash trajectories to determine if the trailing vehicle is about to rear end the lead vehicle. If FCW determines that the trailing vehicle is going to crash into the lead vehicle, a warning is issued to the driver. The FCW application HMI shall warn the driver no more than once when multiple warnings are received within a configurable timeframe, which is required by the OBU procurement specification and verified by Test Cases.
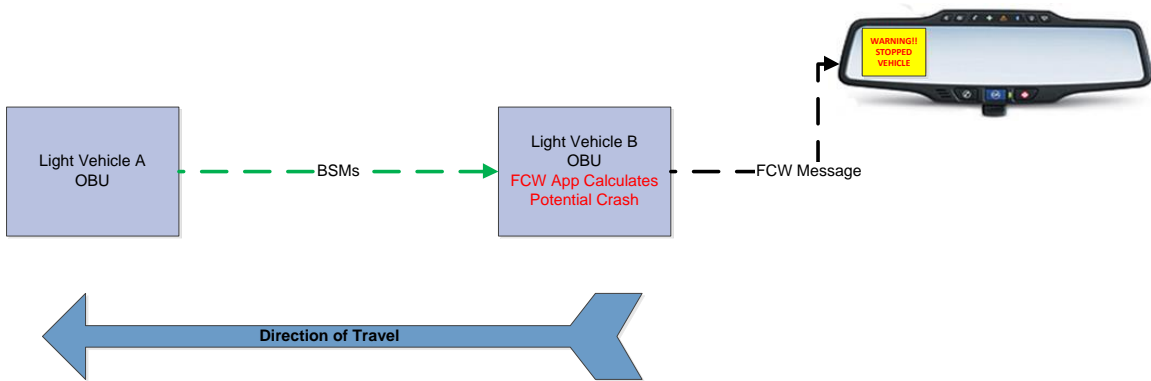
Figure 44: FCW Functional Flow

Anywhere two equipped vehicles interact, FCW will work and provide a driver alert if the right conditions occur as follows: one vehicle following the other; the lead vehicle brakes causing the closing distances to decrease (as calculated) to warrant an alert of a potential collision. The variables and timing of when the message is displayed to the driver and how long it will stay on must be configurable.

3.3.2.7 EEBL

The EEBL application is designed to alert driver of the host vehicle an equipped car that is exceeding the predetermined deceleration in upstream traffic. This provides downstream OBU equipped drivers with additional time to look for, and assess situations developing ahead.
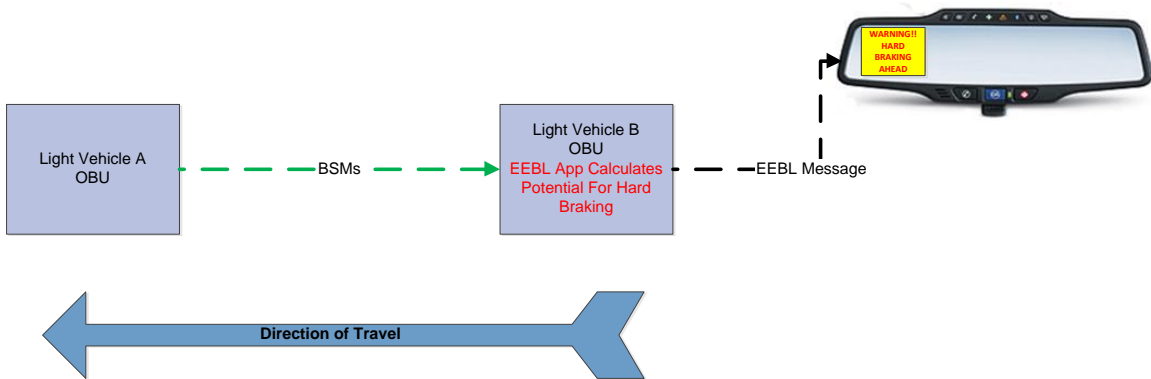
Figure 45: EEBL Functional Flow

The EEBL app receives BSMs from one or more vehicles ahead. Using the BSMs, if EEBL determines any vehicles in the same lane braking/stopping suddenly, the app issues a warning to the driver. This application is particularly useful when the driver's line of sight is obstructed by other vehicles or bad weather conditions (e.g., fog, heavy rain). The variables and timing of when the message is displayed to the driver and how long it will stay on must be configurable, which is part of the OBU procurement specification and verified by Test Cases.

3.3.2.8   IMA

The IMA application is intended to warn the driver when it is not safe to enter an intersection due to high collision probability with other equipped vehicles. IMA is especially useful when something is blocking the driver's view of opposing or crossing traffic.
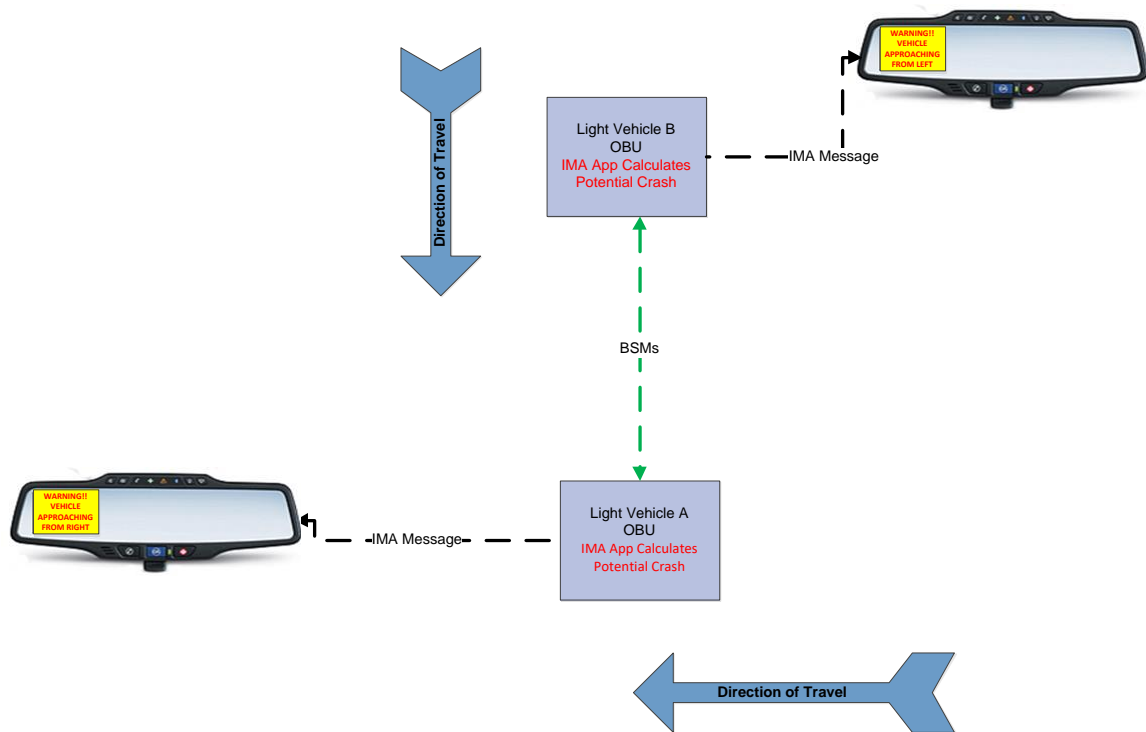
Figure 46: IMA Functional Flow

The IMA app receives BSMs from vehicles approaching the intersection adjacent to the vehicle equipped with IMA. If IMA determines there is a high probability of a collision using relative position, speed and heading of vehicles approaching the intersection, the app warns the driver. The variables and timing of when the message is displayed to the driver and how long it will stay on must be configurable. The variables and timing of when the message is displayed to the driver and how long it will stay on are configurable and set to provide a timely warning.

3.3.2.9   Log Data Collector

See Section 3.2.2.6 of the Roadside Unit Software Design.

3.3.2.10   OTA Update

See Section 3.2.2.7 of the Roadside Unit Software Design.

3.3.2.11 HMI

The HMI aspect of the apps will be run by the OBUs. There will be both visual (presented on the Brandmotion Mirror) warnings as well as auditory warnings, that are tones (emitted by a speaker). A NTSC video signal will be sent to the mirror from the OBU when the OBU determines that a warning has to be displayed to the driver. At the same time, an auditory warning would be sent through an audio cable to the speaker for the driver to perceive.

3.3.2.12 OBU Management

OBU management is the collection of services and functionality for managing basic operations to include:
- broadcast of BSM messages
- application lifecycle management
- health monitoring
- human machine interface
- log collection and software update management.

3.3.3 Interfaces

Reference ICD

3.4 Smartphone (PID)

3.4.1 Platform Design

The platform used for the CV pilot is a standard off-the-shelf Android smartphone which is provided and owned by the study participant. There are only some required capabilities which are defined:
- Phone needs to have working WiFi and GPS
- Android version 5.0 or newer
- Minimum screen resolution 720 x1280 pixel

Android is an open source, Linux-based software stack created for a wide array of devices and form factors. Please see online web resources for further information on Android (e.g. https://developer.android.com).

3.4.2 Software Design

PED-SIG, PED-X, and PTMW are implemented as features of one smartphone application referred to as Pedestrian Safety App (PSA). As such they all share a common software design.
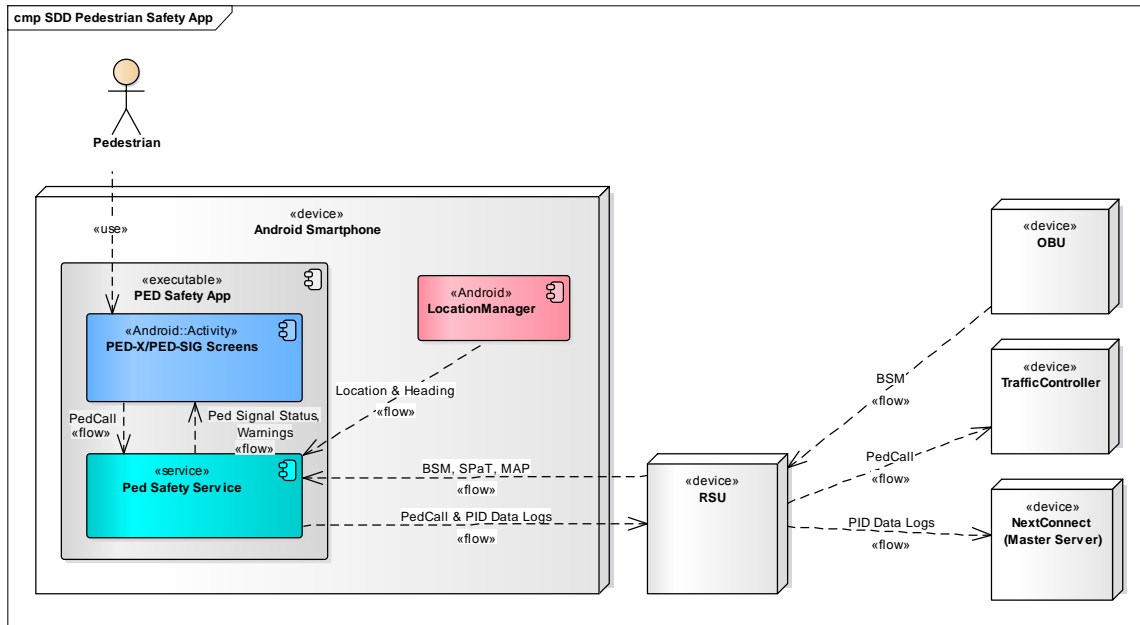
Figure 47: Pedestrian Safety App Software Design

PSA consists of the Ped Safety Service and several UI screens implemented by an Android Activity. The Ped Safety Service is responsible for communicating with nearby RSUs via WiFi and for tracking the smartphone's location. The ped safety service is started in the background when a PSA UI screen is opened by the user. While running, the service will monitor available WiFi networks for an RSU WiFi access point and connect to that WiFi automatically. When the user leaves the PSA, i.e. switches to a different Android application, the ped safety service is stopped and any WiFi connection to an RSU is closed.

The Ped Safety Service receives vehicle BSMs, MAP, and SPaT from the RSU via the established WiFi connection. See ICD: interface 23012 "Proxy Vehicle Location and Motion for PID", interface 23026 "Intersection Geometry" and 23027 "Intersection Status". Ped Safety Service sends pedestrian call request and PID data logs to the RSU via the same connection. See ICD: interface 23028 "Pedestrian Call" and interface 23029 "PID Data Logs".

3.4.2.1 PED-SIG
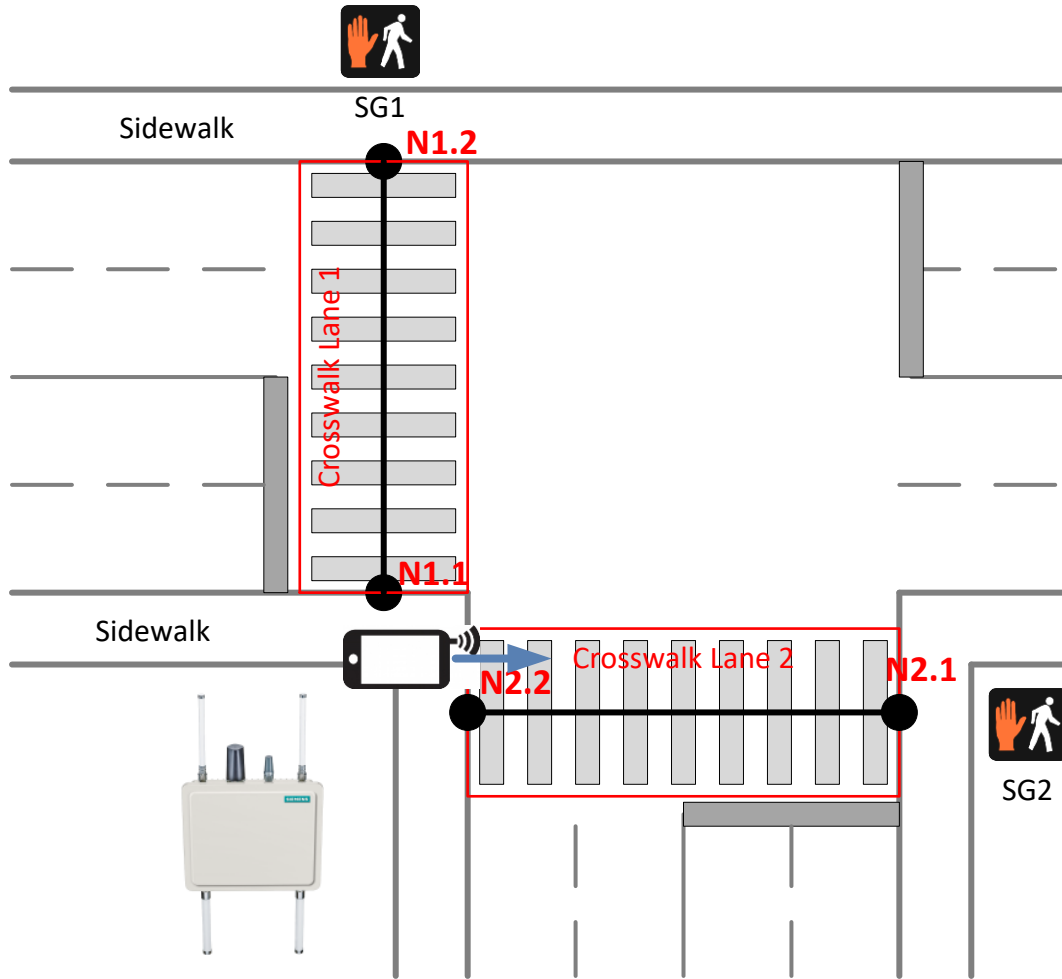
Figure 48: PED-SIG Concept for Determining the Crosswalk Signalgroup

The above figure depicts a smartphone running PSA (phone icon in south-west corner). PSA receives the intersection MAP from the RSU to which the smartphone is connected to via WiFi. The MAP contains crosswalk lanes which represent the crosswalk area. The figure shows an example of an intersection with 2 crosswalk lanes. Crosswalk 1 has start node N1.1 and end node N1.2. Crosswalk 2 has start node N2.1 and end node N2.2. Crosswalk 1 is associated with signal group 1 and crosswalk 2 is associated with crosswalk 2 (see J2735 for more details on crosswalk lanes and how to associate them with signal groups).

PSA determines that the PID is within MaxXWalkDistance[11] from crosswalk 1 and 2. However, based on the current PID heading (i.e. compass orientation) PSA determines that the PID is facing crosswalk

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[11] Parameter will need to be fine-tuned based on phone GPS-accuracy. As initial value 10 meters will be used.

2 which is associated with signal group 2. The following diagram describes what happens when the user presses the "Cross" button on the PED-SIG application screen.
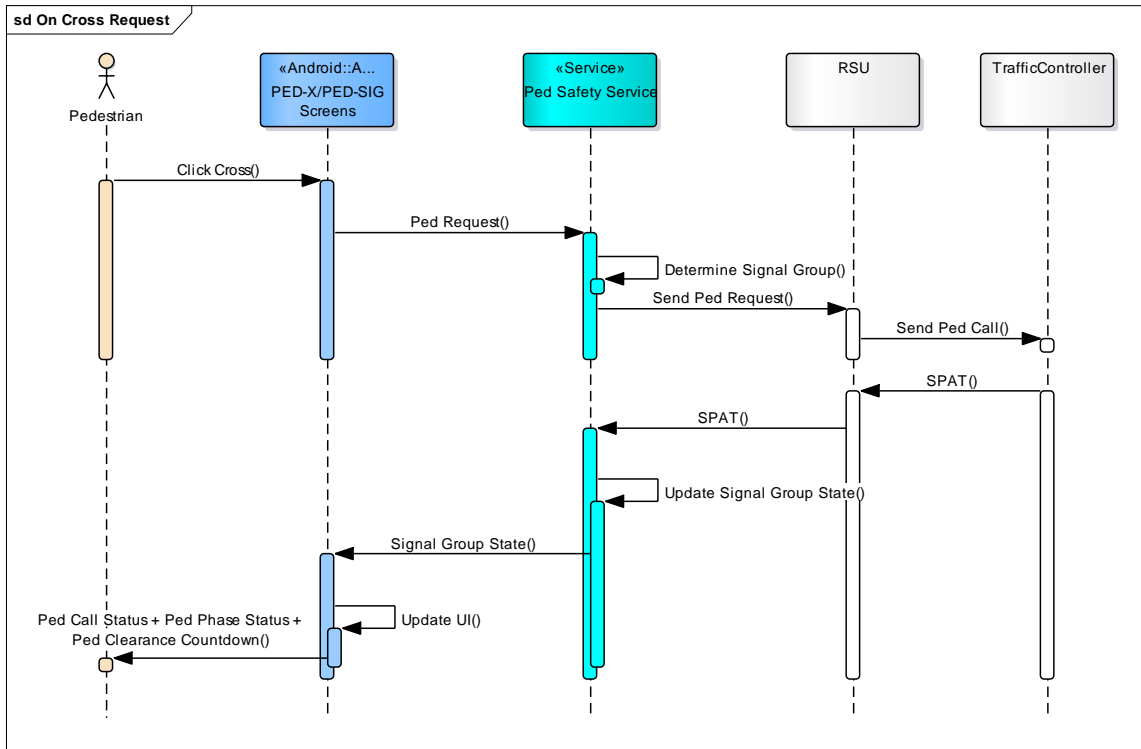
Figure 49: Sequence Diagram of Pedestrian Requesting Walk

When the user presses the button the PED-SIG screen activity sends the ped request to the Ped Safety Service. The Ped Safety Service selects the signal group for the crosswalk that the PID is facing based on the phone's location, the received intersection MAP, and the phone's heading. If a signal group is found which is associated with the crosswalk and heading then it sends a corresponding ped request to the RSU. The RSU transforms the request into a ped call for the phase associated with the identified signal group.

Subsequently SPaT messages are received by the Ped Safety Service from the RSU. The service forwards the phase status and ped call status relevant to the crosswalk to the PED-SIG screen activity. The activity updates the screen UI accordingly. See ICD: interface 23010 "Personal Updates" for more details regarding the PED-SIG user interface.

3.4.2.2   PED-X / PTMW

The PED-X & PTMW application features use the BSMs received in order to perform the following:
- Calculate collision warnings between vehicles and the pedestrian based on the phone's location. These warnings are not displayed to the user and only logged and sent back to the RSU for archiving at the master server.
- Warn the pedestrian of a bus (or streetcar) stopping or starting within an intersection. This event is also logged and sent back to the RSU for archiving at the master server.
- Warn the pedestrian of a VTRFTV event which was detected by a nearby streetcar. This event is also logged and sent back to the RSU for archiving at the master server.

The Ped Safety Service is responsible for calculating these warnings and for creating the PID data log entry. The PED-X screen activity displays the warnings to the user. See ICD: interface 23010 "Personal Updates" for more details regarding the PED-X user interface.

The PED-X application feature receives the current MAP from the RSU. The MAP data is used to match the current position of the PID to the intersection topology (e.g. crosswalks).
The OBUs cyclically send BSMs (Basic Safety Message) containing current position, speed and heading values among others. These BSMs are received by the RSU and forwarded to the registered PIDs. PED-X on the PIDs analyzes the received BSMs, performs collision detection and sends data regarding detected collisions to the data collector.

3.4.2.2.1   Intersection Conflict Area
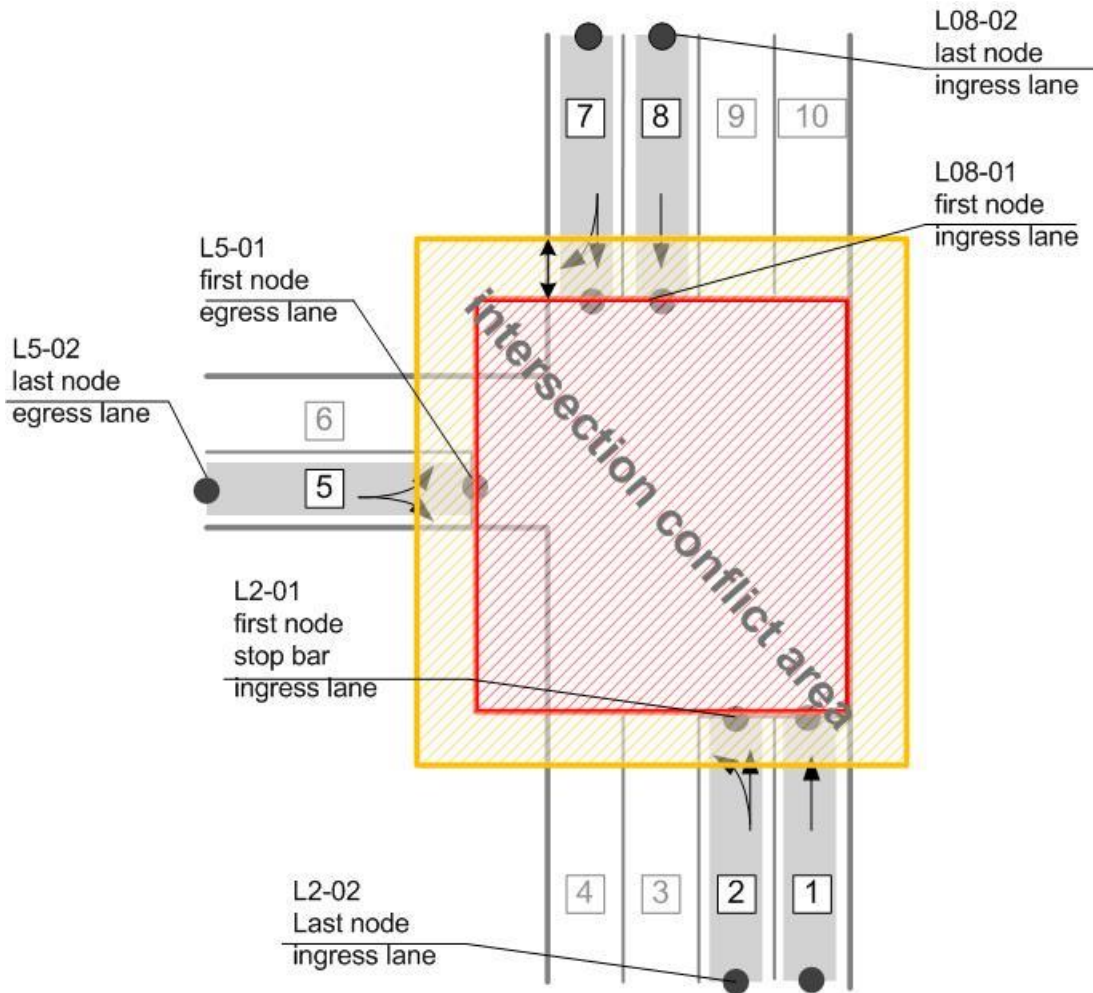
Figure 50: Intersection Conflict Area

In order to detect if a vehicle is crossing the intersection, the PED-X app has to derive a conflict area for the corresponding intersection from the data contained in the MAP. **Error! Reference source not found.** illustrates the MAP data for an example intersection, as well as the derived conflict area. The conflict shall be a rectangle, whose edges are determined by the first nodes (stop line) of the ingress lanes. The PED X App shall use the biggest possible conflict area, thus nodes that are further away from the intersection center shall be preferred to nodes closer to the center. This is depicted as the red rectangle in the figure.

Additionally, there shall be a configurable value ConflictDelta, by which the length and width of conflict area shall be increased in order to cope with inaccurate positioning systems like GPS. This is depicted as the yellow rectangle in the figure.

3.4.2.2.2 Vehicle/PID Conflict Area
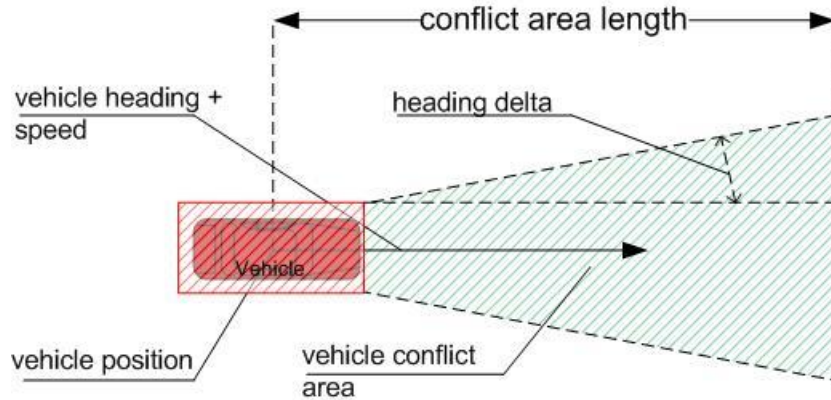
Figure 51: Vehicle Conflict Area

The conflict area of a vehicle shall consist of two parts:

- The first part (red) is a static rectangular area with the vehicle's position as center. Length and width of that area are calculated using the BSM vehicleWidth and vehicleLength values plus a configurable delta.
- The second part (green) is a dynamically calculated trapezoid. The length of that area is calculated by multiplication of the vehicle speed and a configurable pedestrian reaction time[12]. The direction is equal to the heading value of the vehicle. The opening angle is determined by a configurable delta value used to deal with inaccurate heading values.

For the conflict area of a PID, the same concept applies.

3.4.2.2.3 Collision detection (PED-X)

The PED-X App shall calculate the conflict areas of all vehicles, of the PID itself, and if the intersection. Every time these objects change their state (changed position, speed, heading etc.) the corresponding conflict areas shall be updated. A collision shall be defined as the overlap of two or more conflict areas. Examples are given below.

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[12] Based on recommended perception-reaction time (PRT) by AASHTO this value will be initially set to 2.5 seconds
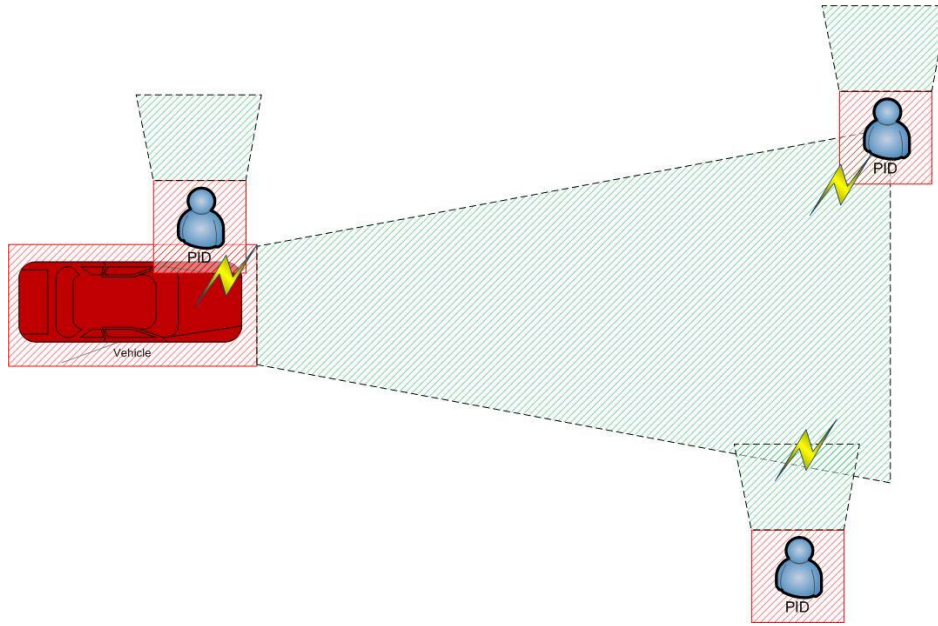
Figure 52: Collision Detection - Vehicle/PID

3.4.2.2.4 Bus Stopping / Proceeding (PTMW)

The PED-X App shall issue a warning when a bus stops or starts in an intersection (is within the intersection conflict area) while the PID is in the intersection conflict area. The bus OBU will be sending BSMs with a value identifying it as a bus (see ICD: interface 20004 "Vehicle location and motion"). Therefore, the PED-X App shall issue the "Bus Stopping / Proceeding Warning" once it receives BSM messages indicating a bus is stopping or starting.

The same warning will be given for streetcars stopping and starting within the intersection conflict area. A streetcar OBU will be sending BSMs with a value identifying it as a streetcar.

3.4.2.2.5 VTRFTV Warning (PTMW)

The streetcar OBU detects other equipped vehicles attempting to make a right turn in front of it and issues a "Vehicle Turning Right in Front of Transit Vehicle" (VTRFTV) Warning to its operator. See section 3.3.2.5 in this document for more details on the OBU operation. The OBU also sets a special field in the BSMs sent out when this warning happens (see ICD: interface 23032 "Transit Safety Alert"). The RSU forwards all BSMs to the PED-X App. The PTMW App detects the VTRFTV Warning field set by the streetcar OBU which is embedded in the streetcar BSMs and notifies the PID user.

3.4.3 Interfaces

Table 17: Interface triple references used by the PID

Triple ID	Triple Name	Used By
23010	Personal Updates	3.4.2.1 PED-SIG 3.4.2.2 PED-X
23012	Proxy Vehicle Location and Motion for PID	3.4.2.2 PED-X
23026	Intersection Geometry	3.4.2.1 PED-SIG 3.4.2.2 PED-X
23027	Intersection Status	3.4.2.1 PED-SIG
23028	Pedestrian Call	3.4.2.1 PED-SIG
23029	PID Data Logs	3.4.2.1 PED-SIG 3.4.2.2 PED-X
23032	Transit Safety Alert	3.4.2.2 PED-X

4 Acronyms

ACRONYM	DEFINITION
ARM	Advanced RISC Machine
BER	Basic Encoding Rules
BRT	Bus Rapid Transit
BSM	Basic Safety Message
BT	Bluetooth
CAMP	Crash Avoidance Metrics Partnership
CAN	Controller Area Network
CBD	Central Business District
CCB	Change Control Board
CFR	Code of Federal Regulations
ConOps	Concept of Operations
CMS	Central Management System
COT	City of Tampa
COTS	Commercial Off the Shelf
CPU	Central Processing Unit
CUTR	Center for Urban Transportation Research
CV	Connected Vehicle
CVRIA	Connected Vehicle Reference Implementation Architecture
CVS	Concurrent Versioning System
DER	Distinguished Encoding Rules
Detector	Infrastructure device that senses moving objects
DMS	Dynamic Message Sign
DRAM	Dynamic Random Access Memory
DSRC	Dedicated Short Range Communications
EEBL	Emergency Electronic Brake Light
ERDW	End of Ramp Deceleration Warning
ESCoS	Ecosystem for Cooperative Systems
ETA	Estimated Time of Arrival
ETSI	European Telecommunications Standards Institute
FBR	File Broadcast RSU
FCW	Forward Collision Warning
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
GB	Gigabyte

ACRONYM	DEFINITION
GLONASS	Globalnaya Navigazionnaya Sputnikovaya Sistema
GND	Ground
GNSS	Global Navigation Satellite System
GNU	G, Not Unix
GPIO	General Purpose Input Output
GPS	Global Positioning System
GZIP	GNU compression file
HA	High Availability
HART	Hillsborough Area Regional Transit
HD	High Definition
HDD	Hard Disk Drive
HDMI	High Definition Multimedia Interface
HMI	Human Machine Interface
HSM	Hardware Security Module
ICD	Interface Control Document
ID	Identifier
IGN	Ignition Signal
IMA	Intersection Movement Assist
IP	Internet Protocol
ISM	Infrastructure Sensor Message of Proxy sent via backhaul, not broadcast to vehicles
ITS	Intelligent Transportation System
IMA	Intersection Movement Assist
IPC	Inter-Process Communications
I-SIG	Intelligent Signal Systems
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organization
JSON	JavaScript Object Notation
KB	Kilobyte
LCD	Liquid Crystal Display
LiDAR	Light Detection and Ranging
LT	Left Turn
LTE	Long Term Evolution
MAFB	MacDill Air Force Base
MAP	MAP message conforming to SAE J2735 standard
MB	Megabyte
MMITSS	Multi-Modal Intelligent Traffic Signal System
MOU	Memorandum of Understanding
MPH	Miles Per Hour

ACRONYM	DEFINITION
MRP	MMITSS Roadside Processor
MTU	Maximum Transfer Unit
MUTCD	Manual on Uniform Traffic Control Devices
NEMA	National Electrical Manufacturers Association
NMEA	National Marine Electronics Association
NA	Not Applicable
NIC	Network Interface Controller
NTCIP	National Transportation Communications for ITS Protocol
NTSC	National Television System Committee
O&M	Operations and Maintenance
OBE	On-Board Equipment
OBU	On-Board Unit
OCIT	Open Communications Interfaces for Traffic Systems
OCPI	Open Content Provider Interface
OEM	Original Equipment Manufacturer
OS	Operating System
OSADP	Open Source Application Development Portal
OTA	Over the Air
OV	Over Voltage
PAN	Personal Area Network
PCW	Pedestrian Collision Warning
PDETM	Probe Data Enabled Traffic Monitoring
PDU	Packet Data Unit
PED-SIG	Mobile Accessible Pedestrian Signals System
PED-X	Pedestrian in a Signalized Crosswalk
PFS	Pooled Fund Study
PID	Personal Information Devices
PII	Personally Identifiable Information
POC	Proof of Concept
Proxy	Software application that converts Detector output to BSM based on detection zone location
PSA	Pedestrian Safety Application
PSID	Private System ID
PSM	Personal Safety Message
PTMW	Pedestrian Transit Movement Warning
PWR	Power
QLE	Queue Length Estimate
RAID	Redundant Array of Independent Disks
RAM	Random Access Memory

ACRONYM	DEFINITION
RDE	Research Data Exchange
REL	Reversible Express Lanes
RISC	Reduced Instruction Set Computer
RLNC	Random Linear Network Code
RSE	Roadside Equipment
RSU	Road Side Unit
RT	Right Turn
SAD	System Architecture Document
SAE	Society of Automotive Engineers
SCMS	Security Credential Management System
SD	Secure Digital
SDD	System Design Document
SEP	System Engineering Process
SQL	Structured Query Language
SRM	Signal Request Message
SSD	Solid State Disk
SSM	Signal Status Message
TB	Terabyte
TERL	Test Evaluation and Research Laboratory
THEA	Tampa Hillsborough Expressway Authority
TIM	Traveler Information Message
TLS	Transport Layer Security
TMC	Transportation Management Center
TMDD	Traffic Management Data Dictionary
TSP	Transit Signal Priority
UDP	User Datagram Protocol
UI	User Interface
USB	Universal Serial Bus
USDOT	United States Department of Transportation
V2I	Vehicle-To-Infrastructure
V2V	Vehicle-To-Vehicle
V2X	Vehicle-To-Everything
VGA	Video Graphics Array
VM	Virtual Machine
VTRFTV	Vehicle Turning Right in Front of a Transit Vehicle
WAVE	Wireless Access in Vehicular Environments
WLAN	Wireless Local Area Network
WSA	Web Services Addressing

ACRONYM	DEFINITION
WSM	WAVE Short Message
WWE	Wrong Way Entry
XER	XML Encoding Rules
XFR	Transfer Interface of the RSU
XML	Extensible Markup Language
Z	Impedance

5 References

Table 18: Documents Referenced

RDn	Document (Title, source, version, date, location)
1	*Connected Vehicle Reference Implementation Architecture Website*, US Department of Transportation, Office of the Assistant Secretary of Transportation for Research and Technology. https://www.iteris.com/cvria
2	*Connected Vehicle Pilot Deployment Program Phase 1, Concept of Operations (ConOps) – Tampa (THEA),* February 2018, FHWA-JPO-16-311 http://ntl.bts.gov/lib/59000/59300/59360/FHWA-JPO-16-299.pdf
3	*Connected Vehicle Pilot Deployment Program Phase 1, System Requirements Specification (SyRS) - Tampa (THEA),* February 2018, FHWA-JPO-16-315 https://ntl.bts.gov/lib/60000/60700/60712/FHWA-JPO-16-315.pdf
4	*Connected Vehicle Pilot Deployment Program Phase 2, System Architecture Document (SAD) - Tampa (THEA)*, January 2019, FHWA-JPO-17-459
5	*Multi-Modal Intelligent Traffic Signal System – Phase II: System Development, Deployment and Field Test*, Final Report, v2.0, September 2016, http://www.cts.virginia.edu/wp-content/uploads/2014/04/53-MMITSS-Phase-2-Final-Report-FINAL-092520161.pdf
6	*Multi-Modal Intelligent Traffic Signal System*, System Design, v1.1, 6/16/2015 http://www.cts.virginia.edu/wp-content/uploads/2014/04/22-MMITSS-Phase-2-Detailed-Design-AZ-final-06162015.pdf
7	*ISO/TS 19091:2017 - Intelligent transport systems -- Cooperative ITS -- Using V2I and I2V communications for applications related to signalized intersections*, International Standards Organization, March, 2017 https://www.iso.org/standard/69897.html
8	*Connected Vehicle Pilot Deployment Program Phase 2, Interface Control Document (ICD) - Tampa (THEA)*, May 2018, FHWA-JPO-17-460
9	*VEHICLE SYSTEMS – On Board Unit (OBU) COMPONENT SPECIFICATION,* OBU_COMPSPEC_BM_THEA v2.3, (unpublished)
10	*RFQ OBU, HMI Interface and Antenna*, merged into R3 (unpublished)
11	*Connected Vehicle Pilot Development Program Phase 1 Participant Training and Stakeholder Education Plan – Tampa (THEA)*, Final Report – August 1, 2016, FHWA-JPO-16-318
12	*Connected Vehicle Pilot Development Program Phase 1, Safety Management Plan – Tampa (THEA),* Final Report –January 2019, FHWA-JPO-16-313
13	*OBU-RSU Data Collection Interface,* Specification Rev 1.3 Final, 8/9/2018, (unpublished)
14	*VEHICLE SYSTEMS – Onboard Unit (OBU) HMI SPECIFICATION,* OBU_HMISPEC_DM_THEA_v1.3, (unpublished)
15	*Connected Vehicle Pilot Development Program Phase 2, Comprehensive Installation Plan – Tampa (THEA), Final Report – May 2018, FHWA-JPO-16-463*

6 Requirements Traceability Matrix

This section consists of a Traceability Matrix used to validate Requirements to the major steps of the System Engineering Process (SEP).   Each SEP step is documented as [RDn] in Table 18.

Table 19: Requirements Traceability Matrix

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC1-001	I-SIG application at Twiggs and Meridian shall transmit southbound estimated queue data to the REL ERDW application.	7.1.1	1	NA	NA	NA	NA	2.2	NA	3.2.2.1.2	MMITSS (QLE) sends queue lengths on lanes to ERDW app	NA	NA
THEA-UC1-002	The drivers shall receive ERDW from ERDW application on the vehicles	7.1.1	1, 6	5.2.2	NA	NA	NA	2.2	NA	3.3.2.1	Drivers receive warning based on their speed and location in reference to the TIM received by the OBU from RSU	3.2.1	23002
THEA-UC1-003	I-SIG application at Twiggs and Nebraska shall transmit westbound queue length data to the CSW application on the REL per lane.		Deleted										
THEA-UC1-004	The Electronic Emergency Brake Light warning (EEBL) application on the braking vehicle shall broadcast an EEBL warning when the vehicle deceleration exceeds predetermined value.	7.1.1	1	5.2.6	NA	NA	4.1.1.1.4	2.8	NA	3.3.2.7	Hard braking vehicle sends out a BSM with a hard-braking event flag to vehicles around.	3.1.1	20005
THEA-UC1-005	The EEBL application on the receiving vehicle shall receive an EEBL warning from the braking vehicle.	7.1.1	2	5.2.6	NA	NA	4.1.1.1.4	2.8	NA	3.3.2.7	EEBL app on the OBU receives BSMs from hard-braking vehicles around	3.1.1	20005
THEA-UC1-006	The EEBL application on the receiving vehicle shall process an EEBL warning from forward vehicles.	7.1.1	2	5.2.6	NA	NA	4.1.1.1.4	2.8	NA	3.3.2.7	EEBL app on the OBU processes BSMs from hard-braking vehicles ahead	3.1.1	20005
THEA-UC1-007	The EEBL application shall warn the driver of other equipped vehicles ahead exceeding the preset deceleration downstream to Twiggs Street.	7.1.1	2	5.2.6	NA	NA	4.1.1.1.4	2.8	NA	3.3.2.7	EEBL application warns the driver of a vehicle of a hard-braking vehicle in the lane ahead	3.2.1	23002

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC1-008	Vehicles equipped with OBUs shall receive BSMs from other vehicles equipped with OBUs within DSRC range.	7.1.1	2	4.9.1.1	NA	NA	NA	NA	NA	3.3.2.12	OBU equipped vehicles continually broadcast and receive BSMs from other equipped vehicles within the range	3.1.1	20004
THEA-UC1-009	The FCW in-vehicle application shall determine potential crash trajectories with other vehicles.	7.1.1	1	5.2.5	NA	NA	NA	2.7	NA	3.3.2.6	FCW application will process BSMs from other vehicles in proximity to determine crash trajectories	NA	NA
THEA-UC1-010	The FCW application shall warn the driver of potential crash trajectories.	7.1.1	2	5.2.5	NA	NA	4.1.1.1.4	2.7	NA	3.3.2.6	Driver will receive a warning if crash is imminent	3.2.1	23002
THEA-UC1-011	The Human Machine Interface (HMI) shall warn the driver no more than once when multiple warnings are received within a configurable timeframe.	7.1.1	2	5.2.5	NA	NA	4.1.1.1.4	1.1.4	NA	3.3.2.6	Driver will receive one warning within a specified timeframe if crash is imminent	3.2.1	23002
THEA-UC1-012	The I-SIG application shall receive BSMs from vehicles equipped with OBUs.	7.1.1	1	5.2.5	NA	NA	NA	NA	NA	3.2.2.3.2	Siemens-MMITSS receives BSMs from vehicles	3.1.1	20004
THEA-UC1-013	I-SIG application running on the RSU at Twiggs and Meridian shall process BSMs to estimate the queue length on the southbound approach from the REL.	7.1.1	1	5.2.5	NA	NA	NA	NA	NA	3.2.2.3.2	MMITSS estimates queue lengths based on received BSMs. See the referenced pre-existing MMITSS Detailed Design.	NA	NA
THEA-UC1-014	I-SIG application at Twiggs and Nebraska shall process BSMs to estimate the queue length.	7.1.1	1, 3, 5	5.2.5	NA	NA	NA	NA	NA	3.2.2.3.2	MMITSS estimates queue lengths based on received BSMs. See the referenced pre-existing MMITSS Detailed Design.	NA	NA
THEA-UC1-015	I-SIG application shall transmit the queue lengths to the THEA master server.	7.1.1	1	5.2.5	NA	NA	NA	NA	NA	3.2.2.6.2	The data collector receives queue lengths from MMITSS and sends them to the master server.	3.12.4	23030
THEA-UC1-016	I-SIG application at Twiggs at Nebraska shall transmit the queue lengths to the THEA master server.		Deleted										
THEA-UC1-017	The Master Server shall receive the queue lengths from I-SIG application running on the RSU.	7.1.1	1	5.2.5	NA	NA	NA	NA		3.1.2.3	The data log archive stores the queue lengths received from RSUs	NA	NA

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC1-018	The Master Server shall store the queue lengths received from I-SIG application.	7.1.1	1	5.2.5	NA	NA	3.0	NA	NA	3.1.2.3	The data log archive stores the queue lengths received from RSUs	NA	NA
THEA-UC1-019	The combination of signal controller and the RSU application shall control signal phases based on Multi-Modal Intelligent Traffic Signal Systems (MMITSS).	7.1.1	4	5.2.5	NA	NA	NA	NA	NA	3.2.2.3.2	MMITSS I-SIG controls phases of an intersection based on received BSMs. See the referenced pre-existing MMITSS Detailed Design.	NA	NA
~~THEA-UC1-020~~	~~The combination of signal controller and the RSU application shall modify the signal phase timing based on estimated queue lengths in order to move traffic efficiently through the intersection at Twiggs at Nebraska.~~	7.1.1	4							3.2.2.3.2	MMITSS I-SIG controls phases of an intersection based on received BSMs. See the referenced pre-existing MMITSS Detailed Design.	NA	NA
~~THEA-UC1-021~~	~~I-SIG application shall prioritize queues that limit safe stopping distance as Priority as defined in the I-SIG requirements.~~		Deleted										
THEA-UC1-022	The RSU ERDW application shall broadcast a recommended standard speed.	7.1.1	6	5.2.5	NA	NA	NA	NA	NA	3.2.2.1.2	ERDW sends out a corresponding TIM with the speed recommendation zones	3.4.3	20014
THEA-UC1-023	The vehicle ERDW application shall receive the recommended standard speed.	7.1.1	6	5.2.5	NA	NA	NA	NA	NA	3.3.2.1	Equipped cars will receive TIM from RSU with the recommended speed	3.4.3	20014
THEA-UC1-024	The RSU ERDW application shall adjust the configurable speed recommendation zone(s) based on the southbound queue length from I-SIG application on Twiggs and Meridian.	7.1.1	6	5.2.5	NA	NA	NA	NA	NA	3.2.2.1	ERDW calculates the safe speed using a regression formula based on the FL drivers manual table	NA	NA
THEA-UC1-025	The vehicle ERDW application shall provide a configurable speed that the agencies can adjust to local practices to an appropriate speed based on the vehicle type.	7.1.1	6	5.2.5	NA	NA	NA	NA	NA	3.2.1.1 3.3.2.1	Depending on vehicle type, the OBU will convert the recommended speed to assure a safe stopping distance	NA	NA

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC1-026	The RSU ERDW application shall calculate the configurable speed recommendation zones to the THEA Master Server.	7.1.1	6							3.2.2.6	The RSU logs all WSM sent out which includes TIMs sent by ERDW. The data collector transfers these logs to NextConnect.	NA	NA
THEA-UC1-026a	The RSU ERDW application shall transmit the configurable speed recommendation zones to the THEA Master Server.	7.1.1	6	5.2.5	NA	NA	3.0	NA	NA	3.2.2.6.2	The TMC Operator can access the current queue length and TIM being broadcast via the RSU service UI.	NA	NA
THEA-UC1-027	TMC operators shall be able to access queue length and corresponding speed recommendation zones.		Deleted										
THEA-UC1-028	A traditional vehicle detector shall issue a call to the RSU when a vehicle occupies the detection zone.	7.1.1	1, 6	5.2.5	NA	NA	NA	NA	NA	3.2.2.1.2	A Wavetronix radar sensor will detector vehicles passing by. The ISG application on the RSU receives the sensor data.	3.9.1	23016
THEA-UC1-029	The RSU shall transmit an ISM (infrastructure sensor message) to I-SIG when the traditional detector issues a call.	7.1.1	1, 6	5.2.5	NA	NA	NA	NA	NA	3.2.2.1.2	The ISG application creates an ISM from the sensor data and sends it MMITSS as input to the queue length estimator.	NA	NA
THEA-UC1-030	Vehicles equipped with OBUs shall broadcast BSMs.	7.1.2	2	5.2.5	NA	NA	NA	NA	NA	3.3.2.12	OBU equipped vehicles continually broadcast and receive BSMs from other equipped vehicles within the range	3.1.1	20004
THEA-UC2-001	Vehicle shall receive the BSMs from other equipped vehicles.	7.1.2	1	5.2.1	NA	NA	NA	NA	NA	3.3.2	OBU equipped vehicles continually broadcast and receive BSMs from other equipped vehicles within the range	3.1.1	20004
THEA-UC2-002	Vehicles traveling in the legal direction shall identify crash trajectory of vehicles traveling opposite the legal direction.		Deleted										

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC2-003	Vehicles shall identify crash trajectory of cross street vehicles	7.1.2	1	5.2.1	NA	NA	NA	2.2	NA	3.3.2.8	The IMA application is intended to warn the driver when it is not safe to enter an intersection	3.2.1	23002
THEA-UC2-003a	Vehicles shall warn the driver of a potential crash.	7.1.2	1	5.2.1	NA	NA	4.1.1.1.4	2.2	NA	3.3.2.8	The IMA application is intended to warn the driver when it is not safe to enter an intersection	3.2.1	23002
THEA-UC2-004	RSU at REL entrance shall host the existing 2-phase traffic signal control application.		Deleted										
THEA-UC2-005	Signal control application Phase 1 at REL entrance shall be RED inbound and GREEN outbound during outbound times of day,		Deleted										
THEA-UC2-006	Signal control application Phase 2 at REL entrance shall be GREEN inbound and RED outbound during inbound times of day.		Deleted										
THEA-UC2-007	The RSU at REL entrance shall transmit the latest published standard SPaT message per J2735/201603.	7.1.2	2	5.2.1	NA	NA	4.0	NA	NA	2.1.2 3.2.2.2 3.4.2	The SPaT-MAP-Daemon broadcasts SPaT and MAP	3.4.2	43013
THEA-UC2-008	The RSU at REL entrance shall transmit the REL entrance lane geometry MAP message per J2735/201603 current version	7.1.2	2	5.2.1	NA	NA	4.0	NA	NA	2.1.2	The SPaT-MAP-Daemon broadcasts SPaT and MAP	3.4.1	20008
THEA-UC2-008b	The MAP message shall identify the REL lanes as revocable lanes.	7.1.2	2	5.2.1	NA	NA	4.0	NA	NA	2.1.2	The MAP message broadcast is configurable and will be configured per this requirement.	NA	NA

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC2-008c	The SPaT message shall contain the enabled / disabled status of the revocable lanes based on status of the gates at the REL entrance.	7.1.2	2	5.2.1	NA	NA	4.0	NA	NA	3.2.2.2.2	The SPaT-MAP-Daemon receives the current gate open/closed status from the local traffic controller via NTCIP. It then translates this status to the enabled status for the corresponding revocable lanes and includes then EnabledLane list with the SPaT message.	3.8.1	23006
THEA-UC2-008d	The WWE application shall receive the open / closed status from the gates at the REL entrance.	7.1.2	2	5.2.1	NA	NA	4.0	NA	NA	3.2.2.2.2	The SPaT-MAP-Daemon receives the current gate open/closed status from the local traffic controller via NTCIP. It then translates this status to the enabled status for the corresponding revocable lanes and includes then EnabledLane list with the SPaT message.	3.8.1	23006
THEA-UC2-009	Participating vehicles shall host the Wrong Way Entry (WWE) application.												
THEA-UC2-010	Vehicle WWE application shall receive the SPaT message.	7.1.2	2	5.2.1	NA	NA	4.0	NA	NA	3.3.2.2	OBU will receive SPaT messages broadcast by the RSUs	3.4.2	23007
THEA-UC2-011	Vehicle WWE application shall receive the MAP message.	7.1.2	2	5.2.1	NA	NA	4.0	NA	NA	3.3.2.2	OBU will receive MAP messages broadcast by the RSUs	3.4.1	20008, 23007
THEA-UC2-012	Vehicle WWE application at the REL entrance shall warn drivers predicted to enter a closed lane or an ingress lane going the wrong way.	7.1.2	2	5.2.1	NA	NA	4.1.1.1.4	2.1	NA	3.3.2.2	OBUs will warn the driver based on the trajectory and the SPaT and MAP messages from the intersection	3.2.1	23002
THEA-UC2-013	A roadside vehicle detector shall issue a call to the proxy app when a vehicle approaches the REL entrance.												

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-UC2-014	A roadside vehicle detector shall issue a call to the WWE app running on the RSU when a vehicle enters the REL entrance going the wrong way.	7.1.2	3	5.2.1	NA	NA	NA	NA	NA	3.2.2.1.1	The RSU WWE app receives a detection input from a wrong-way detection system via the local traffic controller.	3.8.1	23006
THEA-UC2-015	WWE app running on the RSU shall create a wrong way driver warning message when the roadside detector call is asserted.	7.1.2	3, 4	5.2.1	NA	NA	4.1.1.1.4	2.1	NA	3.2.2.1.1	The RSU WWE app broadcasts a corresponding TIM containing the wrong-way driver alert.	3.4.3	23017
THEA-UC2-015b	While receiving wrong way driver warning messages the OBU shall determine if the vehicle is travelling on along the road segment to which the warning applies.	7.1.2	1	5.2.1	NA	NA	4.1.1.1.4	2.1	NA	3.3.2.2	The application will warn the drivers of equipped vehicles of a wrong way driver approaching them on the REL based on a TIM that would be broadcast by the RSU.	3.2.1, 3.4.3	23002, 23017
THEA-UC2-015c	The OBU shall receive TIMs messages containing warning of a wrong way driver.	7.1.2	1	5.2.1	NA	NA	4.1.1.1.4	2.1	NA	3.3.2.2	The application will warn the drivers of equipped vehicles of a wrong way driver approaching them on the REL based on a TIM that would be broadcast by the RSU.	3.2.1, 3.4.3	23002, 23017
THEA-UC2-015d	The OBU shall warn the driver of a wrong way driver.	7.1.2	1	5.2.1	NA	NA	4.1.1.1.4	2.1	NA	3.3.2.2	The application will warn the drivers of equipped vehicles of a wrong way driver approaching them on the REL based on a TIM that would be broadcast by the RSU.	3.2.1, 3.4.3	23002, 23017
THEA-UC2-016	Vehicle WWE application of violator shall issue a wrong-way alert to the wrong way driver while driving the REL going the wrong way.	7.1.2	3	5.2.1	NA	NA	NA	2.1	NA	3.3.2.2	Driver will receive a warning if they are driving the wrong way on the REL	3.2.1	23002
THEA-UC2-017	RLV application of violator shall issue wrong-way alert to the RSU when the RLV application checks out of the REL MAP geometry during RED phase.												

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THEA-UC2-018	Wrong-way alert from the RSU shall be received at the master server.	7.1.2	4	5.2.1	NA	NA	3.0	NA	NA	3.1.2.3	The data collector receives logs from RSUs and stores them at the master server. The logs contain, among other things, the WWE TIMs broadcast by the RSU.	3.12.4	23030
THEA-UC2-019	Wrong-way alert from the RSU shall be stored at the master server.	7.1.2	4	5.2.1	NA	NA	3.0	NA	NA	3.1.2.3	The data collector receives logs from RSUs and stores them at the master server. The logs contain, among other things, the WWE TIMs broadcast by the RSU.	NA	NA
THEA-UC2-020	Wrong-way alert from master server shall be displayed in Concert.	7.1.2	4	5.2.1	NA	NA	NA	NA	NA	2.1.2	The Concert System will display an alert to the TMC operator when a wrong-way driver is detected.	NA	NA
THEA-UC3-001	The OBU shall receive Personal Safety Messages (PSMs).	7.1.3	1, 3	5.2.4	NA	NA	NA	NA	NA	3.3.2.4	OBU will receive a PSM from the RSU at the Courthouse	3.4.5	20012
THEA-UC3-002	The OBU shall determine if there is a potential conflict with a pedestrian.	7.1.3	1, 3	5.2.4	NA	NA	NA	NA	NA	3.3.2.4	PCW app will process the PSMs and determine if the vehicle is on a collision course with the pedestrian.	NA	NA
THEA-UC3-003	The OBU shall warn the driver upon determination of a potential conflict with a pedestrian.	7.1.3	1, 3	5.2.4	NA	NA	4.1.1.1.4	2.4	NA	3.3.2.4	The driver will receive a warning if they are on a collision course with a pedestrian	3.2.1	23002
THEA-UC3-004	The OBU shall receive data from the RSU of a pedestrian entering the crosswalk.		Deleted										
THEA-UC3-005	The PID shall warn the pedestrian in the crosswalk when a vehicle is approaching the crosswalk.		Deleted										
THEA-UC3-006	The PID shall warn the pedestrian approaching the crosswalk when a vehicle is entering the crosswalk.		Deleted										
THEA-UC3-007	The PID shall warn the pedestrian in a non-crosswalk area on the street when there is an impending vehicle conflict.		Deleted										

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THEA-UC3-008	The PID shall transmit PSM to the RSU.	7.1.3	10	5.2.4	NA	NA	3.0	NA	NA	3.2.2.6.1	The PID sends the PSM included inside the data logs to the RSU	3.6.5	23029
THEA-UC3-009	The RSU shall log PID PSM.	7.1.3	10	5.2.4	NA	NA	3.0	NA	NA	3.2.2.6.2 3.4.2.2	The data collector receives the data logs from the PIDs which include the PSM	3.6.5	23029
THEA-UC3-010	The RSU shall convert the PSM into a BSM.		Deleted										
THEA-UC3-011	The RSU shall send all PID PSMs to the master server.	7.1.3	10	5.2.4	NA	NA	3.0	NA	NA	3.2.2.6.2	RSU data collector sends received data logs to the master server (NextConnect) for storage.	3.12.4	23030
THEA-UC3-012	The RSU shall receive vehicle BSMs.	7.1.3	10	5.2.4	NA	NA	NA	NA	NA	3.2.2.5.1	The XFER gateway on the RSU receives BSMs from vehicles and forwards them to connected PIDs via Wi-Fi.	3.1.1	20004
THEA-UC3-013	The RSU shall send a not in crosswalk message to PIDs who are outside the crosswalk.		Deleted										
THEA-UC3-014	The RSU shall convert vehicle BSMs into PSMs		Deleted										
THEA-UC3-015	The RSU shall send vehicle BSMs over Wi-Fi to the PID.	7.1.3	10	5.2.4	NA	NA	NA	NA	NA	3.2.2.5.2	The XFER gateway on the RSU forwards them to connected PIDs via Wi-Fi.	3.6.1	23012
THEA-UC3-016	The PID shall receive BSMs.	7.1.3	10	5.2.4	NA	NA	4.1.1.1.4	NA	NA	3.2.2.5.2	The PED-X app calculates collision warnings and logs them in the PID data log.	3.6.5	23029
THEA-UC3-016a	The PID shall calculate collision warnings using the PID's location.	7.1.3	10	5.2.4	NA	NA	4.1.1.1.4	NA	NA	3.2.2.5.1	The PED-Sig app lets the user press a button on the UI when facing a cross-walk. The app will send a pedestrian call to the local traffic controller via the RSU over Wi-Fi.	3.6.4	23028
THEA-UC3-016b	The PID shall send warnings to the RSU for offline analysis.	7.1.3	10	5.2.4	NA	NA	4.1.1.1.4	NA	NA	3.2.2.6.2	The PED-Sig app receives the SPaT message from the RSU via Wi-Fi including the pedestrian call status.	3.6.3	23027

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THEA-UC3-017	The PID application, Mobile Accessible Pedestrian Signal (PED-SIG), shall allow the pedestrian to place a crossing request on the signal controller via the RSU. ...		Deleted										
THEA-UC3-017a	The PID app shall receive a confirmation for successfully placing the request and display it to the user.		Deleted										
THEA-UC4-001	Transit vehicle shall send Signal Request Message (SRM) to RSU when vehicle matches the location of the intersection approach.	7.1.4	1, 4	5.2.8	NA	NA	NA	NA	NA	3.3.2.3	The OBU will send an SRM to the RSU	3.4.4	20009
THEA-UC4-002	The RSU shall send a priority service request to the master server.	7.1.4	1, 4	5.2.8	NA	NA	NA	NA	NA	3.2.2.3	Siemens-MMITSS receives the SRM and sends a corresponding priority service request to the transit server / master server (NextConnect).	3.11.1	23013
THEA-UC4-003	Master server shall query the HART OneBusAway server for bus schedule deviation status.	7.1.4	1, 4	5.2.8	NA	NA	NA	NA	NA	3.1.2.2	NextConnect TSP looks up the current schedule deviation for the bus requesting priority.	NA	NA
THEA-UC4-004	If bus is behind schedule, the transit central shall grant permission to process the SRM to the originating RSU. Otherwise permission shall be denied.	7.1.4	1, 4, 7, 8, 9	5.2.8	NA	NA	NA	NA	NA	3.1.2.2	NextConnect TSP replies to the priority service request with granting the request if the bus is behind schedule. Otherwise the request is rejected.	NA	NA
THEA-UC4-005	The TSP application of MMITSS shall consider all priority service request of buses behind schedule and compute a phase execution schedule minimizing overall delay as implemented in the available release of MMITSS.	7.1.4	1, 4, 7, 8, 9	5.2.8	NA	NA	NA	NA	NA	3.2.2.3.2	Siemens-MMITSS processes granted priority service requests per the MMITSS design and implementation.	NA	NA
THEA-UC4-006	TSP shall receive priority status from the Controller Unit (CU).		Deleted										

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THEA-UC4-007	TSP shall broadcast a Signal Status Message (SSM) including the decision from the master server whether the request was granted.	7.1.4	1, 4, 7, 8, 9	5.2.8	NA	NA	NA	NA	NA	3.2.2.3	Siemens-MMITSS informs the bus requesting priority whether the request was granted or rejected by broadcasting a corresponding SSM.	3.4.4	20009
THEA-UC4-008	Bus shall receive SSM from TSP.	7.1.4	1, 4, 7, 8, 9	5.2.8	NA	NA	NA	NA	NA	3.3.2.3	RSU sends an SSM to approaching transit vehicles	3.4.4	20009
THEA-UC4-009	SSM shall be displayed as a bus driver notification.	7.1.4	2	5.2.8	NA	NA	NA	2.5	NA	3.3.2.3	Driver will receive a Priority Granted message if they are behind schedule	3.2.1	23002
THEA-UC4-010	Signal controllers shall extend green in order to move vehicle queues that block a bus stop entrance when the bus is behind schedule.	7.1.4	1, 4, 7, 8, 9							3.2.2.3	Siemens-MMITSS controls the phase execution schedule of an NTCIP controller by applying phase calls, force offs, holds, and omits, thereby implementing the desired behavior of either extending green or giving early green.	3.8.1	23013
THEA-UC4-011	PID shall issue an alert to participant pedestrians within in a geo fenced area that a bus is stopping at an intersection.	7.1.4	6	5.2.8	NA	NA	4.0	NA	NA	3.4.2.2.1	The PTMW feature of the pedestrian safety app monitors BSMs of nearby buses within the MAP area of the intersection and alerts the user of a stopping or starting bus.	3.6.1	23012
THEA-UC4-012	Pedestrian Safety app on PIDs shall issue an alert to pedestrians within in a geo fenced area that bus is starting up again.	7.1.4	6	5.2.8	NA	NA	4.0	NA	NA	3.4.2.2.4	The PTMW feature of the pedestrian safety app monitors BSMs of nearby buses within the MAP area of the intersection and alerts the user of a stopping or starting bus.	3.6.1	23012

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THEA-UC4-013	Transit signal priority (TSP) shall be implemented to extend and existing green in the bus route of travel..	7.1.4	1, 4, 7, 8, 9	5.2.8	NA	NA	NA	NA	NA	2.1.6	Siemens-MMITSS controls the phase execution schedule of an NTCIP controller by applying phase calls, force offs, holds, and omits, thereby implementing the desired behavior of either extending green or giving early green.	3.8.1	23013
THEA-UC4-013a	Transit signal priority shall be implemented to request accelerated (early cycle) green.	7.1.4	1, 4, 7, 8, 9							3.2.2.3	Siemens-MMITSS controls the phase execution schedule of an NTCIP controller by applying phase calls, force offs, holds, and omits, thereby implementing the desired behavior of either extending green or giving early green.	3.8.1	23013
THEA-UC5-001	Street car OBUs shall determine the position of received vehicle BSMs within DSRC range.	7.1.5	1, 3							3.3.2.5	OBU equipped vehicles continually broadcast and receive BSMs from other equipped vehicles within the range	3.1.1	20004
THEA-UC5-002	Street car OBUs shall determine the position of received participant PSMs within WiFi range.		Deleted										
THEA-UC5-003	Street car OBUs shall broadcast BSMs.		Deleted										
THEA-UC5-004	RSUs adjacent to street car line shall receive PSMs of in WiFi range pedestrians.		Deleted										
THEA-UC5-005	Pedestrian Safety app on PIDs shall issue an alert to pedestrians within a geo fenced area that the streetcar is stopping..	7.1.5	2, 8, 9, 10	5.2.3	NA	NA	NA	NA	NA	3.4.2.2.2	The PTMW feature of the pedestrian safety app monitors BSMs of nearby buses within the MAP area of the intersection and alerts the user of a stopping or starting streetcar.	3.6.1	23012

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THEA-UC5-006	Pedestrian Safety app on PIDs shall issue an alert to pedestrians within a geo fenced that the streetcar is starting.	7.1.5	2, 8, 9, 10	5.2.3	NA	NA	NA	NA	NA	3.4.2.2.2	The PTMW feature of the pedestrian safety app monitors BSMs of nearby buses within the MAP area of the intersection and alerts the user of a stopping or starting streetcar.	3.6.1	23012
THEA-UC5-007	Streetcar OBUs shall analyze its current position in relation to right turning vehicles to determine if right turning vehicle is in conflict to the streetcar's position.	7.1.5	1, 3	5.2.3	NA	NA	NA	NA	NA	3.4.2.2.5	OBU will use the turn signal of the vehicle in aiding to figure out if there is a potential conflict with the Streetcar	NA	NA
THEA-UC5-007a	Vehicle OBUs shall analyze its current position while preparing to make a right turn across the streetcar tracks in relation to a nearby streetcar to determine if the streetcar is in conflict to the vehicle's projected path.	7.1.5	7	5.2.3	NA	NA	NA	NA	NA	3.3.2.5	OBU will use the turn signal in aiding to figure out if there is a potential conflict with the Streetcar	NA	NA
THEA-UC5-008	Streetcar OBUs shall produce a warning of a vehicle turning in front of the streetcar to streetcar operator.	7.1.5	4	5.2.3	NA	NA	4.1.1.1.4	2.3	NA	3.3.2.5	If the OBU determines that there is a conflict, the Driver will receive a warning and modify a field in the BSM which is sent on to the RSU	3.2.1	23002
THEA-UC5-008a	Vehicle OBUs shall produce a warning of a streetcar conflict to the driver.	7.1.5	7	5.2.3	NA	NA	4.1.1.1.4	2.3	NA	3.3.2.5	If the OBU determines that there is a conflict, the Driver will receive a warning	3.2.1	23003
THEA-UC5-008b	Streetcar OBUs shall produce a warning of a vehicle turning in front of the streetcar to the RSU.	7.1.5	7	5.2.3	NA	NA	4.1.1.1.4	2.3	NA	3.2.2.6.1	If the OBU determines that there is a conflict, the Driver will receive a warning	3.2.1	23002

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THEA-UC5-009	RSUs adjacent to the streetcar line shall send right turning vehicle warning to the Master Server.	7.1.5	2, 8, 9, 10	5.2.3	NA	NA	4.1.1.1.4	NA	NA	3.2.2.6.1 3.2.2.5.2	The VTRFTV warning is included inside the BSM broadcast by the streetcar and is received by the RSU. The data collector RSU app will log the BSM including the VTRFTV warning and forward to the master server.	3.1.1	20004
THEA-UC5-009a	RSUs adjacent to the streetcar line shall send right turning vehicle warning to nearby PIDs.	7.1.5	2, 8, 9, 10	5.2.3	NA	NA	4.1.1.1.4	NA	NA	3.4.2.2.5	The XFER gateway on the RSU receives BSMs from vehicles and forwards them to connected PIDs via Wi-Fi.	3.6.1	23012
THEA-UC5-009b	The PID shall provide warning messages to the pedestrian when a street car stops within an intersection and when it starts back up again.												
THEA-UC5-009c	The PID shall provide warning messages to the pedestrian when a vehicle is turning right in front of the streetcar.	7.1.5	2, 8, 9, 10	5.2.3	NA	NA	4.1.1.1.4	NA	NA	3.4.2.2.5	The PTMW feature of the pedestrian safety app detects the VTRFTV warning included with the BSM received and alerts the user.	3.10.1	23010
THEA-UC5-010	Street car OBUs shall analyze its current position in relation to pedestrians in intersection crossings.		Deleted										
THEA-UC5-011	Street car OBUs shall produce a warning to the street car operator that equipped pedestrians are in conflict to the street car within a configurable threshold defaulted to 100 feet.		Deleted										
THEA-UC5-012	RSUs adjacent to the street car line shall send pedestrian conflicts warnings to the Master Server.		Deleted										
THEA-UC5-013	Street car OBUs shall store the warning message that a pedestrian is crossing the intersection.		Deleted										
THEA-UC5-014	Vehicle OBUs shall receive PSMs from the RSUs adjacent to the street car line.		Deleted										
THEA-UC5-015	Vehicle OBUs shall store the pedestrian crossing warning messages.		Deleted										

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THEA-UC5-016	Vehicle OBUs shall download pedestrians crossing warning messages to the master server		Deleted										
THEA-UC5-017	RSUs adjacent to the street car line shall receive information about location and movement of the street car.		Deleted										
THEA-UC5-018	PIDs shall receive a street car collision warning from the RSUs adjacent to the street car line.		Deleted										
THEA-UC5-019	PIDs shall provide street car collision warning messages to the pedestrian.		Deleted										
THEA-UC5-020	PIDs shall provide vehicle collision warning messages to the pedestrian.		Deleted										
THEA-UC6-001	The master server application shall compute Travel Times from equipped vehicle speeds measured along the corridors specified in other requirements.		Deleted										
THEA-UC6-002	The master server application shall send MAFB gate queues to vehicles and nomadic devices.		Deleted										
THEA-UC6-003	The master server application shall send incident locations to vehicles and nomadic devices.		Deleted										
THEA-UC6-004	PIDs shall transmit PSMs		Deleted										
THEA-UC6-005	Vehicle OBUs shall broadcast BSMs.		Deleted										
THEA-UC6-006	I-SIG application running on their RSU shall receive vehicles BSMs.	7.1.6	1, 2, 3	5.2.2	NA	NA	NA	NA	NA	3.2.2.3.2	Siemens-MMITSS receives BSMs from nearby vehicles	3.1.1	20004

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THEA-UC6-007	MMITSS shall be implemented to minimize overall delay on Meridian Avenue and Florida Avenue as implemented in the available release of MMITSS.	7.1.6	1, 2, 3	NA	NA	NA	NA	NA	NA	3.2.2.3.1	Siemens-MMITSS component MRP_PerformanceObserver calculates intersection delay time metric	NA	NA
THEA-UC6-008	I-SIG shall archive Multi-Modal Intelligent Traffic Signal Systems (MMITSS)-measured intersection delay time at the TMC Master Server.		Deleted										
THEA-UC6-008a	For each selected intersection on Meridian, I-SIG shall estimate the queue lengths on all approaches and compute the phase execution schedule as implemented in the available release of MMITSS.	7.1.6	1, 2, 3	NA	NA	NA	NA	NA	NA	3.2.2.3.1	Siemens-MMITSS component MRP_PerformanceObserver calculates queue length estimate. Siemens-MMITSS I-SIG component determines the phase execution schedule based on estimated queue lengths.	NA	NA
THEA-UC6-008b	For each selected intersection on Florida, I-SIG shall estimate the queue lengths on all approaches and compute the phase execution schedule as implemented in the available release of MMITSS.	7.1.6	1, 2, 3	NA	NA	NA	NA	NA	NA	3.2.2.3.1	Siemens-MMITSS component MRP_PerformanceObserver calculates queue length estimate. Siemens-MMITSS I-SIG component determines the phase execution schedule based on estimated queue lengths.	NA	NA
THEA-UC6-009	The Master Server shall aggregate travel times across the corridor.		Deleted										
THEA-UC6-010	The Master Server shall present travel times to the TMC Operator.		Deleted										
THEA-UC6-011	Travel times along Meridian Avenue shall be determined in a configurable time threshold (starting at 15 seconds).		Deleted										
THEA-UC6-012	Travel times along Meridian Avenue shall be based on length of corridor and detection points.		Deleted										

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THEA-UC6-013	Travel times along Florida Ave and Nebraska Ave shall be determined with the most current data.		Deleted										
THEA-UC6-014	Travel times along Selmon Expressway shall be determined with the most current data.		Deleted										
THEA-UC6-015	I-SIG shall publish travel times along Meridian Avenue to MAFB commuters.		Deleted										
THEA-UC6-016	I-SIG shall publish travel times along Channelside Drive to MAFB commuters.		Deleted										
THEA-UC6-017	I-SIG shall publish travel times along Selmon Expressway to MAFB commuters.		Deleted										
THEA-UC6-018	The Ped-Sig application shall make a pedestrian call to the RSU.	7.1.6	4	NA	NA	NA	NA	NA	NA	3.4.2.1	The PED-Sig app lets the user press a button on the UI when facing a cross-walk. The app will send a pedestrian call to the local traffic controller via the RSU over Wi-Fi.	3.10.1	23010
THEA-UC6-018a	The Ped-Sig applications shall receive a proceed to cross message with the pedestrian clearance timer from the RSU Ped Sig application.		Deleted										
THEA-UC6-018b	The Ped-Sig application shall audibly inform the pedestrian of the ability to cross and the pedestrian clearance timer.	7.1.6	4	NA	NA	NA	NA	NA	NA	3.4.2.1	The PED-Sig feature of the pedestrian safety app uses Android's text-to-speech feature in order to audibly inform the user of the pedestrian signal head status including the "Flashing Don't Walk" countdown timer.	3.10.1	23010
THEA-UC6-018c	The RSU Ped-SIG application shall receive the pedestrian call from the PID.	7.1.6	4	NA	NA	NA	4.0	NA	NA	3.4.2.1	The SPaT-MAP Daemon receives the pedestrian call from the PID and uses the Controller Proxy component in order to place the call with the NTCIP traffic controller.	3.6.4	23028

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THEA-UC6-018d	The RSU Ped-Sig application shall send pedestrian call to the signal controller.	7.1.6	4	NA	NA	NA	4.0	NA	NA	3.4.2.1	The SPaT-MAP Daemon receives the pedestrian call from the PID and uses the Controller Proxy component in order to place the call with the NTCIP traffic controller.	3.8.1	23006
THEA-UC6-018e	The RSU Ped-Sig application shall request the extended walk time, if available, to the signal controller.	7.1.6	4							3.2.2.4	The Controller Proxy component will use the appropriate NTCIP OID for requesting extended walk time, if supported by the NTCIP controller.	3.8.1	23006
THEA-UC6-018f	The RSU Ped Sig application shall receive the pedestrian timing information from the signal controller.	7.1.6	4	NA	NA	NA	4.0	NA	NA	3.2.2.1	The SPaT-MAP Daemon receives the SPaT message from the traffic controller containing the pedestrian call status.	3.8.1	23006
THE-UC6-018g	The RSU Ped-SIg application shall send the proceed to cross message to the Ped-Sig application running on the PID.	7.1.6	4	NA	NA	NA	4.0	NA	NA	3.4.2.1	The PED-Sig app receives the SPaT message from the RSU via Wi-Fi including the pedestrian clearance timer status.	3.6.3	23027
THEA-SAF-001	Equipment, software, processes, and interfaces shall comply with IEEE and SAE standards as prescribed by one of the USDOT approved certification entities.	5.3	NA	NA	NA	Table 5-1 IDs 22 and 23	NA	NA	NA	Table 15 Table 9	All the standards are listed in the OBU spec RSU implements USDOT v4.1 Spec	NA	NA
THEA-SAF-002	Equipment, software, processes, and interfaces shall be tested for interoperability before deployment to ensure they meet those standards for interoperability.					6.1.1 and 6.2					The vehicle integrator, with THEA team concurrence, will provide an interoperability process and the supplier a plan for certification.		
THEA-SAF-003	During operations the TMC Operator and installation technicians shall performs checks on the equipment, software, interfaces, and processes on a six month basis at a minimum.	8				4.3.6, 6.2.2					Organizational Requirement		
THEA-SAF-004	THEA shall maintain the RSUs installed along the roadside by monitoring the RSU status from the Concert System.	9.5.2	NA	NA	NA	NA	NA	NA	3.5 5.2.7	Table 1	Organizational Requirement	NA	NA

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THEA-SAF-005	OBU/Application failure shall not affect the normal operation of the vehicle.	10	NA	3.3.1	NA	Table 5-1 IDs 12, 14, 16	NA	NA	NA	3.3.2.12	The OBU shall not damage the vehicle's electrical systems, electronic systems, or cause a fire or other condition that could damage the vehicle or injure the driver or passengers.	NA	NA
THEA-SAF-006	RSU/Application failure shall not affect the safe operation of the signal controller.	10	NA	NA	NA	Table 5-1 IDs 3, and 4	NA	NA	NA	2.1.6 3.1 3.1.2.1 3.1.2.4 3.2.2.2.2 3.2.2.3.2 3.2.2.4.1 3.3.2.3	RSU uses only standard NTCIP interfaces for communication with the signal controller.	NA	NA
THEA-SAF-007	PID application failure shall not affect the normal operation of the PID.					Table 5-1 ID 18					Android OS implements this requirement.		
THEA-SAF-008	OBUs shall be installed properly in vehicles, buses, and street cars.	9.5.3				6.1.2					Organizational Requirement		
THEA-SAF-009	RSUs shall be installed such that they receive GPS and DSRC signals.										Organizational Requirement;		
THEA-SAF-010	RSUs shall be installed near signal cabinets such that the RSU and signal controller can be connected.	5.2 Goal 2									Organizational Requirement		
THEA-SAF-011	Participants shall bring their vehicles in for inspection within 14 days when the vehicle is involved in a crash.	10	NA	NA	Section 3.1	NA	NA	NA	4.2.9	Not SDD	Organizational Requirement	NA	NA
THEA-SAF-012	The in-vehicle applications shall present information to drivers using a device that drivers are familiar with and limit interaction.									3.3	Private passenger automobiles and light duty trucks – Each respective OEM rear view mirror will be replaced with a compatible rear-view mirror, that is maintaining all original mirror functions	NA	NA
THEA-SAF-013	CV device suppliers shall provide and follow an approved quality management process in designing, constructing and producing their devices.					6.1.2					Organizational Requirement	NA	NA

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THEA-SAF-014	The proposed user interface(s) shall be reviewed and approved by THEA and stakeholders.	5.3	NA	NA	NA	6.1.1	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA
THEA-SAF-015	Safety checks for OBU's and RSU's shall comprise the equipment reset functions upon power loss and restoration.			4.12.1.5		6.1.1					The OBU shall include appropriate watchdog mechanisms that will monitor all software processes and alert the process monitor [on the OBU] when a process appears to be inoperative.		
THEA-SAF-016	Safety checks for OBU's and RSU's shall comprise the redundancy actions upon power loss and restoration.			3.1.4		6.1.1					Upon power loss and restoration, the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it Upon power loss and restoration the OBU performs a secure boot checking the integrity and authenticity of the installed software before executing it..		
THEA-SAF-017	Safety checks for OBU's and RSU's shall comprise the security actions upon power loss and restoration.			3.1.4		6.1.1					Upon power loss and restoration, the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it. Upon power loss and restoration the OBU performs a secure boot checking the integrity and authenticity of the installed software before executing it.		

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~~THEA-SAF-018~~	~~Safety checks for OBU's and RSU's shall comprise the equipment reset functions, redundancy, security, and actions upon power loss and restoration.~~			3.1.4		6.1.1					Upon power loss and restoration, the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it. Upon power loss and restoration the OBU performs a secure boot checking the integrity and authenticity of the installed software before executing it.		
~~THEA-SAF-019~~	~~Uninterruptible power supply units with sufficient holdup time (2 hours) to implement the response plans shall be installed at all signal controller cabinets as part of the pilot.~~					6.1.1					Organizational Requirement		
THEA-SAF-020	Device installers shall be approved by the in-vehicle integrator to install devices in vehicles, buses, streetcars.	9.2	NA	NA	7.3	6.1.2	NA	NA	4.2	Not SDD	The Hillsborough Community College automotive training facilities and personnel to install the vehicle systems.	NA	NA
THEA-SAF-020a	Participants shall be trained in the operation and interaction of the installed Onboard Units.	9.2	NA	NA	3.6		NA	NA	4.2	Section 6 RTM		NA	NA
THEA-SAF-021	Device installers shall be approved by the infrastructure integrator THEA and the COT to install devices in signal cabinets and along the roadside.	9.2	NA	NA	7.3	6.1.2	NA	NA	4.2	Section 6 RTM	Organizational Requirement	NA	NA

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~~THEA-SAF-022~~	~~RSUs installed for the pilot shall have a hardware fail safe mode.~~			4.12.1.5		6.1.2					Upon power loss and restoration, the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it. Only know good application software will be launched and allowed to broadcast via DSRC. The operating platform shall be able to reload and restart the failed process and shall make an entry in a log indicating that this action took place. Such actions shall include managed hysteresis that will avoid continuous retries for a failed process until it receives an update.		
THEA-PFM-001	The CUTR Server shall collect baseline or "before CV treatment" performance metrics for each CV App used in each Use Case if available.	11.2.1	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	Organizational Requirement	NA	NA
THEA-PFM-002	The CUTR Server shall store baseline or "before CV treatment" performance metrics for each CV App used in each Use Case if available.	11.2.1	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	Organizational Requirement	NA	NA
THEA-PFM-003	The CUTR Server shall collect performance metrics for each CV App used during each Use Case	11.21	NA	NA	NA	NA	3.0	NA	NA	3.1.2.3	The data log archive includes metrics for each deployed CV app	NA	NA
THEA-PFM-004	The CUTR Server shall store performance metrics for each CV App used during each Use Case	11.2.1, 11.2.2	NA	NA	NA	NA	3.0	NA	NA	3.1.2.3	The data log archive includes metrics for each deployed CV app	NA	NA
THEA-PFM-005	The CUTR Server shall enable the analysis or compare historical or "before CV treatment" performance metrics for each CV App used in each Use Case to "after CV treatment" performance metrics for each CV App used in each Use Case.	11.2.5	NA	NA	NA	NA	3.0	NA	NA	3.1.2.3	The data log archive stores data log from both the "before CV treatment" time period and the "after CV treatment" time period.	NA	NA

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THEA-PFM-006	The CUTR Server shall automate routine performance reports.	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	Reporting Service can be configured to generate reports automatically.	NA	NA
THEA-PFM-007	The CUTR Server shall support on demand performance reports.	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	Reports can also be requested on demand from Reporting Service.	NA	NA
THEA-PFM-008	The Master Server shall support daily performance reports.	11.2.5								3.1.2.4	Reports can be scheduled to run automatically. Daily, weekly, and monthly reports are supported.		
THEA-PFM-009	The Master Server shall automate weekly performance reports.	11.2.5								3.1.2.4	Reports can be scheduled to run automatically. Daily, weekly, and monthly reports are supported.		
THEA-PFM-010	The Master Server shall automate monthly performance reports.	11.2.5								3.1.2.4	Reports can be scheduled to run automatically. Daily, weekly, and monthly reports are supported.		
THEA-PFM-011	The Master Server shall transmit reports to USDOT.	11.2.5								3.1.2.4	Reporting jobs can send reports to a provided email address.		

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THEA-PFM-012	The Concert system shall collect: • BSM and ISM queue length • crashes, conflicts, or near misses • approaching speed on REL • BSM travel times • number of wrong way violations • approaching speed on Twiggs Street toward the REL • approaching speed on Nebraska Avenue toward the REL • approaching speed on Florida Avenue toward the REL • vehicle's speed approaching the crosswalk • bus percent arrival on green • number of times priority is requested and granted • number of time priority is requested and denied • ~~number of times priority is requested, granted, and then denied due to a higher priority~~ • approach speed at intersections along Meridian Avenue • approach speed at intersections along Florida Avenue	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	See table 3-3 for the list of supported reports	NA	NA
THEA-PFM-012a	The Concert system shall compute • travels times along Meridian • travel times along Florida	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.4		NA	NA

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THEA-PFM-012b	The Centracs system shall collect: • percent arrival on green • percent arrival on green along Meridian Avenue	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	Centracs supports these via an addon module which will be installed and configured by the City of Tampa	NA	NA
THEA-PFM-012c	The HART system shall collect: • bus travel time through the deployment region • bus percent arrival on schedule	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.2	HART has existing metrics supporting this.	NA	NA
THEA-PFM-012d	The CUTR server shall collect: • delay time • travel time from Bluetooth travel time system • travel time reliability indices • travel time delay on REL • travel time delay on adjacent arterial • pedestrian delay time at the crosswalk • vehicle delay time at the crosswalk • delay time along Meridian Avenue • delay time along Nebraska Avenue • delay time along Florida Avenue	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	An internal document is being developed that identifies each performance data element and required calculations and communication methods. This Performance Measures Data Design Document is under development and is targeted for completion by 9/30/17	NA	NA

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THEA-PFM-013	The CUTR system shall store: • delay time • queue length • crashes, conflicts, or near misses • approaching speed on REL • travel time reliability indices • travel times • percent arrival on green • percent wrong way violation • travel time delay on REL • travel time delay on adjacent arterial • approaching speed on Twiggs Street toward the REL • vehicle delay time at the crosswalk • pedestrian delay time at the crosswalk • vehicle's speed approaching the crosswalk • bus travel time through the deployment region • bus percent arrival on schedule • bus percent arrival on green • number of times priority is requested and granted • number of time priority is requested and denied • number of times priority is requested, granted, and then denied due to a higher priority • travel times along Meridian Avenue • delay time along Meridian Avenue • percent arrival on green along Meridian Avenue • approach speed at intersections along Meridian Avenue	11.2.5	NA	NA	NA	NA	NA	NA	NA	3.1.2.4	All source data for these performance measures is stored on the master server. See table 3-2 for the list of data sources for each performance measure.	NA	NA

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THEA-SEC-001	OBU Wireless Access in Vehicular Environments (WAVE) shall comply with IEEE 1609.2: Standard for WAVE – Security Services for Applications and Management Messages	11.3.1	NA	4.10.1	NA	NA	NA	NA	NA	Table 15	OBUs shall conform to all the required standards listed in the OBU Spec RSU complies with USDOT v4.1 Spec	NA	NA
THEA-SEC-001a	RSU Wireless Access in Vehicular Environments (WAVE) shall comply with IEEE 1609.2: Standard for WAVE – Security Services for Applications and Management Messages	11.3.1	NA	NA	NA	NA	NA	NA	NA	3.2.1		NA	NA
THEA-SEC-002	Devices shall sign and/or encrypt data non-DSRC IP communication (i.e., cellular, WiFi) interfaces with X.509 certificates.	11.3.2	NA	NA	NA	NA	NA	NA	NA	Table 9	RSU supports Wi-Fi WPA2 plus TLS encryption via Wi-Fi. RSU supports OpenVPN encryption via LTE.	NA	NA
THEA-SEC-003	THEA CV Pilot devices shall support requirements identified in the SCMS POC Implementation End Entity (EE) Requirements and Specifications as of November 1, 2017.	11.3.1	NA	4.10.1	NA	NA	NA	NA	NA	3.2.1	The Vehicle System shall have security as defined by the Security Certificate Management System (SCMS) POC and provide data privacy. Human Use and Privacy requirements to be developed. RSU complies with USDOT v4.1 Spec	NA	NA
THEA-SEC-004	Datasets shall be required to have PII information removed prior to being made publicly available.	11.3.2	NA	NA	NA	NA	3.0	NA	NA	3.1.2.3	Data Log Archive performs PII removal before copying data to the public storage area.	NA	NA
THEA-SEC-005	Monitoring systems shall be enabled and used to perform intrusion detection	11.3.1	NA	4.7.3	NA	NA	NA	NA	NA	Table 15	The OBU equipment shall be able to detect when there are any new connections or insertions into the USB port or SD Card slot.	NA	NA
THEA-SEC-006	The RSU firewall shall be enabled and used to prevent unauthorized activity on an IP connection.	11.3.1	NA	NA	NA	NA	NA	NA	NA	Not SDD	Organizational Requirement to use firewall correctly	NA	NA
THEA-SEC-006a	The OBU firewall shall be enabled and used to prevent unauthorized activity on an IP connection.	11.3.1	NA	4.7.1	NA	NA	NA	NA	NA	Not SDD	Organizational Requirement to use firewall correctly	NA	NA

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THEA-SEC-007	OBU hardware shall meet FIPS-140-2 Level 2												
THEA-SEC-008	PIDs shall meet FIPS 140-2 Level 2 or equivalent.												
THEA-SEC-009	RSU hardware shall meet FIPS 140-2 Level 2.												
THEA-SEC-010	ITS Roadway Equipment communications shall be developed meet FIPS 140-2 Level 2 or equivalent.												
THEA-SEC-011	New field cabinets shall include tamper alerts.	11.3.1									Organizational Requirement (responsibility of City of Tampa)		
THEA-SEC-012	New field cabinet tamper alerts shall be sent to the TMC when an unauthorized access occurs.	11.3.1									Organizational Requirement (responsibility of City of Tampa)		
THEA-SEC-013	All participant data, as defined in the SMOC, shall be encrypted with minimum standards, password protected, and maintained separate from the application and performance measurement data (Separate systems, separate login and user access at a minimum).	11.3.2									Organizational Requirement		
THEA-SEC-014	Access to participant data shall be identified in the Human Use Approval document,	11.3.2	NA	NA	NA	NA	NA	NA	NA	3.1.2.3	Organizational Requirement	NA	NA
THEA-SEC-015	The definition of how applications are authorized to communicate shall be using valid certificates.	11.3.1									Organizational Requirement		
THEA-SEC-016	No person shall transfer PII information in an unencrypted state.	11.3.1									Organizational Requirement		
THEA-SEC-017	The participant's location information shall not be provided unless it is part of an application and no correlation to the participants personal information.	11.3.1									Organizational Requirement		
THEA-SEC-018	PII shall not be used as a unique identifier except for buses.	11.3.1									OBUs will be identified using a numeric ID.		

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THEA-SEC-019	For broadcast and transactional unicast transmissions by OBUs, temporary and one-time identifiers shall be used during the pilot, but removed following the completion of the pilot.	11.3.1	NA	4.11	NA	NA	NA	NA	NA	3.1.2.3	OBUs will be identified using a static numeric ID in the TemporaryID field of the BSM. At the end of the study the static ID will be replaced by a true temporary ID according to J2945/1_201603	NA	NA
THEA-SEC-020	The user shall consent to providing data in an agreement that spells out how the data is used and by whom (including re-distribution to third parties).	11.3.2									Organizational Requirement		
THEA-SEC-021	The Master Server Network and remote access shall support remote authenticated access.	11.3.1	NA	NA	NA	NA	NA	NA	NA	Table 2	RSU supports remote access via browser UI which requires a user name and password.	NA	NA
THEA-SEC-022	OBU's and PIDs shall not support remote access of the connected vehicle applications.	11.3.1									OBUs do not have access via SSH or HTTP		
THEA-SEC-023	The OBU shall support physical access to support bootstrapping activities.	11.3.1	NA	4.1.9	NA	NA	NA	NA	NA	Table 3	A management port will be used for data transfers as well as firmware and software upgrades	NA	NA
THEA-SEC-023a	The RSU shall support physical access to support bootstrapping activities.	11.3.1	NA	NA	NA	NA	NA	NA	NA	Table 2		NA	NA
THEA-SEC-024	OBUs and RSUs shall support role-based authentication to enable physical access.												
THEA-SEC-025	The host processor and its operating software shall be delivered in an operational state.	Deleted	NA	NA							The RSU is delivered fully operational with software pre-installed.		
THEA-SEC-026	The host processor and its operating software shall be delivered such that required protections are implemented.	Deleted	NA	NA							The RSU is delivered with a security provisioning pre-installed.		
THEA-SEC-027	If the host processor is initialized in a manufacturing state, the required protections shall not be required.	11.3.1									The RSU isn't delivered to the end-customer in a manufacturing state		

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THEA-SEC-028	Any devices designed so they can return from the operating state to the manufacturing state shall wipe all privileged applications from the processor and all keys as part of the transition.	11.3.1									"Reset to manufacturing state" is done via provisioning files, that also delete/reset all keys & credentials. Only authenticated user can perform this, i.e. via WebGUi.		
THEA-SEC-029	The device shall allow a user to perform a reset to a manufacturing state without any authentication if the reset mechanism guarantees the physical presence of the user.	11.3.1									"Reset to manufacturing state" is done via provisioning files, that also delete/reset all keys & credentials. Only authenticated user can perform this, i.e. via WebGUi.		
THEA-SEC-030	The host processor shall perform integrity checks on boot to ensure that it is in a known good software state.	11.3.1									The RSU uses secure boot with verification of signed code before its execution.		
THEA-SEC-031	If the host processor determines it is not in a known good software state on boot up, it shall not continue and will log an error when possible.	11.3.1									The RSU uses secure boot with verification of signed code before its execution.		
THEA-SEC-032	The host processor integrity checks shall require the use of a hardware-protected value.	11.3.1									The RSU secure boot depends upon an eFuse stored in a masked ROM.		
THEA-SEC-033	The host processor shall not allow any privileged application to request signing until the integrity checks have passed.	11.3.1									If integrity check fails, the system does not boot up. So this is implicit.		
THEA-SEC-034	If the host processor fails the integrity checks it shall not grant access for any process to private keys.	11.3.1									If integrity check fails, the system does not boot up. So this is implicit.		
THEA-SEC-035	If the host processor fails the integrity checks it shall not allow any privileged application to operate.	11.3.1									If integrity check fails, the system does not boot up. So this is implicit.		

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THEA-SEC-036	The host processor integrity check shall carry out a check that stored root CA certificates have not been modified since they were last accessed.	11.3.1									The RSU checks that installed root CA certificates haven't been modified during secure boot. It also checks the installed certificates during runtime in regular intervals.		
THEA-SEC-037	If the integrity check fails, the device shall reject all incoming signed messages that chain back to those root CA certificates as invalid.	11.3.1									If the certificate check fails the RSU logs an error and disables the modified root CA certificates. This automatically leads to incoming signed messages being rejected if their signing certificate chains back to the disabled root CA certificate.		
THEA-SEC-038	Each privileged application shall map to a role as defined in the SMOC.	11.3.1									Privileged applications on the RSU run as a limited rights Linux user which allows them to sign / encrypt messages and verify signatures as well as decrypt messages.		
THEA-SEC-039	The discretionary access control mechanisms of the host processor operating system shall be configured to specify the set of roles that has execute permissions on each private key stored within the Hardware Security Module (HSM).	11.3.1									RSU supports mandatory access control on executing HSM functions		
THEA-SEC-040	The discretionary access control mechanisms of the host processor operating system shall be configured to: specify the set of roles that can modify (i.e., write, replace, and delete) the following programs and plaintext data stored within the host processor boundary												

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-SEC-041	The discretionary access control mechanisms of the host processor operating system shall be configured to specify the set of roles that can read data stored within the host processor boundary and which data can be read by those roles	11.3.2									There are only certain processes that can read and decrypt the encrypted data, but other applications cannot (as part of mandatory control mechanism).		
THEA-SEC-042	The discretionary access control mechanisms of the host processor operating system shall be configured to specify the set of roles that can enter cryptographic keys.	11.3.1									There are only certain processes that can read and decrypt the encrypted data, but other applications cannot (as part of mandatory control mechanism).		
THEA-SEC-043	The host processor OS shall allow processes that correspond to privileged applications to operate without explicit authentication by a user,	11.3.1									The RSU supports daemon processes.		
THEA-SEC-044	The host processor OS shall allow processes that update private key material within the HSM to operate without explicit authentication by a user.	11.3.1									An RSU process with sufficient permission is able to update private keys by generating a new key pair. However, it is not possible to read the private key.		
THEA-SEC-045	The host processor OS shall allow processes to install new software or firmware if that software or firmware is signed by the original developer/manufacturer.	11.3.1									The RSU will only install properly signed software.		
THEA-SEC-046	The host processor OS shall not allow processes to write private key material to the HSM.	11.3.1									The HSM does not allow processes to write private keys.		
THEA-SEC-047	The host processor OS shall require explicit authentication for processes that modify or inspect executing processes.	11.3.1									The RSU supports process inspection privileges as a built-in Linux security feature.		
THEA-SEC-048	The OS shall not allow processes that read private cryptographic key material from the HSM.	11.3.1									The HSM of the RSU does not allow reading any private key material.		
THEA-SEC-049	The host processor shall require that all software installed is signed	11.3.1									The RSU software update only accepts signed software.		

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-SEC-050	The integrity of the verification key shall be protected by local hardware.	11.3.1									The RSU software update only accepts signed software.		
THEA-SEC-051	The hardware protection shall be equivalent to FIPS 140-2 at the level appropriate to the device as a whole.												
THEA-SEC-052	The host processor shall require that software be installed only by an authenticated user.	11.3.1									The RSU software update can only be done from the browser UI after successful login.		
THEA-SEC-053	The update mechanism for the host processor shall include mechanisms to prevent updates from being rolled back. List of exception from comment	11.3.1									The RSU software update allows installation of an older software version per exception list from requirement comment.		
THEA-SEC-054	If an update fails, the host processor shall notify the update mechanism of the failure.	11.3.1									If the update fails the previous version is restored.		
THEA-SEC-055	If the update mechanism receives an update failure, it shall publish a notification of the failure and instruct the host processor to roll back.	11.3.1									If the update fails the previous version is restored.		
THEA-SEC-056	All cryptographic software and firmware shall be developed and installed in a form that protects the software and firmware source and executable code from unauthorized disclosure and modification	11.3.1									The cryptographic software and firmware is contained within the HSM where it is protected from unauthorized disclosure and modification.		
THEA-SEC-057	The HSM shall be certified by one of the approved certification entities or if they are not available the HSM shall be self-certified by the vendor at a minimum.												
THEA-SEC-058	A cryptographic mechanism using an approved integrity technique shall be applied to all cryptographic software and firmware components within the HSM.												

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-SEC-059	If the HSM itself calculates the Message Authentication Code when the software is installed using a secret key known only to the HSM, and uses this secret key to verify the software on boot or if the software provider has a unique shared key with each distinct device and uses this to authenticate the software, the message authentication code shall be us.												
THEA-SEC-060	A Message Authentication Code shall not be used to protect the software unless the Message Authentication Code key is unique to the HSM.												
THEA-SEC-061	Cryptographic software and firmware, cryptographic keys, and control and status information shall be under the control of an operating system that meets the functional requirements specified in the Protection Profiles listed in FIPS 140-2 Annex B and is capable of evaluation at the CC evaluation assurance level EAL2, or an equivalent trusted operating system.												
THEA-SEC-062	To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to specify the set of roles that can execute stored cryptographic software and firmware.	11.3.2									Permission is required and enforced by Linux OS for the user to perform operations on the HSM.		
THEA-SEC-063	To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to specify the set of roles that can modify (i.e., write, replace, and delete) the following cryptographic module software or firmware components stored within the cryptographic boundary: cryptographic programs, cryptographic data .	11.3.2									Permission is required and enforced by Linux OS for the user to perform operations on the HSM.		

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-SEC-064	To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to specify the set of roles that can read the cryptographic software components stored within the cryptographic boundary: cryptographic data.	11.3.2									Permission is required and enforced by Linux OS for the user to perform operations on the HSM.		
THEA-SEC-065	To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to specify the set of roles that can execute stored cryptographic software and firmware.	11.3.2									Permission is required and enforced by Linux OS for the user to perform operations on the HSM.		
THEA-SEC-066	The operating system shall prevent all operators without the appropriate permissions (i.e., system admin) and executing processes from modifying executing cryptographic processes (i.e., loaded and executing cryptographic program images).	11.3.1									Permission is required and enforced by Linux OS for the user to perform operations on the HSM.		
THEA-SEC-067	The operating system shall prevent operators without the appropriate permissions (i.e., system admin) and executing processes from reading cryptographic software stored within the cryptographic boundary.	11.3.1									The HSM of the RSU does not allow read operations.		
THEA-SEC-068	The HSM shall maintain two roles, User which can execute software and firmware, write and delete cryptographic keys, and install signed software and firmware and Security Officer which can install unsigned software and firmware in the event that specialized new software and/or firmware is being tested and troubleshot.												
THEA-SEC-069	Activities carried out by the user role shall not be explicitly authenticated, once the user role has successfully logged in.	11.3.1									Once the user is logged in, the user can exercise activities granted by his role without further authentication		

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-SEC-070	In a networked architecture which includes the host processor, other processors, and the HSM, the host processor shall authenticate itself to the HSM with an authentication mechanism based in hardware with the same physical security as the HSM.	11.3.1									The HSM and RSU form a "connected architecture". So this requirement doesn't apply.		
THEA-SEC-071	OBUs shall support security requirements identified in SAE J2945/1 V5, such as the BSM transmission and reception security profile.	11.3.1		4.9.1							OBUs have to conform to J2935/1 standards		
THEA-SEC-072	All unused media ports shall be sealed with a removable tamper evident seal or better.	11.3.1	NA	4.7.2	NA	NA	NA	NA	NA	Table 15	The OBU shall provide evidence to detect tampering (e.g. opening of the case) through tamper-evident seals on all unused input ports and screw holes. RSU is delivered with tamper-evident seals on ports and enclosure per SCMS and Certification	NA	NA
THEA-SEC-073	OBU devices shall support the ability to reset default user names and passwords by users with Administrative functions (ENG, MRG, and DYNACAdmin).	11.3.1									OBUs do not support access via SSH or HTTP as there is no WiFi module		
THEA-SEC-074	RSU devices shall meet the WAVE Service Advertisement (WSA) security profile covered in IEEE 1609.3 (2016)	11.3.1									The RSU complies with IEEE 1609.3 (2016).		
THEA-SEC-075	RSU devices shall meet the SpaT, MAP and Traveler Information Message (TIM) security profiles covered in the COC system Functional and Performance Specification Version 0.4.0.	11.3.1									RSU will implement security profiles agreed upon between CV pilot sites.		
THEA-SEC-076	RSU devices shall support security requirements identified in SAE J2945/1 V5, such as the BSM transmission and reception security profile	11.3.1									The RSU does not transmit BSMs. The RSU supports the BSM security profile for reception.		

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
~~THEA-SEC-077~~	~~RSU devices shall support the ability to reset default user names and passwords by users with Administrative functions (ENG, MRG, and DYNACAdmin).~~	11.3.1									The RSU supports installation of a provisioning file which resets passwords. Only authenticated user can perform this, i.e. via WebGUi.		
THEA-INM-001	The system shall review participants' personal information including name, address, vehicle make/model, driver's license number at a minimum.	11.3.2	NA	NA	NA	NA	NA	NA	NA	3.1.2.3	This information isn't stored within the CV system.	NA	NA
THEA-INM-002	Personal information collected when registering participants shall be electronically stored separately from connected vehicle data (i.e., BSMs, alerts).	11.3.2	NA	NA	NA	NA	NA	NA	NA	3.1.2.3	This information isn't stored within the CV system.	NA	NA
THEA-INM-003	Personal data access shall require a login with password protection.	11.3.2	NA	NA	NA	NA	NA	NA	NA	3.1.2.3	Organizational Requirement	NA	NA
THEA-INM-004	Data shall be removed of PII before being released to the Public Data Hub.	11.3.2	NA	NA	NA	NA	NA	NA	NA	3.1.2.3	The master server performs PII removal before data is copied to the public storage area. Only data from the public storage area is uploaded to the Public Data Hub.	NA	NA
THEA-SGD-001	Data collected by Vehicles (i.e., OBUs) shall be stored on a storage device connected locally to the vehicle.	8	NA	4.11	NA	NA	2	NA	NA	Table 15	The units must include a minimum of 8 GB SD or micro SD card with a slot for storage of data.	NA	NA
THEA-SGD-002	Messages (i.e., alerts, SPAT, PSMs, TIMs, SSMs) transmitted and received (i.e. BSMs, SRMs) by RSUs shall be stored on a storage device connected locally to the RSU	8	NA	NA	NA	NA	4.0	NA	NA	Table 2	The RSU Data Collector app stores transmitted and received WSMs until they have been transferred to the master server.	NA	NA
THEA-SGD-003	Data locally stored on OBUs (OBU logs) shall be transmitted wirelessly to RSUs through a secure communications connection.	8	NA	4.11	NA	NA	3	NA	NA	3.2.2.7.3	OBUs transfer data logs to nearby RSUs via the Data Log Transfer protocol.	NA	NA
THEA-SGD-004	Data locally stored on RSUs (RSU logs) shall be transmitted to the Master Server through a secure communications connection.	8	NA	NA	NA	NA	NA	NA	NA	3,1 3.2.2.6.2	The RSU Data Collector transmits all collected data to the master server via	NA	NA

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
											encrypted websocket connection (XFER).		
~~THEA-SGD-005~~	~~The frequency at which data locally stored on OBUs is transmitted to the Master Server shall be determined by the ability of those devices to wirelessly transmit the data.~~	8					2				OBUs will transfer data logs to nearby RSUs whenever possible.		
~~THEA-SGD-006~~	~~The frequency at which data locally stored on RSUs is transmitted to the Master Server shall be determined based on the RSUs' storage capacity and communication bandwidth to master server.~~	8					NA				The RSU Data Collector transmits all collected data to the master server via encrypted websocket connection (XFER). Data is transferred as fast as possible.		
THEA-SGD-007	The Master Server shall securely archive the system generated data (BSMs, TIMS, etc.) to protect and provide redundancy.	8	NA	NA	NA	NA	NA	NA	6.2.9	3.1.1	The master server is hosted on a VMWare Host server which has a RAID hard disk array in order to ensure data availability. Also, it will use VMWare HA in order to provide failover of virtual machines.	NA	NA
THEA-SGD-008	Access to the Master Server shall require a login and password.	11.3.1	NA	NA	NA			NA	NA	3.1.1	Organizational Requirement	NA	NA
THEA-SGD-009	Access to the Master Server shall be limited to authorized personnel as defined in the published version of the SMOC.	11.3.1	NA	NA	NA	NA	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-001	RSU communication failures shall be responded to within one business day in accordance with the City of Tampa and THEA procedures.	9.5.2	NA	NA	NA	NA	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-002	RSU communication shall be restored in accordance with the City of Tampa and THEA procedures.	9.5.2	NA	NA	NA	NA	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-003	RSU hardware failures shall be addressed in accordance with the City of Tampa and THEA procedures.	9.5.2	NA	NA	NA	NA	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-MNT-004	RSU application issues shall be responded in accordance with the City of Tampa and THEA procedures..	9.5.2	NA	NA	NA	NA	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-005	Planned RSU maintenance shall be scheduled in accordance with the City of Tampa and THEA procedures	9.5.2	NA	NA	NA	NA	NA	NA	3.5 5.2.7	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-006	Planned RSU maintenance shall be performed during off peak hours of the Pilot's operation.	9.5.2	NA	NA	NA	NA	NA	NA	3.5 5.2.7	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-007	OBU failures shall be logged at the time they are reported.	9.5.2	NA	4.12.1.5	NA	NA	3.0	NA	4.2.9	Not SDD	the operating platform shall be able to reload and restart the failed process and shall make an entry in a log indicating that this action took place.	NA	NA
THEA-MNT-008	OBUs shall alert the participant, if possible, of a failure.	9.5.2	NA	4.12.1.5	NA	NA	NA	1.4	NA	Not SDD	There is a heartbeat in HMI that will let the participant know if there is something wrong with the system	NA	NA
THEA-MNT-009	In order to diagnose OBU failures, an appointment to bring the vehicle into the support facility shall be made at the participant's convenience, but no more than seven business days out.	9.5.2	NA	NA	3.7	NA	NA	NA	4.2.9	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-010	When a participant brings in their vehicle because of an OBU failure, the unit shall be exchanged in order to minimize the time the participant is in the facility or if feasible, the device is replaced at the participant's choice of location.	9.5.2	NA	NA	NA	NA	NA	NA	4.2.9	Not SDD	Organizational Requirement	NA	NA
~~THEA-MNT-011~~	~~When a PID issue is identified, the participant shall follow the instructions for attempting to address the issue before contacting support.~~	9.5.2									Organizational Requirement		
THEA-MNT-012	Support staff shall be trained to troubleshoot and diagnose RSU, OBU, and PID issues.	9.5.2	NA	NA	7.4	NA	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA
THEA-MNT-013	A set of support, diagnostic and troubleshooting procedures shall be developed to guide the support staff.	9.5.2	NA	NA	7.4.2	NA	NA	NA	NA	Not SDD	Organizational Requirement	NA	NA

Requirement ID [RD3]	Requirement Description [RD3]	Con Ops Chapter [RD2]	User Need Number [RD2]	OBU Component Specification [RD9]	Participant Training and Stakeholder Education Plan [RD11]	Safety Management Plan [RD12]	OBU-RSU-Data Collection Interface [RD13]	OBU HMI Spec [RD14]	Comprehensive Installation Plan [RD15]	SDD Section	Design Element Function (See SDD Section 8 "Related Design Element" for exact wording)	ICD Chapter [RD8]	Flow ID [RD8]
THEA-MNT-014	The CoT shall maintain the RSUs installed in signal cabinets.	9.5.2									Organizational Requirement		
THEA-SRL-001	RSUs, and OBUs shall meet the latest published specification as of September 2016 at a minimum.	5.3		1.4, 4.9, 5							OBUs shall conform to latest specs at the time of document release The RSU complies with USDOT RSU spec v4.1		
THEA-SRL-002	RSUs shall not delete or rollover the data until it has confirmed the data has been successfully transmitted to the master Server and properly stored unless the local storage device has reached 90% capacity.	8	NA	NA	NA	NA	3.0	NA	NA	3.2.2.6.2	OBUs transfer data logs to nearby RSUs via the Data Log Transfer protocol. Data may only be deleted / overwritten if it has been transferred successfully or if free space on the storage medium runs out. The RSU Data Collector transmits all collected data to the master server via encrypted websocket connection (XFER). Data may only be deleted / overwritten if it has been transferred successfully or if free space on the storage medium runs out.	3.4.6 3.12.4	23015 23030
THEA-SRL-003	OBUs shall not delete or rollover the data until it has confirmed the data has been successfully transmitted to the master Server and properly stored unless the local storage device has reached 90% capacity.		NA	4.11	NA	NA	NA	NA	NA	3.2.2.6.1 Section 6 RTM		NA	NA
THEA- PAR-001	The RSUs shall obtain proper licensing from FDOT and the FCC to broadcast using DSRC.	5.3	NA	NA	NA	NA	NA	NA	NA	3.2.1 Section 6 RTM	Organizational Requirement	NA	NA

7 Appendix

7.1 OBU Data Logged

Table 20: OBU Data Logged

Data Management - OBU data potentially data logged	
Data Description	Priority Rating
Display activation (graphics change)	Medium
WWE Screen activation (graphics change)	Medium if audio alert is captured
WWE Audio alert activation	High
ERDW screens activation (graphics change)	Medium if audio alert is captured
ERDW audio activation	High
VTRFTV screen activation (graphics change)	Medium if audio alert is captured
VTRFTV audio alert activation	High
IMA screen activation (graphics change)	Medium if audio alert is captured
IMA audio alert activation	High
PED-X screen activation (graphics change)	Medium if audio alert is captured
PED-X audio alert activation	High
EEBL screen activation (graphics change)	Medium if audio alert is captured
EEBL audio activation	High
FCW screen activation (graphics change)	Medium if audio alert is captured
FCW audio alert activation	High
TSP screen activation (graphics change)	Medium if audio alert is captured
TSP audio alert	High
Display - system activated indicator	Low
Other OBU output activated, TBD	Low
Speed data logged, TBD sampling	High- other methods available
CAN Data (not planned)	N/A
MAP logging	High
RSA logging	High
TIM logging	High
BSM logging	High
Spat logging	High
PSM logging	High
TSP logging	High

Data Management - OBU data potentially data logged	
Data Description	Priority Rating
SSM logging	High
SRM logging	High
USB data transfer	Medium
OTA transfer activation (data transferred)	Medium
All antenna status	Medium
Turn signal activation (graphics change)	High
Ignition state	Low
Reverse state	High
SD card activation	Low
Tampering/security activation	Medium
Firmware download/install	Medium
SCMS connection & download time	Medium

8 Traceability

This section consists of the Workbook, which is the result of the following project workflows:
- Workbook developed by THEA Pilot team during project Phase 1, Task 6 Requirements
- Walkthrough of Requirements by USDOT AOR and reviewers in April 2016
- Updated Workbook per results of Requirements Walkthrough
- Walkthrough of System Design by USDOT AOR and reviewers in September 2017
- Updated Workbook per results of System Design Walkthrough
- Updated to final System Requirements in February 2018 after Quality Gate 3 review by CCB
- Updated Workbook per updated System Requirements
- Workbook appended to this System Design Document
- Added "Related Design Elements" to the Workbook for each Requirement
- Inserted cross-references from Related Design Elements of this section to design sections of this Systems Design Document for each Requirement

Requirement Group	Related Section
THEA-UC1-001	Con Ops
Related Needs	1
Parent Section	7.1.1

Requirement Text

I-SIG application at Twiggs and Meridian shall transmit southbound estimated queue data to the REL ERDW application.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1.2 The ERDW application receives the currently estimated queue length (QLE) for the REL from MMITSS (I-SIG) through a local inter-process communication (IPC) interface provided by the ESCoS stack. MMITSS estimates queue lengths on intersection approaches monitoring BSMs of vehicles approaching the intersection.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-002	Con Ops			
Related Needs	1, 6			
Parent Section	7.1.1			

Requirement Text
The drivers shall receive ERDW from ERDW application on the vehicles.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			ERDW_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.1 ERDW application is designed to audible tone warning drivers incoming on the REL of a queue that has formed at the intersection of Twiggs St and Meridian Ave. The warning shall recommend a safe speed which will allow the vehicle to safely stop before it reaches the end of the queue / stopped traffic.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-003	
Related Needs	
Parent Section	

Requirement Text

I-SIG application at Twiggs and Nebraska shall transmit westbound queue length data to the CSW application on the REL per lane.

Requirement Text (Comments/Changes)

<mark>Deleted</mark> The queue on the right turn lane from the REL towards Twiggs and Nebraska is not controlled by Twiggs and Meridian. However, I-SIG at Twiggs and Meridian would measure the southbound queue on the REL, including vehicles queueing up for the right turn towards Twiggs and Nebraska.

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-UC1-004	Con Ops		
Related Needs	1		
Parent Section	7.1.1		

Requirement Text

The Electronic Emergency Brake Light warning (EEBL) application on the braking vehicle shall broadcast an EEBL warning when the vehicle deceleration exceeds predetermined value.

Requirement Text (Comments/Changes)

Add comment:

See J2945/1 for detailed performance requirements of EEBL

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			EEBL_A EEBL_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.7 The EEBL app receives BSMs from one or more vehicles ahead.

ICD 20005

Design (Comments/Changes): BSM is broadcasted from leading car, not EEBL

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-005	Con Ops
Related Needs	2
Parent Section	7.1.1

Requirement Text
The EEBL application on the receiving vehicle shall receive an EEBL warning from the braking vehicle..

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			EEBL_A EEBL_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.7 Using the BSMs, if EEBL determines any vehicles in the same lane braking/stopping suddenly, the app issues a warning to the driver.

ICD 20005

Design (Comments/Changes): EEBL is not received by trailing car, BSMs are received

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-006	Con Ops
Related Needs	2
Parent Section	7.1.1

Requirement Text
The EEBL application on the receiving vehicle shall process an EEBL warning from forward vehicles.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			EEBL_A EEBL_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.7 Using the BSMs, if EEBL determines any vehicles in the same lane braking/stopping suddenly, the app issues a warning to the driver.

ICD 20005

Design (Comments/Changes): EEBL computes deceleration based on received BSMs

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X		Modify		Implement Later		Drop
Comments							

Requirement Group	Related Section
THEA-UC1-007	Con Ops
Related Needs	2
Parent Section	7.1.1

Requirement Text

The EEBL application shall warn the driver of vehicles exceeding the preset deceleration downstream to Twiggs Street.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			EEBL_A EEBL_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.7 Using the BSMs, if EEBL determines any vehicles in the same lane braking/stopping suddenly, the app issues a warning to the driver.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop	
Comments						

Requirement Group	Related Section
THEA-UC1-008	Con Ops
Related Needs	2
Parent Section	7.1.1

Requirement Text

Vehicles equipped with OBUs shall receive BSMs from other vehicles equipped with OBUs within DSRC range.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			EEBL_A EEBL_B FCW_A FCW_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.12 OBU management is the collection of services and functionality for managing basic operations to include broadcast of BSM messages

ICD 20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-009	Con Ops			
Related Needs	1			
Parent Section	7.1.1			

Requirement Text

The FCW in-vehicle application shall identify crash trajectories with other vehicles.

Requirement Text (Comments/Changes)

Added Comment:

See J2945/1 for detailed performance requirements of FCW.

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			FCW_A FCW_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.6 Using the lead vehicle's BSM data, FCW calculates crash trajectories to determine if the trailing vehicle is about to rear end the lead vehicle.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-010	Con Ops			
Related Needs	2			
Parent Section	7.1.1			

Requirement Text
The FCW application shall warn the driver of crash trajectories.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			FCW_A FCW_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.6 If FCW determines that the trailing vehicle is going to crash into the lead vehicle, a warning is issued to the driver.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-011	Con Ops			
Related Needs	2			
Parent Section	7.1.1			

Requirement Text
The Human Machine Interface shall warn the driver no more than once when multiple warnings are received within a configurable timeframe.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			EEBL_A EEBL_B FCW_A FCW_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.6 The FCW application HMI shall warn the driver no more than once when multiple warnings are received within a configurable timeframe.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-012	Con Ops			
Related Needs	1			
Parent Section	7.1.1			

Requirement Text
The I-SIG application at Twiggs and Meridian shall receive BSMs from vehicles equipped with OBUs.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I_SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.2 Siemens-MMITSS receives BSMs from OBUs

ICD 20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-013	Con Ops			
Related Needs	1			
Parent Section	7.1.1			

Requirement Text
I-SIG application at Twiggs and Meridian shall process BSMs to determine the queue length on the southbound approach from the REL.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.2 Siemens-MMITSS receives BSMs from OBUs and estimates queue lengths based on monitoring each vehicle's speed and location as it approaches the intersection.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-014	Con Ops			
Related Needs	1, 3, 5			
Parent Section	7.1.1			

Requirement Text
I-SIG application at Twiggs and Nebraska shall process BSMs to determine the queue length.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.2 Siemens-MMITSS receives BSMs from OBUs and estimates queue lengths based on monitoring each vehicle's speed and location as it approaches the intersection.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-015	Con Ops			
Related Needs	1			
Parent Section	7.1.1			

Requirement Text
I-SIG application at Twiggs and Meridian shall transmit the queue lengths to the THEA master server.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.2 The Data Collector receives estimated Queue Lengths from Siemens-MMITSS through a local inter-process communication (IPC) interface provided by the ESCoS stack. The Data Collector creates batches of data logs from Flash Storage and sends them to the master server via XFER.

ICD 23030

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
~~THEA-UC1-016~~	Con Ops
Related Needs	1, 3, 5
Parent Section	7.1.1

Requirement Text

I-SIG application at Twiggs at Nebraska shall transmit the queue lengths to the THEA master server.

Requirement Text (Comments/Changes)

Deleted, duplicated of THEA-UC1-015

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.2   The data collector receives queue lengths from MMITSS and sends them to the master server.
3.12.4   23030

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC1-017	Con Ops			
Related Needs	1			
Parent Section	7.1.1			
The Master Server shall receive the queue lengths from I-SIG application running on the RSU				

Requirement Text (Comments/Changes)
Changed 'analyze' to 'store.'

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 The Data Converter receives the Data Logs from the RSUs.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-018	Con Ops			
Related Needs	1			
Parent Section	7.1.1			

Requirement Text
The Master Server shall store the queue lengths from I-SIG application.

Requirement Text (Comments/Changes)
Changed 'analyze' to 'store.'

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 Data Converter passes the Data Logs on to the DataBuffer component. DataBuffer combines the data logs into batches and saves them to protected storage.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-019	Con Ops
Related Needs	4
Parent Section	7.1.1

Requirement Text

The combination of signal controller and the RSU application shall control signal phases based on Multi-Modal Intelligent Traffic Signal Systems (MMITSS).

Requirement Text (Comments/Changes)

Changed 'I-SIG… timing when the queue length exceeds a configurable threshold…' to '…based on estimated queue lengths in order to move traffic efficiently through the intersection…'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.2 Siemens-MMITSS interfaces with the traffic controller via NTCIP in order to receive information about the controller configuration, current signal plan, and vehicle calls and volume from detectors. It then uses phase control commands (i.e. phase calls, holds, omits, and force offs) to control the phase execution.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-020	Con Ops
Related Needs	4
Parent Section	7.1.1

Requirement Text

The combination of signal controller and the RSU application shall modify the signal phase timing based on estimated queue lengths in order to move traffic efficiently through the intersection at Twiggs at Nebraska.

Requirement Text (Comments/Changes)

Deleted, duplicate of THEA-UC1-019

Changed 'I-SIGR… when the queue length exceeds a configurable threshold…' to '…based on estimated queue lengths in order to move traffic efficiently through the intersection…'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

3.2.2.3.2 MMITSS I-SIG controls phases of an intersection based on received BSMs. See the referenced pre-existing MMITSS Detailed Design.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-UC1-021~~	2.4.1 Use Case 1 - Morning Peak Hour Queues
Related Needs	
Parent Section	

Requirement Text

I-SIG application shall prioritize queues that limit safe stopping distance as Priority as defined in the I-SIG requirements.

Requirement Text (Comments/Changes)

Deleted. Duplicate of THEA-UC1-020.

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-UC1-022	Con Ops		
Related Needs	6		
Parent Section	7.1.1		

Requirement Text

The RSU ERDW application shall broadcast a recommended standard speed.

Requirement Text (Comments/Changes)

Changed 'CSW' to 'ERDW.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			ERDW_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1.2 The ERDW configuration UI allows a user to set a TIM(x) to be broadcast for a particular traffic situation defined by min and max value of the vehicle queue. The user can add a row to the table for each traffic situation.

The ERDW application uses the received queue length estimation to select a TIM to broadcast based on its configuration.

ICD 20014

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-023	Con Ops			
Related Needs	6			
Parent Section	7.1.1			

Requirement Text
The vehicle ERDW application shall receive the recommended standard speed.

Requirement Text (Comments/Changes)

Changed 'CSW' to 'ERDW.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			ERDW_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.1 The estimated end of the queue would be transmitted to the vehicle OBUs using a TIM from the RSU that would then be interpreted by the OBUs to display the recommended speed to the driver.

ICD 20014

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop	
Comments					

Requirement Group	Related Section
THEA-UC1-024	Con Ops
Related Needs	6
Parent Section	7.1.1

Requirement Text

The RSU ERDW application shall adjust the configurable speed recommendation zone(s) based on the southbound queue length from I-SIG application on Twiggs and Meridian.

Requirement Text (Comments/Changes)

Changed 'vehicle CSW' to 'RSU ERDW,' 'recommended' to 'configurable,'
Changed 'The delay time is equivalent to the queue that forms in the right turn land and onto the shoulder' to 'The begin and end of a speed recommendation zone for a particular speed is moved upstream on the REL with longer queue lengths.'
Added 'recommendation zone(s).'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			ERDW_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.1 As the driver makes their way closer to the end of the queue, the recommended speed would lower so that they have ample time to safely stop their vehicle before reaching the end of the queue.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-025	Con Ops
Related Needs	6
Parent Section	7.1.1

Requirement Text

The vehicle ERDW application shall provide a configurable speed that agencies can adjust to local practices to an appropriate speed based on the vehicle type.

Requirement Text (Comments/Changes)

System design does not dictate local policy.

Changed 'CSW' to 'ERDW.'

Comment: e.g., passenger cars, commercial vehicles, transit could have different recommended safe speeds in a curve.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			ERDW_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1.1 For a complete ERDW configuration on the REL the following items are defined
- For a particular traffic situation (x), i.e. queue length range (min and max), the location and length of each of the 3 speed zones shall be defined. The speed zones shall be encoded in a TIM for that traffic situation referred to as TIM(x)
- Traffic situation TIM(x) shall be defined for a sufficient number of situations up to a queue length of 500 meters.

3.3.2.1 The estimated end of the queue would be transmitted to the vehicle OBUs using a TIM from the RSU that would then be interpreted by the OBUs to display the recommended speed to the driver.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-026	Con Ops
Related Needs	6
Parent Section	7.1.1

Requirement Text
Deleted Duplicate of THEA-UC1-026
The RSU ERDW application shall calculate the configurable speed recommendation zones to the THEA Master Server.

Requirement Text (Comments/Changes) Changed 'CSW' to 'ERDW,' 'recommend curve' to 'configurable.'
Added 'recommendation zones.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements
3.2.2.6 The RSU logs all WSM sent out which includes TIMs sent by ERDW. The data collector transfers these logs to NextConnect.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC1-026a	Con Ops			
Related Needs	6			
Parent Section	7.1.1			

Requirement Text
The RSU ERDW application shall transmit the configurable speed recommendation zones to the THEA Master Server.

Requirement Text (Comments/Changes) Changed 'CSW' to 'ERDW,' 'recommend curve' to 'configurable.'
Added 'recommendation zones.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			ERDW_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.2 The Data Collector also stores BSMs and SRMs received from OBUs as well as certain WSMs (WAVE Short Messages) sent by the RSU (i.e. MAP, SPAT, TIM, PSM, SSM). The Data Collector stores the WSMs, the Queue Lengths, and the received data logs in local Flash Storage.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-027	Con Ops			
Related Needs				
Parent Section	8			

Requirement Text

TMC operators shall be able to access queue length and corresponding speed recommendation zones.

Requirement Text (Comments/Changes)

Deleted

Changed 'standard curve speed' to 'queue length and corresponding speed recommendation zones'

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1 The TMC Operator can access the current queue length and TIM being broadcast via the RSU service UI.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC1-028	Con Ops			
Related Needs	1, 6			
Parent Section	7.1.1			

Requirement Text
A traditional vehicle detector shall issue a call to the RSU when a vehicle occupies the detection zone.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1.2 In addition to BSM monitoring the Tampa CV pilot will install one Wavetronix SmartSensor HD radar detector on the REL at a location upstream to capture free flow vehicle data.

ICD 23016

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC1-029	Con Ops			
Related Needs	1, 6			
Parent Section	7.1.1			

Requirement Text

The proxy app shall transmit an ISM (infrastructure sensor message) to I-SIG when the traditional detector issues a call.

Requirement Text (Comments/Changes)

Changed 'BSM' to 'ISM (infrastructure sensor message) to I-SIG.'

Modified comment: An ISM would contain details about the detector event (e.g. timestamp, detector location, vehicle speed if supported by detector). An ISM is expected not to be sent over the air via DSRC.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1.2 This information is received by MMITSS in the form of an infrastructure sensor message (ISM) coming from the Infrastructure Sensor Gateway (ISG). The ISM contains the timestamp, location and speed of a single detected vehicle. The ISMs are used along with the BSMs as input for the MMITSS queue length estimation algorithm.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC1-030	Con Ops
Related Needs	2
Parent Section	7.1.1

Requirement Text
Vehicles equipped with OBUs shall broadcast BSMs.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.12 OBU management is the collection of services and functionality for managing basic operations to include broadcast of BSM messages

ICD 20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-001	Con Ops
Related Needs	1
Parent Section	7.1.2

Requirement Text
Vehicle shall receive the BSMs from other equipped vehicles

Requirement Text (Comments/Changes)
Added BSM(s) 'from' and added a period after vehicles.
Omitted: of… traveling opposite the legal direction.
Comment: 10 times per second

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2 OBU equipped vehicles continually broadcast receive BSMs from other equipped vehicles within the range as described in each subsection application.

ICD 20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-002	2.4.2 Use Case 2 - Wrong Way Entries
Related Needs	
Parent Section	

Requirement Text

Deleted Vehicles traveling in the legal direction receive a message from the RSU of a wrong way driver.

Vehicles traveling in the legal direction shall identify crash trajectory of vehicles traveling opposite the legal direction.

Requirement Text (Comments/Changes)

Deleted. Vehicles traveling in the legal direction receive a message from the RSU of a wrong way driver.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC2-003	Con Ops			
Related Needs	1			
Parent Section	7.1.2			

Requirement Text

Vehicles shall identify crash trajectory of cross street vehicles

Requirement Text (Comments/Changes)

Modified (added): '…and warn driver.'

Comments: Calculates crash threat based on the location, heading, speed and elevation of both vehicles.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			IMA_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.8 If IMA determines there is a high probability of a collision using relative position, speed and heading of vehicles approaching the intersection

ICD 3002

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-003a	Con Ops			
Related Needs	1			
Parent Section	7.1.2			

Requirement Text
Vehicles shall warn the driver of a potential crash

Requirement Text (Comments/Changes)
Split out from a compound requirement
Comments: Calculates crash threat based on the location, heading, speed and elevation of both vehicles.

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			IMA_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.8 The app warns the driver.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-004	
Related Needs	
Parent Section	

Requirement Text
RSU at REL entrance shall host the existing 2-phase traffic signal control application.

Requirement Text (Comments/Changes)
Deleted. WWE will use MAP of physical intersection to determine wrong way violation. With the 2016 J2735 standard revision this is the preferred solution.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements
E

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-UC2-005~~	
Related Needs	
Parent Section	

Requirement Text

Signal control application Phase 1 at REL entrance shall be RED inbound and GREEN outbound during outbound times of day.

Requirement Text (Comments/Changes)

Deleted. WWE will use MAP of physical intersection to determine wrong way violation. With the 2016 J2735 standard revision this is the preferred solution.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC2-006	
Related Needs	
Parent Section	

Requirement Text

Signal control application Phase 2 at REL entrance shall be GREEN inbound and RED outbound during inbound times of day.

Requirement Text (Comments/Changes)

Deleted. WWE will use MAP of physical intersection to determine wrong way violation. With the 2016 J2735 standard revision this is the preferred solution.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC2-007	Con Ops			
Related Needs	2			
Parent Section	7.1.2			

Requirement Text
The RSU at REL entrance shall transmit the latest published standard SPaT message per J2735/201603.

Requirement Text (Comments/Changes)
Changed 'Signal control' to 'SPAT-MAP.'
Comments: Compatible with the message payload and security of OEM Class 1 OBU.

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			SPaT MAP	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

2.1.2 The RSU app broadcasts the MAP and Signal and Phasing Timing (SPaT) message. According to J2735_201603, each MAP zone includes an allowed direction of vehicle travel, plus a revocable indication for each zone.

3.2.2.2.2 The SPaT-MAP-Daemon uses the gate status in order to set the enabledLanes in the broadcast SPaT message.

3.4.2   43013

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-008	Con Ops
Related Needs	2
Parent Section	7.1.2

Requirement Text

The RSU at REL entrance shall transmit the REL entrance lane geometry MAP message per J2735/201603.

Requirement Text (Comments/Changes)

Changed 'Signal control' to 'SPAT-MAP.'

Comments: Compatible with the message payload and security of OEM Class 1 OBU.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			SPaT MAP	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

2.1.2 The RSU app broadcasts the MAP and Signal and Phasing Timing (SPaT) message. According to J2735_201603, each MAP zone includes an allowed direction of vehicle travel, plus a revocable indication for each zone.

ICD 20008, 23007

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-UC2-008b	Con Ops		
Related Needs	2		
Parent Section	7.1.2		

Requirement Text
The MAP message shall identify the REL lanes as revocable lanes.

Requirement Text (Comments/Changes)

Comments: Added. Adds the capability of 2016 J2735 standard.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			SPaT MAP	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

2.1.2 plus a revocable indication for each zone

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-008c	Con Ops			
Related Needs	2			
Parent Section	7.1.2			

Requirement Text

The SPaT message shall contain the enabled / disabled status of the revocable lanes based on status of the gates at the REL entrance.

Requirement Text (Comments/Changes)

Added.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			SPaT MAP	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.2.2 The SPaT-MAP-Daemon uses the gate status in order to set the enabledLanes in the broadcast SPaT message.
.
ICD 23006

Design (Comments/Changes)			
	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-008d	Con Ops
Related Needs	2
Parent Section	7.1.2

Requirement Text

The WWE application shall receive the open / closed status from the gates at the REL entrance.

Requirement Text (Comments/Changes)

Added: Assume the traffic controller at Twiggs and Meridian has existing detector input to obtain gate status from via NTCIP 1202 v2.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			SPaT MAP	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.2.2 The SPaT-MAP-Daemon uses the gate status in order to set the enabledLanes in the broadcast SPaT message.

ICD 23006

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
~~THEA-UC2-009~~	Con Ops			
Related Needs	2, 3			
Parent Section	7.1.2			

Requirement Text
Participating vehicles shall host the Wrong Way Entry (WWE) application.

Requirement Text (Comments/Changes)
Deleted
Changed 'Red Light Violation' to 'Wrong Way Entry (WWE)'
Comments: Existing RLV application can be adapted to detect wrong way entry to an ingress lane or closed lane.

Requirement Criteria		Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 OBUs will have WWE installed

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-UC2-010	Con Ops		
Related Needs	2		
Parent Section	7.1.2		

Requirement Text
Vehicle WWE application shall receive the signal control application SPaT message.

Requirement Text (Comments/Changes)
Changed 'RVL' to 'Vehicle WWE.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_A WWE_B WWE_C WWE_D WWE_E WWE_F	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 WWE app is designed to warn OBU equipped vehicles trying to wrong way enter an RSU equipped intersection which provides the MAP and SPaT messages through DSRC.

ICD 23007

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-011	Con Ops			
Related Needs	2			
Parent Section	7.1.2			

Requirement Text
Vehicle WWE application shall receive the MAP message.

Requirement Text (Comments/Changes)
Changed 'RVL' to 'Vehicle WWE.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_A WWE_B WWE_C WWE_D WWE_E WWE_F	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 WWE app is designed to warn OBU equipped vehicles trying to wrong way enter an RSU equipped intersection which provides the MAP and SPaT messages through DSRC.

ICD 20008, 23007

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-012	Con Ops			
Related Needs	2			
Parent Section	7.1.2			

Requirement Text

Vehicle WWE application at the REL entrance shall warn drivers predicted to enter a closed lane or an ingress lane going the wrong way.

Requirement Text (Comments/Changes)

Changed 'RVL' to 'WWE.'
Added: '…enter a closed lane or an ingress lane going the wrong way.'
Omitted: violate the RED phase.
Comment: OBUs compare their location, heading, speed and elevation to the RSU SPAT and MAP to predict wrong way violation indicating that the vehicle is on a wrong-way trajectory.

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_A WWE_B WWE_C WWE_D WWE_E WWE_F	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 The driver would receive a first level warning when their OBU equipped vehicle is on a path that is projected to enter a part of the intersection that would make them go the wrong way based on their trajectory and speed. There is also another warning message displayed to the driver using this app where the equipped vehicle finds itself in an area where no traffic is allowed which is specific to the REL exit

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank	
1	Is the design unambiguous?	X		
2	Is the design logically consistent with Parent(s), and sibling design components?	X		
3	Is the design feasible?	X		
4	Is the design verifiable?	X		
5	Is the requirement fulfilled by the design?	X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
~~THEA-UC2-013~~	2.4.2 Use Case 2 - Wrong Way Entries
Related Needs	
Parent Section	

Requirement Text

A roadside vehicle detector shall issue a call to the proxy app when a vehicle approaches the REL entrance.

Requirement Text (Comments/Changes)

<mark>Deleted.</mark> Detecting an approaching unequipped vehicle is not effective as the unequipped vehicle cannot warn its driver of a predicted violation.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC2-014	Con Ops			
Related Needs	3			
Parent Section	7.1.2			

Requirement Text
A roadside vehicle detector shall issue a call to the WWE app running on the RSU when a vehicle enters the REL entrance going the wrong way.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_Warning	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1.1 Unequipped vehicles going the wrong way are detected by a radar system that covers the 4 possible lanes to drive onto the REL with detection zones. Detection zones on the outbound access lanes aren't needed since the gates are closed when these lanes are closed for traffic.

ICD 23006

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-015	Con Ops			
Related Needs	3, 4			
Parent Section	7.1.2			

Requirement Text WWE app running on the RSU shall create a wrong way driver warning message when the roadside detector call is asserted.

Requirement Text (Comments/Changes)

Changed 'Proxy' to 'WWE.'

Deleted "…proxy Red Light Violations (RLV) when the advance…" and added "…wrong way driver warning message when the roadside…"

Added "is asserted" and deleted "…and followed by the local detection call is asserted during red phase."

Deleted comment: "Advance detector call followed by local detection call during red phase predicts RLV of unequipped vehicle. The distance between calls divided by the time between calls equals the violation speed."

Added comment: "The traditional vehicle detector can distinguish vehicle direction in order to distinguish wrong-way driving from legal distinguish wrong-way driving from legal driving."

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_Warning	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.1.1 The WWE application on the RSU receives the corresponding detection and broadcasts a TIM with a wrong way driver alert. Equipped vehicles driving inbound on the REL receive the alert and warn their driver via the HMI.

ICD 23017

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-015b	Con Ops
Related Needs	1
Parent Section	7.1.2

Requirement Text

While receiving wrong way driver warning messages the OBU shall determine if the vehicle is travelling on along the road segment to which the warning applies.

Requirement Text (Comments/Changes)

Added requirement group.

Added Comment. The warning message sent out from the RSU is expected to contain information about the road segment that the warning applies to (e.g. Geographical Path inside a TIM).

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 The driver would receive a first level warning when their OBU equipped vehicle is on a path that is projected to enter a part of the intersection that would make them go the wrong way based on their trajectory and speed. If the vehicle continues to go up a road in the wrong way manner, the driver of the vehicle would receive a secondary warning letting them know that they are already going the wrong way. There is also another warning message displayed to the driver using this app where the equipped vehicle finds itself in an area where no traffic is allowed which is specific to the REL exit. Another feature of the app is that it will warn the drivers of equipped vehicles of a wrong way driver approaching them on the REL based on a TIM that would be broadcast by the RSU.
.

ICD 23002, 23017

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-015c	Con Ops
Related Needs	1
Parent Section	7.1.2

Requirement Text

The OBU shall receive TIMs messages containing warning of a wrong way driver.

Requirement Text (Comments/Changes)

Added requirement group.

Added Comment. The warning message sent out from the RSU is expected to contain information about the road segment that the warning applies to (e.g. Geographical Path inside a TIM).

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 warn the drivers of equipped vehicles of a wrong way driver approaching them on the REL based on a TIM that would be broadcast by the RSU

ICD 23002, 23017

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-015d	Con Ops			
Related Needs	1			
Parent Section	7.1.2			

Requirement Text

The OBU shall warn the driver of a wrong way driver.

Requirement Text (Comments/Changes)

Added requirement group.

Added Comment. The warning message sent out from the RSU is expected to contain information about the road segment that the warning applies to (e.g. Geographical Path inside a TIM).

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 warn the drivers of equipped vehicles of a wrong way driver approaching them on the REL based on a TIM that would be broadcast by the RSU

ICD 23002, 23017

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC2-016	Con Ops
Related Needs	3
Parent Section	7.1.2

Requirement Text

Vehicle WWE application of violator shall issue a wrong-way alert to the wrong way driver while driving the REL going the wrong way.

Requirement Text (Comments/Changes)

Changed 'RVL' to 'Vehicle WWE' and changed "…the wrong way driver when the RLV application leaves the REL MAP geometry during RED phase…" to "…the wrong way driver while driving the REL going the wrong way…"

Changed in comments: "…while the signal phase is in red. Applies to both equipped and unequipped vehicles…" changed to "…and detects an impending wrong way entry based on the vehicle's current trajectory."

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_D WWE_E WWE_F	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.2 If the vehicle continues to go up a road in the wrong way manner, the driver of the vehicle would receive a secondary warning letting them know that they are already going the wrong way

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-017				
Related Needs				
Parent Section				

Requirement Text

RLV application of violator shall issue wrong-way alert to the RSU when the RLV application checks out of the REL MAP geometry during RED phase.

Requirement Text (Comments/Changes)

Deleted: RSU will determine violation solely based on traditional detection.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC2-018	Con Ops
Related Needs	4
Parent Section	7.1.2

Requirement Text
Wrong-way alert from the RSU shall be received at the master server.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 The SQL Reporter extracts information from the data logs in the ProtectedStorage and saves it into a SQL database for reporting purposes.

ICD 23030

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-019	Con Ops			
Related Needs	4			
Parent Section	7.1.2			

Requirement Text
Wrong-way alert from the RSU shall be stored at the master server.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			WWE_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 The data stored in SQL is anonymous. It includes the following:
- Wrong Way Entry events

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC2-020	Con Ops			
Related Needs	4			
Parent Section	7.1.2			

Requirement Text

Wrong-way alert from master server shall be displayed in Concert.

Requirement Text (Comments/Changes)

Deleted "…available to law enforcement dispatch" and added "…available to the TMC operator."

Changed part of comment by deleting "law enforcement dispatch and law enforcement officials. Need advice as to interface from master server to law enforcement" and adding "TMC operators."

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal	Test	Demo
6	If feasible and verifiable, by which method?			WWE_Warning	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

2.1.2. The RSU app provides an alert to the TMC that a vehicle is going the wrong way

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC3-001	Con Ops			
Related Needs	1, 3			
Parent Section	7.1.3			

Requirement Text

The OBU shall receive Personal Safety Messages (PSMs).

Requirement Text (Comments/Changes)

Made PSM plural by adding an 's.'

Added comment: A sensor system (e.g. LiDAR) connected to the RSU provides individual pedestrian location with sufficient accuracy. The RSU converts this information to PSMs being broadcast on behalf of pedestrians.

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_B PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.4 To PSMs and send them over DSRC for the HMI

ICD 20012

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC3-002	Con Ops			
Related Needs	1, 3			
Parent Section	7.1.3			

Requirement Text
The OBU shall determine if there is a potential conflict with a pedestrian.

Requirement Text (Comments/Changes)
Omitted Comment "A pedestrian BSM is a standard BSM that is created by the RSU using data received from a PID"
Added Comment "This is a Personal Safety Message based on J2735_201603. PSMs shall be compliant with requirements listed in J2945/9 (among other things this standard prescribes a minimum location accuracy)" to comments.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_B PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.4 are projected to be in the intended path of the vehicle

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section	
THEA-UC3-003	Con Ops	
Related Needs	1, 3	
Parent Section	7.1.3	

Requirement Text

The OBU shall warn the driver upon determination of a potential conflict with a pedestrian.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_B PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.4 To warn drivers when pedestrians, within the crosswalk, are projected to be in the intended path of the vehicle.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section
THEA-UC3-004	
Related Needs	
Parent Section	

Requirement Text
The PID shall warn the pedestrian in the crosswalk when a vehicle is approaching the crosswalk.

Requirement Text (Comments/Changes)
<mark>Deleted.</mark> This is covered by THEA-UC3-001.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-UC3-005~~	2.4.3 Use Case 3 - Pedestrian Safety
Related Needs	
Parent Section	

Requirement Text
The PID shall warn the pedestrian in the crosswalk when a vehicle is approaching the crosswalk.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> due to PID GPS inaccuracies that could cause lead to false positives and false negatives.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC3-006				
Related Needs				
Parent Section				

Requirement Text
The PID shall warn the pedestrian approaching the crosswalk when a vehicle is entering the crosswalk.

Requirement Text (Comments/Changes)
==Deleted== due to PID GPS inaccuracies that could cause lead to false positives and false negatives.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC3-007	2.4.3 Use Case 3 - Pedestrian Safety			
Related Needs				
Parent Section				

Requirement Text
The PID shall warn the pedestrian in a non-crosswalk area on the street when there is an impending vehicle conflict.

Requirement Text (Comments/Changes)
Deleted due to PID GPS inaccuracies that could cause lead to false positives and false negatives.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC3-008	Con Ops			
Related Needs	10			
Parent Section	7.1.3			

Requirement Text

The PID shall transmit PSM to the RSU.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.1 The PED-X smartphone application also collects logs which contain the smartphone location (PSM is included inside the data logs to the RSU).

ICD 23029

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC3-009	Con Ops			
Related Needs	10			
Parent Section	7.1.3			

Requirement Text
The RSU shall receive PID PSM.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_B PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.2 PED-X sends PID data logs to the Data Collector containing the smartphone location

3.4.2.2 This event is also logged and sent back to the RSU for archiving at the master server.

ICD 23029

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
~~THEA-UC3-010~~	2.4.3 Use Case 3 - Pedestrian Safety
Related Needs	
Parent Section	

Requirement Text
The RSU shall convert the PSM into a BSM.

Requirement Text (Comments/Changes)
==Deleted.== J2735-201603 has an appropriate PSM message defined. Will use that instead of a proxy BSM.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-UC3-011	Con Ops		
Related Needs	10		
Parent Section	7.1.3		

Requirement Text

The RSU shall send all PID PSMs to the master server.

Requirement Text (Comments/Changes)

Omitted 'send a converted BSM from a pedestrian PSN over DSRC' and added 'log the receive PID PSM and store at the master server.'

Comment Added: The intent is to compare location information sent by the PID with location information determined from the pedestrian sensor system.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_B PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.2 PED-X sends PID data logs to the Data Collector containing the smartphone location

ICD 23030

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC3-012	Con Ops
Related Needs	10
Parent Section	7.1.3

Requirement Text
The RSU shall receive vehicle BSMs.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_B PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.5.1 The XFER Gateway also receives BSMs from nearby OBUs via WAVE.

ICD 20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X		Modify		Implement Later	Drop	
Comments							

Requirement Group	Related Section
~~THEA-UC3-013~~	2.4.3 Use Case 3 - Pedestrian Safety
Related Needs	
Parent Section	

Requirement Text

The RSU shall send a not in crosswalk message to PIDs who are outside the crosswalk.

Requirement Text (Comments/Changes)

Deleted due to PID GPS inaccuracies that could cause lead to false positives and false negatives.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop D
Comments				

Requirement Group	Related Section			
~~THEA-UC3-014~~	2.4.3 Use Case 3 - Pedestrian Safety			
Related Needs				
Parent Section				

Requirement Text
The RSU shall convert vehicle BSMs into PSMs.

Requirement Text (Comments/Changes)
<mark>Deleted:</mark> PID will use BSMs. See requirement THEA-UC3-016

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC3-015	Con Ops			
Related Needs	10			
Parent Section	7.1.3			

Requirement Text
The RSU shall send vehicle BSMs over Wi-Fi to the PID.

Requirement Text (Comments/Changes)

Added '…to the PID' and removed '…a converted PSM from a.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_B PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.5.2 It forwards those BSMs to the pedestrian safety app on nearby smartphones connected via WiFi to the RSU.

ICD 23012

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC3-016	Con Ops			
Related Needs	10			
Parent Section	7.1.3			

Requirement Text

The PID shall receive BSMs.

Requirement Text (Comments/Changes)

Added '…BSMs and calculate collision warnings using the PID's location. Warnings shall be logged and sent to the RSU for offline analysis.' Removed 'PSMs.'

Added comment: Intent is to use this information for a feasibility analysis of collision warning to pedestrians from the PID.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.5.2 It forwards those BSMs to the pedestrian safety app on nearby smartphones connected via WiFi to the RSU.

ICD 23029

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC3-016a	Con Ops			
Related Needs	10			
Parent Section	7.1.3			

Requirement Text
The PID shall calculate collision warnings using the PID's location.

Requirement Text (Comments/Changes)
Added '…BSMs and calculate collision warnings using the PID's location. Warnings shall be logged and sent to the RSU for offline analysis.' Removed 'PSMs.'
Added comment: Intent is to use this information for a feasibility analysis of collision warning to pedestrians from the PID.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.5.1 The pedestrian collision warning (PCW) app on the OBU receives the PSMs and uses the vehicle's location and trajectory to calculate a pedestrian collision threat

ICD 23029

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC3-016b	Con Ops			
Related Needs	10			
Parent Section	7.1.3			

Requirement Text

The PID shall send warnings to the RSU for offline analysis.

Requirement Text (Comments/Changes)

Added '…BSMs and calculate collision warnings using the PID's location. Warnings shall be logged and sent to the RSU for offline analysis.' Removed 'PSMs.'

Added comment: Intent is to use this information for a feasibility analysis of collision warning to pedestrians from the PID.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-X PCW_A PCW_C PCW_D	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.2 PED-X sends PID data logs to the Data Collector containing the smartphone location and any collision warnings which were computed but not displayed to the user via XFER.

ICD 23029

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
~~THEA-UC3-017~~	Con Ops
Related Needs	
Parent Section	7.1.3

Requirement Text

The PID application, Mobile Accessible Pedestrian Signal (PED-SIG), shall allow the pedestrian to place a crossing request on the signal controller via the RSU.

Requirement Text (Comments/Changes)

==Deleted==, duplicated of THEA-UC3-018 Added '…allow the pedestrian to place a crossing request on the signal controller via the RSU.' Removed 'inform the pedestrian, they are not in the crosswalk.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 The PED-Sig app lets the user press a button on the UI when facing a cross-walk. The app will send a pedestrian call to the local traffic controller via the RSU over Wi-Fi. 3.6.4   23028

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-UC3-017a~~	Con Ops
Related Needs	
Parent Section	7.1.3

Requirement Text
The PID app shall receive a confirmation for successfully placing the request and display it to the user.

Requirement Text (Comments/Changes)
<mark>Deleted</mark>, duplicate of THEA-UC3-018
Added requirement identifier and requirement text.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 The PED-Sig app receives the SPaT message from the RSU via Wi-Fi including the pedestrian call status.
3.6.3   23027

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC4-001	Con Ops			
Related Needs	1, 4			
Parent Section	7.1.4			

Requirement Text

Transit vehicle shall send Signal Request Message (SRM) to RSU when vehicle matches the location of the intersection approach.

Requirement Text (Comments/Changes).

Omitted "…and no request if signal is already green."

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.3 at intersections and along arterial corridors … The OBU sends an SRM to the RSU

ICD 20009

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-002	Con Ops			
Related Needs	1, 4			
Parent Section	7.1.4			

Requirement Text
The RSU shall send a priority service request to the master server.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.3 The OBU sends an SRM to the RSU. The RSU forwards that to the Transit Server at the TMC.

ICD 23013

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-003	Con Ops			
Related Needs	1, 4			
Parent Section	7.1.4			

Requirement Text

Master server shall query the HART OneBusAway server for bus schedule deviation status.

Requirement Text (Comments/Changes)

Added 'route, run' and 'adherence status.'

Changed 'a' to 'the.'

Added to comment: "Bus AVL system monitors whether bus is on schedule and maintains the adherence status information (e.g. in a text file)."

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_C	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.2 NextConnect TSP receives current bus schedule deviation from HART's OneBusAway server.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC4-004	Con Ops
Related Needs	1, 4, 7, 8, 9
Parent Section	7.1.4

Requirement Text

If bus is behind schedule, the transit central shall grant permission to process the SRM to the originating RSU. Otherwise permission shall be denied.

Requirement Text (Comments/Changes)

Added '…grant permission to process…' and "Otherwise permission shall be denied." Omitted 'return'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.2 If the bus is behind schedule the priority service request is granted.

Design (Comments/Changes): Not granting priority is logically equal to denying priority

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-005	Con Ops			
Related Needs	1, 4, 7, 8, 9			
Parent Section	7.1.4			

Requirement Text

The TSP application of MMITSS shall consider all priority service request of buses behind schedule and compute a phase execution schedule minimizing overall delay as implemented in the available release of MMITSS.

Requirement Text (Comments/Changes)

Changed "The TSP shall request signal priority of the controller when SRM is received from transit central and is of the highest priority." to "The TSP application of MMITSS shall consider all pending signal priority requests and compute a phase execution schedule minimizing overall delay as implemented in the available release of MMITSS."

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.2 If the priority service request is granted by the NextConnect TSP then Siemens-MMITSS processes it along with other granted requests in the TSP component. … It then uses phase control commands (i.e. phase calls, holds, omits, and force offs) to control the phase execution.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-006				
Related Needs				
Parent Section				

Requirement Text

TSP shall receive priority status from the Controller Unit (CU).

Requirement Text (Comments/Changes)

Deleted: MMITSS doesn't use the controller's priority feature. It rather controls the current phases via phase holds, omits, and force offs. Therefore, no priority status is available from the controller. Rather MMITSS will accommodate a granted request among other pending requests according to the priority solver's configuration for the various modes and approaches to consider. Suggest to remove this requirement.

Requirement Criteria		Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

Design Criteria		Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC4-007	Con Ops			
Related Needs	1, 4, 7, 8, 9			
Parent Section	7.1.4			

Requirement Text

TSP shall send Signal Status Message (SSM) to bus including the decision from the master server whether the request was granted.

Requirement Text (Comments/Changes)

Added: '…including the decision from the master server whether the request was granted or denied.' SSM indicates the Granted requests, if not granted, OBU treats as denied.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.3 At the same time, RSU sends the SSM to the approaching equipped transit vehicles to inform which has received priority to extend the green and which vehicles have been denied priority.

ICD 20009

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-008	Con Ops			
Related Needs	1, 4, 7, 8, 9			
Parent Section	7.1.4			
Requirement Text Bus shall receive SSM from TSP.				
Requirement Text (Comments/Changes)				

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.3 RSU sends the SSM to the approaching equipped transit vehicles.

ICD 20009

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-009	Con Ops			
Related Needs	2			
Parent Section	7.1.4			

Requirement Text
SSM shall be displayed as a bus driver notification.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.3 If signal priority has been granted, the driver of the transit vehicle is notified.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC4-010	Con Ops
Related Needs	1, 4, 7, 8, 9
Parent Section	7.1.4

Requirement Text

Signal controllers shall extend green in order to move vehicle queues that block a bus stop entrance when the bus is behind schedule.

Requirement Text (Comments/Changes)

Deleted: This requirement is deleted as testing how the signal controller responds to information sent to it from the RSU is out of scope, rather part of MMITSS project scope. Removed '…prevent vehicles from blocking…'
Added '…extend green in order to move vehicle queues that…' and 'block a.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3 Siemens-MMITSS controls the phase execution schedule of an NTCIP controller by applying phase calls, force offs, holds, and omits, thereby implementing the desired behavior of either extending green or giving early green.
3.8.1   23013

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC4-011	Con Ops			
Related Needs	6			
Parent Section	7.1.4			

Requirement Text

PID shall issue an alert to participant pedestrians within in a geo fenced area that a bus is stopping at an intersection.

Requirement Text (Comments/Changes)

Changed: 'TSP' to 'PID.'
Added: '…stopping at an intersection…'
Removed: '…at an intersection where a bus is about to be given priority.'

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTWM	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2.1 In order to detect if a vehicle is crossing the intersection, the PED-X app has to derive a conflict area for the corresponding intersection from the data contained in the MAP

ICD 23012

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-012	Con Ops			
Related Needs	6			
Parent Section	7.1.4			

Requirement Text

PID shall issue an alert to participant pedestrians within in a geo fenced area that bus is starting up again.

Requirement Text (Comments/Changes)

Changed 'RSU' to 'PIDs' and 'about to proceed' to 'starting up again.'

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTMW	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2.4 The PED-X App shall issue a warning when a bus stops or starts in an intersection (is within the intersection conflict area) while the PID is in the intersection conflict area.

ICD 23012

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-013	Con Ops			
Related Needs	1, 4, 7, 8, 9			
Parent Section	7.1.4			

Requirement Text
Transit signal priority shall be implemented to extend and existing green in the bus route of travel.

Requirement Text (Comments/Changes)
Added '…extend and existing green in the bus route of travel.'
Removed '…control signals at streets crossing the bus route.'
Changed 'provides' to 'extends.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			TSP_A TSP_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

2.1.6 The RSU determines priority of all SRMs received from all approaching vehicles, and then selects the controller phase via NTCIP objects to extend the green, allowing the bus to proceed through the intersection.

ICD 23013

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC4-013a	Con Ops			
Related Needs	1, 4, 7, 8, 9			
Parent Section	7.1.4			

Requirement Text

Transit signal priority shall be implemented to request accelerated (early cycle) green.

Requirement Text (Comments/Changes)

Deleted: per the SDD walkthrough

Comment: TSP requests the minimum greens to cycle the green to the bus's direction of travel as quickly as possible.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3 Siemens-MMITSS controls the phase execution schedule of an NTCIP controller by applying phase calls, force offs, holds, and omits, thereby implementing the desired behavior of either extending green or giving early green.
3.8.1   23013

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC5-001	Con Ops
Related Needs	1, 3
Parent Section	7.1.5

Requirement Text
Deleted: Per the SDD Walkthrough. Covered by THEA-UC1-008
Street car OBUs shall determine the position of received vehicle BSMs within DSRC range.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.5 OBU equipped vehicles
3.1.1   20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC5-002	
Related Needs	
Parent Section	

Requirement Text

Deleted: Removed due to GPS inaccuracy for PID location.

Street car OBUs shall determine the position of received participant PSMs within WiFi range.

Requirement Text (Comments/Changes)

Deleted. Due to GPS inaccuracy for PID location.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-UC5-003~~	Con Ops
Related Needs	7
Parent Section	7.1.5

Requirement Text
Street car OBUs shall broadcast BSMs.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> per the SDD Walkthrough. Covered by THEA-UC1-030.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.5 OBU equipped vehicles continually broadcast and receive BSMs from other equipped vehicles within the range
3.1.1   20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC5-004				
Related Needs				
Parent Section				

Requirement Text

RSUs adjacent to street car line shall receive PSMs of in WiFi range pedestrians.

Requirement Text (Comments/Changes)

Deleted. No longer attempting to track pedestrian movements around the streetcars.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC5-005	Con Ops
Related Needs	2, 8, 9, 10
Parent Section	7.1.5

Requirement Text

Pedestrian Safety app on PIDs shall issue an alert to pedestrians within in a geo fenced area that the streetcar is stopping.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTMW	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2.2 Warn the pedestrian of a bus (or streetcar) stopping or starting within an intersection. This event is also logged and sent back to the RSU for archiving at the master server.

ICD 23012

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC5-006	Con Ops			
Related Needs	2, 8, 9, 10			
Parent Section	7.1.5			

Requirement Text
Pedestrian Safety app on PIDs shall issue an alert to pedestrians within in a geo fenced that the streetcar is starting.

Requirement Text (Comments/Changes)

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTMW	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2.2 Warn the pedestrian of a bus (or streetcar) stopping or starting within an intersection. This event is also logged and sent back to the RSU for archiving at the master server.

ICD 23012

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC5-007	Con Ops			
Related Needs	1, 3			
Parent Section	7.1.5			

Requirement Text

Street car OBUs shall analyze its current position in relation to right turning vehicles to determine if right turning vehicle is in conflict to the street car's position.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			VTRFTV_A VTRFTV_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2.5 The streetcar OBU detects other equipped vehicles attempting to make a right turn in front of it and issues a "Vehicle Turning Right in Front of Transit Vehicle" (VTRFTV) Warning to its operator.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC5-007a	Con Ops
Related Needs	7
Parent Section	7.1.5

Requirement Text

Vehicle OBUs shall analyze its current position while preparing to make a right turn across the streetcar tracks in relation to a nearby streetcar to determine if the streetcar is in conflict to the vehicle's project path.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			VTRFTV_A VTRFTV_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.5 . Once a blinker of the equipped vehicle that is approaching the intersection is engaged while passing the streetcar as well as the trajectory and speed determined by the OBU matches that of the potential collision …The equipped vehicle receives a warning that they are on a collision course with streetcar as well.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC5-008	Con Ops			
Related Needs	4			
Parent Section	7.1.5			

Requirement Text
Street car OBUs shall produce a warning of a vehicle turning in front of the street car to street car operator.

Requirement Text (Comments/Changes)
Added '…and to the RSU.'
Removed "…and to the RSU."

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			VTRFTV_A VTRFTV_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.5 …the streetcar OBU will give the streetcar driver a warning.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC5-008a	Con Ops			
Related Needs	7			
Parent Section	7.1.5			

Requirement Text
Vehicle OBUs shall produce a warning of a street car conflict to the driver.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			VTRFTV_A VTRFTV_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2.5 The equipped vehicle receives a warning that they are on a collision course with streetcar as well.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC5-008b	Con Ops
Related Needs	7
Parent Section	7.1.5

Requirement Text

Streetcar OBUs shall produce a warning of a vehicle turning in front of the streetcar to the RSU

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTMW	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.1 Additionally PED-X also collects logs … when the VTRFTV warning is displayed.

ICD 23002

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC5-009	Con Ops			
Related Needs	2, 8, 9, 10			
Parent Section	7.1.5			

Requirement Text

RSUs adjacent to the street car line shall send right turning vehicle warning to the Master Server.

Requirement Text (Comments/Changes)

Added '…and to nearby PID'

Added comment: "RSU gets log of warnings from streetcar OBU and sends it to master server. Additionally, a real-time warning for PIDs is also sent from street car OBU and forwarded to PIDs by RSU."

Removed "…and to nearby PID" as a compound requirement

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTMW	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.1 Additionally PED-X also collects logs … when the VTRFTV warning is displayed.

3.2.2.5.2 The XFER Gateway also receives BSMs from nearby OBUs via WAVE

ICD 20004, 23012

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC5-009a	Con Ops			
Related Needs	2, 8, 9, 10			
Parent Section	7.1.5			

Requirement Text
RSUs adjacent to the streetcar line shall send right turning vehicle warning to nearby PIDs.

Requirement Text (Comments/Changes)
Added from compound requirement 9

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTMW	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2.5 The OBU also sets a special field in the BSMs sent out when this warning happens. The RSU forwards all BSMs to the PED-X App. The PTMW App detects the VTRFTV Warning field set by the streetcar OBU which is embedded in the streetcar BSMs and notifies the PID user.

ICD 23010

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
~~THEA-UC5-009b~~	Con Ops
Related Needs	2, 8, 9, 10
Parent Section	7.1.5

Requirement Text

The PID shall provide warning messages to the pedestrian when a street car stops within an intersection and when it starts back up again.

Requirement Text (Comments/Changes)

Deleted: Duplicate of THEA-UC5-005 and THEA-UC5-006.

Added requirement identifier, text, and validation method.

Added comment: The intent is to warn pedestrians who may want to cross the street of a nearby street car.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2 The PTMW feature of the pedestrian safety app detects the VTRFTV warning included with the BSM received and alerts the user.
3.10.1 23010

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC5-009c	Con Ops			
Related Needs	2, 8, 9, 10			
Parent Section	7.1.5			

Requirement Text
The PID shall provide warning messages to the pedestrian when a vehicle is turning right in front of the streetcar.

Requirement Text (Comments/Changes)
Added from compound requirement 9

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PTMW	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.2.5 The OBU also sets a special field in the BSMs sent out when this warning happens. The RSU forwards all BSMs to the PED-X App. The PTMW App detects the VTRFTV Warning field set by the streetcar OBU which is embedded in the streetcar BSMs and notifies the PID user.

ICD 23010

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC5-010	
Related Needs	
Parent Section	

Requirement Text
Street car OBUs shall analyze its current position in relation to pedestrians in intersection crossings.

Requirement Text (Comments/Changes)
Deleted. Due to GPS inaccuracy for PID location.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC5-011				
Related Needs				
Parent Section				

Requirement Text

Street car OBUs shall produce a warning to the street car operator that equipped pedestrians are in conflict to the street car within a configurable threshold defaulted to 100 feet.

Requirement Text (Comments/Changes)

<mark>Deleted</mark>. Due to GPS inaccuracy for PID location.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC5-012	
Related Needs	
Parent Section	

Requirement Text

RSUs adjacent to the street car line shall send pedestrian conflicts warnings to the Master Server.

Requirement Text (Comments/Changes)

Deleted. Due to GPS inaccuracy for PID location.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC5-013	
Related Needs	
Parent Section	

Requirement Text

RSUs adjacent to the street car line shall send pedestrian conflicts warnings to the Master Server.

Requirement Text (Comments/Changes)

Deleted. Due to GPS inaccuracy for PID location.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC5-014				
Related Needs				
Parent Section				

Requirement Text
Vehicle OBUs shall receive PSMs from the RSUs adjacent to the street car line.

Requirement Text (Comments/Changes)
Deleted. Due to GPS inaccuracy for PID location.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-UC5-015			
Related Needs			
Parent Section			

Requirement Text
Vehicle OBUs shall store the pedestrian crossing warning messages.

Requirement Text (Comments/Changes)
Deleted. Due to GPS inaccuracy for PID location.

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC5-016				
Related Needs				
Parent Section				
Requirement Text				
Requirement Text (Comments/Changes) Deleted. Due to GPS inaccuracy for PID location.				

Requirement Criteria		Yes		No/Rank
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC5-017	Con Ops			
Related Needs	2, 8, 9, 10			
Parent Section	7.1.5			

Requirement Text

RSUs adjacent to the street car line shall receive information about location and movement of the street car.

Requirement Text (Comments/Changes)

<mark>Deleted:</mark> Per the SDD walkthrough

Added Comment: From the BSMs broadcast by street car OBU (see THEA-UC5-003).

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6 The VTRFTV warning is included inside the BSM broadcast by the streetcar and is received by the RSU. The data collector RSU app will log the BSM including the VTRFTV warning and forward to the master server.
3.1.1   20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
~~THEA-UC5-018~~				
Related Needs				
Parent Section				

Requirement Text

PIDs shall receive a street car collision warning from the RSUs adjacent to the street car line.

Requirement Text (Comments/Changes)

<mark>Deleted.</mark> Due to GPS inaccuracy for PID location.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC5-019	
Related Needs	
Parent Section	

Requirement Text

PIDs shall provide street car collision warning messages to the pedestrian.

Requirement Text (Comments/Changes)

Deleted. Due to GPS inaccuracy for PID location.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC5-020				
Related Needs				
Parent Section				

Requirement Text
PIDs shall provide vehicle collision warning messages to the pedestrian.

Requirement Text (Comments/Changes)
Deleted. Due to GPS inaccuracy for PID location.

	Requirement Criteria		Yes		No/Rank	
1	Is the requirement well-formed?					
2	Is the requirement unambiguous?					
3	Is the requirement logically consistent with Parent(s), and sibling requirements?					
4	Is the requirement feasible?					
5	Is the requirement verifiable?					
			Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?					

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-001	Con Ops			
Related Needs	11.2.1			
Parent Section	7.1.6			

Requirement Text

The master server application shall compute Travel Times from equipped vehicle speeds measured along the corridors specified in other requirements.

Requirement Text (Comments/Changes)

<mark>Deleted</mark> per the SDD walk-though

Added 'compute' and '…from equipped vehicle speeds measured along the corridors specified in other requirements…'

Removed '…to vehicles and nomadic devices.'

Requirement Criteria		Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 The master server (Concert) receives vehicle speed (and count) from RSUs. It computes travel time from the speed for a road segment using a configured length of that road segment.
3.12.1 23014

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-002				
Related Needs				
Parent Section				

Requirement Text
The master server application shall send MAFB gate queues to vehicles and nomadic devices.

Requirement Text (Comments/Changes)
<mark>Deleted.</mark> The MAFB app project was discontinued.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-003				
Related Needs				
Parent Section				

Requirement Text
The master server application shall send incident locations to vehicles and nomadic devices.

Requirement Text (Comments/Changes)
Deleted. Incident information is not available and therefore cannot be provided.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-004				
Related Needs				
Parent Section				

Requirement Text
PIDs shall transmit PSMs

Requirement Text (Comments/Changes)
Deleted. Duplicate requirement; THEA-UC3-008

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC6-005	Con Ops
Related Needs	1, 2, 3
Parent Section	7.1.6

Requirement Text
Vehicle OBUs shall broadcast BSMs.

Requirement Text (Comments/Changes)

Deleted per the SDD Walkthrough. Covered by THEA-UC1-030

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.3.2   OBU equipped vehicles continually broadcast and receive BSMs from other equipped vehicles within the range
3.1.1   20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-006	Con Ops			
Related Needs	1, 2, 3			
Parent Section	7.1.6			

Requirement Text

I-SIG application running on the RSU shall receive vehicles BSMs.

Requirement Text (Comments/Changes)

Removed '… and PSMs.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.2 Siemens-MMITSS receives BSMs from OBUs

ICD 20004

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC6-007	Con Ops
Related Needs	1, 2, 3
Parent Section	7.1.6

Requirement Text
MMITSS shall be implemented to minimize overall delay on Meridian Avenue and Florida Avenue as implemented in the available release of MMITSS.

Requirement Text (Comments/Changes)
Change to identify specific corridors using available release of MMITSS.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.1 Siemens-MMITSS includes all of the following processes defined in the MMITTS Detailed Design document [6]: … MRP_PerformanceObserver

Design (Comments/Changes): MRP_Performance Observer minimizes overall delay, see [6].

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC6-008	Con Ops
Related Needs	1, 2, 3
Parent Section	7.1.6

Requirement Text
I-SIG shall archive Multi-Modal Intelligent Traffic Signal Systems (MMITSS)-measured intersection delay time at the TMC Master Server.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6 The RSU data collector app receives queue length, delay time and other metrics from Siemens-MMITSS and logs them. The data is forwarded to the master server for storage.
3.12.4   23030

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-008a	Con Ops			
Related Needs	1, 2, 3			
Parent Section	7.1.6			

Requirement Text

For each selected intersection on Meridian, I-SIG shall estimate the queue lengths on all approaches and compute the phase execution schedule as implemented in the available release of MMITSS.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.1 Siemens-MMITSS includes all of the following processes defined in the MMITTS Detailed Design document [6]: … MRP_PerformanceObserver

Design (Comments/Changes): MRP_PerformanceObserver calculates queues, see [6]

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC6-008b	Con Ops			
Related Needs	1, 2, 3			
Parent Section	7.1.6			

Requirement Text

For each selected intersection on Florida, I-SIG shall estimate the queue lengths on all approaches and compute the phase execution schedule as implemented in the available release of MMITSS.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			I-SIG	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.3.1 Siemens-MMITSS includes all of the following processes defined in the MMITTS Detailed Design document [6]: … MRP_PerformanceObserver

Design (Comments/Changes): MRP_PerformanceObserver calculates queues, see [6]

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC6-009	Con Ops
Related Needs	11.2.1
Parent Section	7.1.6

Requirement Text

The Master Server shall aggregate travel times across the corridor.

Requirement Text (Comments/Changes)

Deleted per SDD walkthrough

Omitted 'delay.'

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Concert computes aggregated travel times for configured links which are composed of road segments.

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
~~THEA-UC6-010~~	Con Ops			
Related Needs				
Parent Section	8			

Requirement Text

The Master Server shall present travel times to the TMC Operator.

Requirement Text (Comments/Changes)

<mark>Deleted</mark> per SDD walkthrough

Omitted 'delay.'

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Concert displays travel times of links in it UI to the user.

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC6-011	Con Ops
Related Needs	1, 2, 3
Parent Section	7.1.6

Requirement Text
Travel times along Meridian Avenue shall be determined in a configurable time threshold (starting at 15 seconds).

Requirement Text (Comments/Changes)
Deleted per SDD walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Travel time calculation in Concert is configurable

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC6-012	Con Ops
Related Needs	1, 2, 3
Parent Section	7.1.6

Requirement Text
Travel times along Meridian Avenue shall be based on length of corridor and detection points.

Requirement Text (Comments/Changes)
Deleted per SDD walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Travel time calculation in Concert is configurable

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
~~THEA-UC6-013~~	Con Ops			
Related Needs	1, 2, 3			
Parent Section	7.1.6			

Requirement Text

Travel times along Florida Ave and Nebraska Ave shall be determined with the most current data.

Requirement Text (Comments/Changes)

==Deleted== per SDD walkthrough

Added 'Florida and Nebraska Ave'

Removed 'Channelside Drive'

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Concert receives current speed data from RSUs and calculates travel time based on the current data.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC6-014	
Related Needs	
Parent Section	

Requirement Text

Travel times along Selmon Expressway shall be determined with the most current data.

Requirement Text (Comments/Changes)

Deleted. Travel times are calculated for Meridian, Florida, and Nebraska.

Requirement Criteria		Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

Design Criteria		Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-UC6-015			
Related Needs			
Parent Section			

Requirement Text

I-SIG shall publish travel times along Meridian Avenue to MAFB commuters.

Requirement Text (Comments/Changes)

Deleted. The MAFB gate app was not completed. There is no mechanism to provide information to MAFB commuters directly.

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC6-016	
Related Needs	
Parent Section	

Requirement Text
I-SIG shall publish travel times along Channelside Drive to MAFB commuters.

Requirement Text (Comments/Changes)
Deleted. The MAFB gate app was not completed. There is no mechanism to provide information to MAFB commuters directly.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-017				
Related Needs				
Parent Section				

Requirement Text
I-SIG shall publish travel times along Selmon Expressway to MAFB commuters.

Requirement Text (Comments/Changes)
Deleted. The MAFB gate app was not completed. There is no mechanism to provide information to MAFB commuters directly.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-018	Con Ops			
Related Needs	4			
Parent Section	7.1.6			

Requirement Text
The Ped-Sig application shall make a pedestrian call to the RSU to the RSU.

Requirement Text (Comments/Changes)

	Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		X	
2	Is the requirement unambiguous?		X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		X	
4	Is the requirement feasible?		X	
5	Is the requirement verifiable?		X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-SIG_A PED-SIG_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 The RSU transforms the request into a ped call for the phase associated with the identified signal group.

ICD 23010

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
~~THEA-UC6-018a~~	Con Ops
Related Needs	4
Parent Section	7.1.6

Requirement Text

The Ped-Sig application shall allow a user to point their PID in the direction they want to cross and press the CROSS button to request to cross the street to the RSU Ped-Sig application.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough. Duplicate of THEA-UC6-018
Added requirement identifier and text.

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 The PED-Sig app receives the SPaT message from the RSU via Wi-Fi including the pedestrian clearance timer status.
3.6.3   23027

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-UC6-018b	Con Ops			
Related Needs	4			
Parent Section	7.1.6			

Requirement Text

The Ped-Sig application shall audibly inform the pedestrian of the ability to cross and the pedestrian clearance timer.

Requirement Text (Comments/Changes)

Added requirement identifier and text.

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-SIG_A PED-SIG_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 The activity updates the screen UI accordingly.

ICD 23010: The PED-Sig feature of the pedestrian safety app uses Android's text-to-speech feature in order to audibly inform the user of the pedestrian signal head status including the "Flashing Don't Walk" countdown timer.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-UC6-018c	Con Ops			
Related Needs	4			
Parent Section	7.1.6			
Requirement Text				
The RSU Ped-SIG application shall receive the pedestrian call from the PID.				
Requirement Text (Comments/Changes)				
Added requirement identifier and text.				

	Requirement Criteria	**Yes**	**No/Rank**
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-SIG_A PED-SIG_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 When the user presses the button the PED-SIG screen activity sends the ped request to the Ped Safety Service. The Ped Safety Service selects the signal group for the crosswalk that the PID is facing based on the phone's location, the received intersection MAP, and the phone's heading. If a signal group is found which is associated with the crosswalk and heading then it sends a corresponding ped request to the RSU.

ICD 23028

Design (Comments/Changes)

	Design Criteria	**Yes**	**No/Rank**
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-UC6-018d	Con Ops
Related Needs	4
Parent Section	7.1.6

Requirement Text

The RSU Ped-Sig application shall send a pedestrian call to the signal controller.

Requirement Text (Comments/Changes)

Added requirement identifier and text.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-SIG_A PED-SIG_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 The RSU transforms the request into a ped call for the phase associated with the identified signal group.

ICD 23006

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
~~THEA-UC6-018e~~	Con Ops			
Related Needs	4			
Parent Section	7.1.6			

Requirement Text

The RSU Ped-Sig application shall request the extended walk time, if available, to the signal controller.

Requirement Text (Comments/Changes)

Deleted: The signal controller vendor has verified this option is not available in their signal controller.
Added requirement identifier and text.

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.4 The Controller Proxy component will use the appropriate NTCIP OID for requesting extended walk time, if supported by the NTCIP controller.
3.8.1   23006

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-UC6-018f	Con Ops
Related Needs	4
Parent Section	7.1.6

Requirement Text

The RSU Ped Sig application shall receive the pedestrian timing information from the signal controller.

Requirement Text (Comments/Changes)

Added requirement identifier and text.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-SIG_A PED-SIG_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 Subsequently SPaT messages are received by the Ped Safety Service from the RSU.

ICD 23006

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THE-UC6-018g	Con Ops			
Related Needs	4			
Parent Section	7.1.6			

Requirement Text

The RSU Ped-SIg application shall send the proceed to cross message to the Ped-Sig application running on the PID.

Requirement Text (Comments/Changes)

Added requirement identifier and text.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			PED-SIG_A PED-SIG_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.4.2.1 The service forwards the phase status and ped call status relevant to the crosswalk to the PED-SIG screen activity.

ICD 23027

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SAF-001	RFQ OBU, HMI Interface and Antenna; Safety Management Plan
Related Needs	
Parent Section	4.0; Table 5-1 IDs 22 and 23

Requirement Text

Equipment, software, processes, and interfaces shall comply with IEEE and SAE standards as prescribed by one of the USDOT approved certification entities.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Standards			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 15: Industry Standards applicable to OBU Design

Error! Reference source not found.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA-SAF-002	RFQ OBU, HMI Interface and Antenna; Safety Management Plan			
Related Needs				
Parent Section	4.3 BM-010; 6.1.1 and 6.2			

Requirement Text

Equipment, software, processes, and interfaces shall be tested for interoperability before deployment to ensure they meet those standards for interoperability.

Requirement Text (Comments/Changes)

Deleted per the SDD walkthrough

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The vehicle integrator, with THEA team concurrence, will provide an interoperability process and the supplier a plan for certification.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SAF-003~~	Con Ops; Safety Management Plan
Related Needs	
Parent Section	8; 4.3.6, 6.2.2

Requirement Text
During operations the TMC Operator and installation technicians shall performs checks on the equipment, software, interfaces, and processes on a six month basis at a minimum.

Requirement Text (Comments/Changes)
Deleted per the SDD walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				X

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SAF-004	Con Ops
Related Needs	
Parent Section	9.5.2

Requirement Text

THEA shall maintain the RSUs installed along the roadside by monitoring the RSU status from the Concert System.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Maintenance

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 1: Backend Server Functions

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-SAF-005	OBU Component Specification; Safety Management Plan		
Related Needs			
Parent Section	3.3.1; Table 5-1 IDs 12, 14, 16		

Requirement Text
OBU/Application failure shall not affect the normal operation of the vehicle.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			Safe_A	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

The OBU shall not damage the vehicle's electrical systems, electronic systems, or cause a fire or other condition that could damage the vehicle or injure the driver or passengers.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SAF-006	Safety Management Plan
Related Needs	
Parent Section	Table 5-1 IDs 3, and 4

Requirement Text
RSU/Application failure shall not affect the safe operation of the signal controller.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			Safe_B	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

RSU uses only standard NTCIP interfaces for communication with the signal controller.

Design (Comments/Changes): RSU must not be failed to create NTCIP phase SET messages

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SAF-007	Safety Management Plan			
Related Needs				
Parent Section	Table 5-1 ID 18			

Requirement Text
PID application failure shall not affect the normal operation of the PID.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	App failure doc			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Android OS implements this requirement.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SAF-008	Con Ops; Safety Management Plan
Related Needs	
Parent Section	9.5.3;6.1.2

Requirement Text
OBUs shall be installed properly in vehicles, buses, and street cars.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	X			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SAF-009	Con Ops; Safety Management Plan
Related Needs	
Parent Section	9.5.3;6.1.2

Requirement Text
RSUs shall be installed such that they receive GPS and DSRC signals.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SAF-010	Con Ops			
Related Needs				
Parent Section	5.2 Goal 2			

Requirement Text
RSUs shall be installed near signal cabinets such that the RSU and signal controller can be connected.

Requirement Text (Comments/Changes)
 Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	X			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SAF-011	Participant Training and Stakeholder Education Plan
Related Needs	
Parent Section	Section 3.1

Requirement Text
Participants shall bring their vehicles in for inspection within 14 days when the vehicle is involved in a crash.

Requirement Text (Comments/Changes)
This is to ensure the equipment is working properly after the vehicle has been repaired

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				OBU Inspection

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SAF-012	RFQ OBU, HMI Interface and Antenna
Related Needs	
Parent Section	Section 4.2

Requirement Text

The invehicle applications shall present information to drivers using a device that drivers are familiar with and limit interaction.

Requirement Text (Comments/Changes)

Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				X

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Private passenger automobiles and light duty trucks – Each respective OEM rear view mirror will be replaced with a compatible rear-view mirror, that is maintaining all original mirror functions

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SAF-013~~	RFQ OBU, HMI Interface and Antenna; Safety Management Plan
Related Needs	
Parent Section	Section 5.6; Section 6.1.2

Requirement Text
CV device suppliers shall provide and follow an approved quality management process in designing, constructing and producing their devices.

Requirement Text (Comments/Changes)
==Deleted== per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	X			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved		Modify		Implement Later		Drop X
Comments							

Requirement Group	Related Section			
THEA-SAF-014	Safety Management Plan			
Related Needs				
Parent Section	Section 6.1.1			

Requirement Text
The proposed user interface(s) shall be reviewed and approved by THEA and stakeholders.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	HMI Graphics			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
~~THEA-SAF-015~~	OBU Component Specification; Safety Management Plan
Related Needs	
Parent Section	Section 4.12.1.5; Section 6.1.1

Requirement Text
Safety checks for OBU's and RSU's shall comprise the equipment reset functions upon power loss and restoration.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The OBU shall include appropriate watchdog mechanisms that will monitor all software processes and alert the process monitor [on the OBU] when a process appears to be inoperative.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SAF-016~~	OBU Component Specification; Safety Management Plan
Related Needs	
Parent Section	Section 3.1.4; Section 6.1.1

Requirement Text
Safety checks for OBU's and RSU's shall comprise the equipment reset functions upon power loss and restoration.

Requirement Text (Comments/Changes)
 Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			x	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

"Upon power loss and restoration the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it

Upon power loss and restoration the OBU performs a secure boot checking the integrity and authenticity of the installed software before executing it.."

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SAF-017	OBU Component Specification; Safety Management Plan
Related Needs	
Parent Section	Section 3.1.4; Section 6.1.1

Requirement Text
Safety checks for OBU's and RSU's shall comprise the security actions upon power loss and restoration.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

"Upon power loss and restoration the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it.

Upon power loss and restoration the OBU performs a secure boot checking the integrity and authenticity of the installed software before executing it."

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SAF-018	OBU Component Specification; Safety Management Plan
Related Needs	
Parent Section	Section 3.1.4; Section 6.1.1

Requirement Text
Safety checks for OBU's and RSU's shall comprise the equipment reset functions, redundancy, security, and actions upon power loss and restoration.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

"Upon power loss and restoration the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it.

Upon power loss and restoration the OBU performs a secure boot checking the integrity and authenticity of the installed software before executing it."

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SAF-019~~	Safety Management Plan
Related Needs	
Parent Section	Section 6.1.1

Requirement Text
Uninterruptible power supply units with sufficient holdup time (2 hours) to implement the response plans shall be installed at all signal controller cabinets as part of the pilot.

Requirement Text (Comments/Changes)
<mark>Deleted</mark>

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SAF-020	Safety Management Plan
Related Needs	
Parent Section	Section 6.1.2

Requirement Text
Device installers shall be approved by the in-vehicle integrator to install devices in vehicles, buses, street cars.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Installers			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

The Hillsborough Community College automotive training facilities and personnel to install the vehicle systems.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA-SAF-020a	Safety Management Plan			
Related Needs				
Parent Section	Section 6.1.2			

Requirement Text
Participants shall be trained in the operation and interaction of the installed Onboard Units.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Training			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

The Hillsborough Community College automotive training facilities and personnel to install the vehicle systems.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SAF-021	Safety Management Plan
Related Needs	
Parent Section	Section 6.1.2

Requirement Text

Device installers shall be approved by the infrastructure integrator THEA and the COT to install devices in signal cabinets and along the roadside.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Installers			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SAF-022	OBU Component Specification; Safety Management Plan
Related Needs	
Parent Section	Section 4.12.1.5; Section 6.1.2

Requirement Text
RSUs installed for the pilot shall have a fail-safe mode.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> as there are no hardware failure scenario where harm could be caused.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			x	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

"Upon power loss and restoration the RSU performs a secure boot checking the integrity and authenticity of the installed software before executing it. Only know good application software will be launched and allowed to broadcast via DSRC.

The operating platform shall be able to reload and restart the failed process and shall make an entry in a log indicating that this action took place. Such actions shall include managed hysteresis that will avoid continuous retries for a failed process until it receives an update."

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-PFM-001	Con Ops
Related Needs	
Parent Section	Section 11.2.1

Requirement Text

The CUTR Server shall collect historical or "before CV treatment" performance metrics for each CV App used in each Use Case if available.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data Logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 NextConnect collects the data logs coming from the RSUs. The CUTR Server accesses to the protected storage area in order to obtain those data logs.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section
THEA-PFM-002	Con Ops
Related Needs	
Parent Section	Section 11.2.1

Requirement Text

The CUTR Server shall store historical or "before CV treatment" performance metrics for each CV App used in each Use Case if available.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data Logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Ultimately all data used as basis for performance measures is concentrated at the CUTR Server.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-PFM-003	Con Ops			
Related Needs				
Parent Section	Section 11.2.1			

Requirement Text
The CUTR Server shall collect performance metrics for each CV App used during each Use Case

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data Logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 NextConnect collects the data logs coming from the RSUs. The CUTR Server accesses to the protected storage area in order to obtain those data logs. Additional information comes from the Concert Server which hosts a SQL database (Microsoft SQL Server) and Reporting Service (SQL Server Reporting Services). RSUs measure average vehicle speed based on observed BSMs and send this information to Concert". Concert associated this data with traffic links and calculates link speed and travel time metrics. It saves those in the SQL database from where the data can be access by the CUTR server, which shares data per the Performance Measurement and Evaluation Support Plan. The Reporting Service allows a user to run a report and specify certain report-specific parameters (e.g. time period). It also allows the user to schedule reports to be created in regular intervals (daily, weekly, or monthly) automatically. Such reporting jobs can also be configured to send the report to a provided email address. Please see further below for a list of supported reports. Finally, the existing Centracs traffic control system at the City of Tampa TMC collects traffic counts and percent arrival on green from connected traffic controllers. The CUTR server can access this information from the Centracs system used to manage the traffic signal controllers via NTCIP.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-PFM-004	Con Ops			
Related Needs				
Parent Section	Section 11.2.1 & 11.2.2			

Requirement Text
The CUTR Server shall store performance metrics for each CV App used during each Use Case

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data Logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 NextConnect collects the data logs coming from the RSUs. The CUTR Server accesses to the protected storage area in order to obtain those data logs. Additional information comes from the Concert Server which hosts a SQL database (Microsoft SQL Server) and Reporting Service (SQL Server Reporting Services). RSUs measure average vehicle speed based on observed BSMs and send this information to Concert". Concert associated this data with traffic links and calculates link speed and travel time metrics. It saves those in the SQL database from where the data can be access by the CUTR server, which shares data per the Performance Measurement and Evaluation Support Plan. The Reporting Service allows a user to run a report and specify certain report-specific parameters (e.g. time period). It also allows the user to schedule reports to be created in regular intervals (daily, weekly, or monthly) automatically. Such reporting jobs can also be configured to send the report to a provided email address. Please see further below for a list of supported reports. Finally the existing Centracs traffic control system at the City of Tampa TMC collects traffic counts and percent arrival on green from connected traffic controllers. The CUTR server can access this information from the Centracs system used to manage the traffic signal controllers via NTCIP.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-PFM-005	Con Ops			
Related Needs				
Parent Section	Section 11.2.5			

Requirement Text
The CUTR Server shall enable the analysis or compare historical or "before CV treatment" performance metrics for each CV App used in each Use Case to "after CV treatment" performance metrics for each CV App used in each Use Case.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data Logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 CUTR server, which shares data per the Performance Measurement and Evaluation Support Plan.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-PFM-006	Con Ops			
Related Needs				
Parent Section	Section 11.2.5			

Requirement Text
The CUTR Server shall automate routine performance reports.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Reports

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 The Reporting Service allows a user to run a report and specify certain report-specific parameters (e.g. time period). It also allows the user to schedule reports to be created in regular intervals (daily, weekly, or monthly) automatically

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-PFM-007	Con Ops			
Related Needs				
Parent Section	Section 11.2.5			

Requirement Text
The CUTR Server shall support on demand performance reports.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Reports

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 The Reporting Service allows a user to run a report and specify certain report-specific parameters (e.g. time period).

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-PFM-008	Con Ops		
Related Needs			
Parent Section	11.2.5		

Requirement Text

The Master Server shall support daily performance reports.

Requirement Text (Comments/Changes)

<mark>Deleted</mark> per the SDD walkthrough

Changed 'automate' to 'support.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Reports can be scheduled to run automatically. Daily, weekly, and monthly reports are supported.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-PFM-009	Con Ops		
Related Needs			
Parent Section	11.2.5		

Requirement Text
The Master Server shall automate weekly performance reports.

Requirement Text (Comments/Changes)
 Deleted per the SDD walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Reports can be scheduled to run automatically. Daily, weekly, and monthly reports are supported.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-PFM-010	Con Ops		
Related Needs			
Parent Section	11.2.5		

Requirement Text
The Master Server shall automate monthly performance reports.

Requirement Text (Comments/Changes)
Deleted per the SDD walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Reports can be scheduled to run automatically. Daily, weekly, and monthly reports are supported.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-PFM-011~~	Con Ops
Related Needs	
Parent Section	11.2.5

Requirement Text
The Master Server shall transmit reports to USDOT.

Requirement Text (Comments/Changes)
 <mark>Deleted</mark> per the SDD walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Reporting jobs can send reports to a provided email address.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-PFM-012	Con Ops
Related Needs	
Parent Section	11.2.5

Requirement Text

The Concert system shall collect:

- BSM and ISM queue length

- crashes, conflicts, or near misses

- approaching speed on REL

- BSM travel times

- number of wrong way violations

- approaching speed on Twiggs street toward the REL

- approaching speed on Florida Avenue toward the REL

- vehicle's speed approaching the crosswalk

- bus percent arrival on green

- number of times priority is requested and granted

- number of time priority is requested and denied

- approach speed at intersections along Meridian Avenue

- approach speed at intersections along Florida Avenue

Requirement Text (Comments/Changes)

Added: 'Concert.'
Removed: 'delay time,' 'travel time reliability indices,' 'percent arrival on green,' 'percent…red light running,' 'travel time delay on REL,' 'bus travel time through the deployment region,' 'bus percent arrival on schedule,' 'bus percent red light violation running,' 'delay time along Meridian Avenue,' 'percent arrival on green along Meridian Avenue,' 'percent red light violation/running along Meridian.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data Logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Error! Reference source not found.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	

| 4 | Is the design verifiable? | X | |
| 5 | Is the requirement fulfilled by the design? | X | |

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-PFM-012a	Con Ops
Related Needs	
Parent Section	11.2.5

Requirement Text

The Concert system shall compute:
- travel times along Meridian
- travel times along Florida

Requirement Text (Comments/Change)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Finally the existing Centracs traffic control system at the City of Tampa TMC collects traffic counts and percent arrival on green from connected traffic controllers.

Design (Comments/Changes): BT Travel time from FDOT system, not City of Tampa

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-PFM-012b	Con Ops		
Related Needs			
Parent Section	11.2.5		

Requirement Text

The Centracs system shall collect:
- percent arrival on green
- percent arrival on green along Meridian Avenue

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Finally the existing Centracs traffic control system at the City of Tampa TMC collects traffic counts and percent arrival on green from connected traffic controllers.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-PFM-012c	Con Ops			
Related Needs				
Parent Section	11.2.5			

Requirement Text

The HART system shall collect:
- bus travel time through the deployment region
- bus percent arrival on schedule

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

HART has existing metrics supporting this.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-PFM-012d	Con Ops
Related Needs	
Parent Section	11.2.5

Requirement Text

The CUTR system shall collect:

• delay time

• travel time from Bluetooth travel time system

• travel time reliability indices

• travel time delay on REL

• travel times

• travel time delay on adjacent arterial

• pedestrian delay time at the crosswalk

• vehicle delay time at the crosswalk

• delay time along Meridian Avenue

• delay time along Nebraska Avenue

• delay time along Florida Avenue

Requirement Text (Comments/Changes)

Added: 'Concert.'

Removed: 'delay time,' 'travel time reliability indices,' 'percent arrival on green,' 'percent…red light running,' 'travel time delay on REL,' 'bus travel time through the deployment region,' 'bus percent arrival on schedule,' 'bus percent red light violation running,' 'delay time along Meridian Avenue,' 'percent arrival on green along Meridian Avenue,' 'percent red light violation/running along Meridian.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4. It saves those in the SQL database from where the data can be access by the CUTR server, which shares data per the Performance Measurement and Evaluation Support Plan.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.				
Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-PFM-013	Con Ops
Related Needs	
Parent Section	11.2.5

Requirement Text

The CUTR system shall store:

- delay time

- queue length

- crashes, conflicts, or near misses

- approaching speed on REL

- travel time reliability indices

- travel times

- percent arrival on green

- percent wrong way violation

- travel time delay on REL

- travel time delay on adjacent arterial

- approaching speed on Twiggs street toward the REL

- vehicle delay time at the crosswalk

- pedestrian delay time at the crosswalk

- vehicle's speed approaching the crosswalk

- bus travel time through the deployment region

- bus percent arrival on schedule

- bus percent arrival on green

- number of times priority is requested and granted

- number of time priority is requested and denied

- number of times priority is requested, granted, and then denied due to a higher priority

- travel times along Meridian Avenue

- delay time along Meridian Avenue

- percent arrival on green along Meridian Avenue

- approach speed at intersections along Meridian Avenue

Requirement Text (Comments/Changes)

Added missing 'l' to shall.
Added missing 'e' to speed.
Omitted red light running and added wrong way.
Omitted 'bus percent red light violation/running,' and 'percent red light violation/running along Meridian Avenue.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	

2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.4 Ultimately all data used as basis for performance measures is concentrated at the CUTR Server. … It saves those in the SQL database from where the data can be access by the CUTR server, which shares data per the Performance Measurement and Evaluation Support Plan.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SEC-001	Con Ops; OBU Component Specification			
Related Needs				
Parent Section	11.3.1; 4.10.1			

Requirement Text
OBU Wireless Access in Vehicular Environments (WAVE) shall comply with IEEE 1609.2: Standard for WAVE – Security Services for Applications and Management Messages

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Certification			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 15: Industry Standards applicable to OBU Design

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SEC-001a	Con Ops; OBU Component Specification			
Related Needs				
Parent Section	11.3.1; 4.10.1			

Requirement Text
RSU Wireless Access in Vehicular Environments (WAVE) shall comply with IEEE 1609.2:
Standard for WAVE – Security Services for Applications and Management Messages

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Certification			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.1 It is a commercial off-the-shelf (COTS) product which is compliant to the USDOT RSU Specification and fulfills the specific requirements of the pilot.

Design (Comments/Changes): Currently v4.1, Paragraph 3.7.1.3

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SEC-002	Con Ops			
Related Needs				
Parent Section	11.3.2			

Requirement Text
Devices shall sign and/or encrypt data non-DSRC IP communications (i.e., cellular, Wi-Fi) interfaces with X.509 certificates.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Message log			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

RSU supports Wi-Fi WPA2 plus TLS encryption via Wi-Fi. RSU supports OpenVPN encryption via LTE.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA-SEC-003	Con Ops; OBU Component Specification; RFQ OBU, HMI Interface and Antenna			
Related Needs				
Parent Section	11.3.1; 4.10.1; 4.3 BM-009			

Requirement Text
THEA CV Pilot devices shall support requirements identified in the SCMS POC Implementation End Entity (EE) Requirements and Specifications as of November 1, 2017.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Certificates			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 15: Industry Standards applicable to OBU Design

3.2.1 It is a commercial off-the-shelf (COTS) product which is compliant to the USDOT RSU Specification and fulfills the specific requirements of the pilot.

6 Requirements Traceability Matrix

"The Vehicle System shall have security as defined by the Security Certificate Management System (SCMS) POC and provide data privacy. Human Use and Privacy requirements to be developed.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SEC-004	Con Ops			
Related Needs				
Parent Section	11.3.2			

Requirement Text
Datasets shall be required to have PII information removed prior to being made publicly available.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Data logged			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 This component removes Personally Identifiable Information (PII) in a nightly batch job. Data of the last 24 hours is read from the Protected Storage and transferred over to the Public Storage.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section		
THEA-SEC-005	Con Ops; OBU Component Specification		
Related Needs			
Parent Section	11.3.1; 4.7.3		

Requirement Text
Monitoring systems shall be enabled and used to perform intrusion detection.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes			No/Rank
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Per DPP			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

The OBU equipment shall be able to detect when there are any new connections or insertions into the USB port or SD Card slot.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section		
THEA-SEC-006	Con Ops		
Related Needs			
Parent Section	11.3.1		

Requirement Text
The RSU firewall shall be enabled and used to detect abnormal unauthorized activity on an IP connection.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	RSU settings			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes): Enabling is organizational policy enforcement, not design

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-SEC-006a	Con Ops		
Related Needs			
Parent Section	11.3.1		

Requirement Text
The OBU firewall shall be enabled and used to detect abnormal unauthorized activity on an IP connection.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	OBU settings			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes): Enabling is organizational policy enforcement, not design

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop	
Comments						

Requirement Group	Related Section			
THEA-SEC-007				
Related Needs				
Parent Section				
Requirement Text				
OBU hardware shall meet FIPS-140-2 Level 2.				
Requirement Text (Comments/Changes)				
Deleted. This is part of the overall SCMS requirements. See THEA-SEC-003				

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-008				
Related Needs				
Parent Section				

Requirement Text
PIDs shall meet FIPS 140-2 Level 2 or equivalent.

Requirement Text (Comments/Changes)
<mark>Deleted.</mark> Standard smartphones provided by participants are planned to use WiFi to interface with the RSU. Standard consumer smartphones usually do not meet FIPS 140-2 Level 2

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-009				
Related Needs				
Parent Section				

Requirement Text
RSU hardware shall meet FIPS 140-2 Level 2.

Requirement Text (Comments/Changes)
Deleted. This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-010				
Related Needs				
Parent Section				

Requirement Text

ITS Roadway Equipment communications shall be developed meet FIPS 140-2 Level 2 or equivalent.

Requirement Text (Comments/Changes)

Deleted. This requirement is based on / derived from the SMOC, chapter 4.2.3, and applies to new traffic controllers. The chapter solely mentions the FIPS standard as applicable to hardware, not software. Reason to remove the requirement is that current standard traffic controllers and communications do not fulfill FIPS.

Requirement Criteria		Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

Design Criteria		Yes	No/Rank	
1	Is the design unambiguous?			
2	Is the design logically consistent with Parent(s), and sibling design components?			
3	Is the design feasible?			
4	Is the design verifiable?			
5	Is the requirement fulfilled by the design?			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-011	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
New field cabinets shall include tamper alerts.

Requirement Text (Comments/Changes)

Deleted: This is covered under the Florida Department of Transportation's Traffic Engineering Research Laboratory Approved Products Lists test specifications

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement (responsibility of City of Tampa)

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-012	Con Ops			
Related Needs				
Parent Section	11.3.1			

Requirement Text
New field cabinet tamper alerts shall be sent to the TMC when an unauthorized access occurs.

Requirement Text (Comments/Changes)
Deleted as field cabinets are already in place.
Removed 'the tamper seal is broken.'
Added 'an unauthorized access occurs.'

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement (responsibility of City of Tampa)

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-013	Con Ops
Related Needs	
Parent Section	11.3.2

Requirement Text
All participant data, as defined in the SMOC, shall be encrypted with minimum standards, password protected, and maintained separate from the application and performance measurement data (Separate systems, separate login and user access at a minimum).

Requirement Text (Comments/Changes)
Deleted: Redundant with THEA-INM-002

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-014	Con Ops
Related Needs	
Parent Section	11.3.2

Requirement Text
Access to participant data shall be identified in the Human Use Approval document

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Server access			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 The ProtectedStorage is a directory structure on an encrypted file system. Only authorized users will have read access to the protected storage.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SEC-015	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The definition of how applications are authorized to communicate shall be using valid certificates.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-016	Con Ops			
Related Needs				
Parent Section	11.3.1			

Requirement Text
No person shall transfer PII information in an unencrypted state.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-017	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The participant's location information shall not be provided unless it is part of an application and no correlation to the participants personal information.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-SEC-018	Con Ops		
Related Needs			
Parent Section	11.3.1		

Requirement Text
PII shall not be used as a unique identifier except for buses.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

OBUs will be identified using a numeric ID.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-019	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

For broadcast and transactional unicast transmissions by OBUs, temporary and one-time identifiers shall be during the pilot, but removed following the completion of the pilot.

Requirement Text (Comments/Changes)

Added '…during the pilot, but removed…'

Removed '…used to protect against inadvertently providing PII…'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	PII data logs			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

OBUs will be identified using a static numeric ID in the TemporaryID field of the BSM. At the end of the study the static ID will be replaced by a true temporary ID according to J2945/1_201603

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SEC-020	Con Ops
Related Needs	
Parent Section	11.3.2

Requirement Text
The user shall consent to providing data in an agreement that spells out how the data is used and by whom (including re-distribution to third parties).

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	X			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-021	Con Ops			
Related Needs				
Parent Section	11.3.1			
Requirement Text				
The Master Server Network and remote access shall support remote authenticated access.				
Requirement Text (Comments/Changes)				

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Server Access

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

RSU supports remote access via browser UI which requires a user name and password.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SEC-022	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
OBU's and PIDs shall not support remote access of the connected vehicle applications.

Requirement Text (Comments/Changes)
Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

OBUs do not have access via SSH or HTTP

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-023	Con Ops; OBU Component Specification			
Related Needs				
Parent Section	11.3.1; 4.1.9			

Requirement Text
The OBU shall support physical access to support bootstrapping activities.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	OBU housing			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 3: OBU Functions

Support functionality for managing basic OBU operations such as broadcast of BSM messages. Functions for application lifecycle management, health monitoring, and human machine interface. Functions for log collection and software update management. (COTS)

Figure 29: OBU Subsystems and Input/Output – Car, bus and Streetcars

Management Port

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SEC-023a	Con Ops; RSU Component Specification			
Related Needs				
Parent Section	11.3.1; 4.1.9			

Requirement Text
The RSU shall support physical access to support bootstrapping activities.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	RSU housing			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 2: RSU Functions

Support functions for managing basic RSU operations such as broadcast of MAP and SPaT messages. Functions for application lifecycle management, health monitoring, and browser-based user access. Functions for configuration of core RSU services such as Message Forwarder. Functions for log collection and software update management. (COTS)

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SEC-024				
Related Needs				
Parent Section				

Requirement Text
OBUs and RSUs shall support role-based authentication to enable physical access.

Requirement Text (Comments/Changes)
Deleted. Unclear how role-based authentication to a device could prevent physical access to the device. For example, RSUs are mounted on a pole. Nothing prevents a malicious actor from climbing up the pole and physically accessing the RSU

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-SEC-025	Con Ops		
Related Needs			
Parent Section	11.3.1		

Requirement Text

The host processor and its operating software shall be delivered in an operational state.

Requirement Text (Comments/Changes)

Deleted per SDD walkthrough; part of RSU 4.1 specification

In comment: Replaced 05 with a '10' to 'THEA-SEC-10.'

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU is delivered fully operational with software pre-installed.

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-026	Con Ops			
Related Needs				
Parent Section	11.3.1			

Requirement Text
The host processor and its operating software shall be delivered such that required protections are implemented.

Requirement Text (Comments/Changes)
Deleted per SDD walkthrough; part of RSU 4.1 specification
In comment: Replaced 05 with a '10' to 'THEA-SEC-10.'

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU is delivered with a security provisioning pre-installed.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-027	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
If the host processor is initialized in a manufacturing state, the required protections shall not be required.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU isn't delivered to the end-customer in a manufacturing state

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-028	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

Any devices designed so they can return from the operating state to the manufacturing state shall wipe all privileged applications from the processor and all keys as part of the transition.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

Omitted 'once the devices are returned to THEA.'

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

"Reset to manufacturing state" is done via provisioning files, that also delete/reset all keys & credentials. Only authenticated user can perform this, i.e. via WebGUi.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-029	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The device shall allow a user to perform a reset to a manufacturing state without any authentication if the reset mechanism guarantees the physical presence of the user.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

"Reset to manufacturing state" is done via provisioning files, that also delete/reset all keys & credentials. Only authenticated user can perform this, i.e. via WebGUi.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-030	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The host processor shall perform integrity checks on boot to ensure that it is in a known good software state.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU uses secure boot with verification of signed code before its execution.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-031	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

If the host processor determines it is not in a known good software state on boot up, it shall not continue and will log an error when possible.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU uses secure boot with verification of signed code before its execution.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-032	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The host processor integrity checks shall require the use of a hardware-protected value.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU secure boot depends upon an eFuse stored in a masked ROM.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-033	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The host processor shall not allow any privileged application to request signing until the integrity checks have passed.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

If integrity check fails, the system does not boot up. So this is implicit.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-034	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
If the host processor fails the integrity checks it shall not grant access for any process to private keys.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

If integrity check fails, the system does not boot up. So this is implicit.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-035	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
If the host processor fails the integrity checks it shall not allow any privileged application to operate.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

If integrity check fails, the system does not boot up. So this is implicit.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-036	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The host processor integrity check shall carry out a check that stored root CA certificates have not been modified since they were last accessed.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU checks that installed root CA certificates haven't been modified during secure boot. It also checks the installed certificates during runtime in regular intervals.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
~~THEA-SEC-037~~	Con Ops		
Related Needs			
Parent Section	11.3.1		

Requirement Text
If the integrity check fails, the device shall reject all incoming signed messages that chain back to those root CA certificates as invalid.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

If the certificate check fails the RSU logs an error and disables the modified root CA certificates. This automatically leads to incoming signed messages being rejected if their signing certificate chains back to the disabled root CA certificate.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-038	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
Each privileged application shall map to a role as defined in the SMOC.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	X			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Privileged applications on the RSU run as a limited rights Linux user which allows them to sign / encrypt messages and verify signatures as well as decrypt messages.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SEC-039~~	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The discretionary access control mechanisms of the host processor operating system shall be configured to specify the set of roles that has execute permissions on each private key stored within the Hardware Security Module (HSM).

Requirement Text (Comments/Changes)

<mark>Deleted</mark> per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				X

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

RSU supports mandatory access control on executing HSM functions

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-040				
Related Needs				
Parent Section				

Requirement Text

The discretionary access control mechanisms of the host processor operating system shall be configured to: specify the set of roles that can modify (i.e., write, replace, and delete) the following programs and plaintext data stored within the host processor boundary.

Requirement Text (Comments/Changes)

Deleted. This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-SEC-041	Con Ops		
Related Needs			
Parent Section	11.3.2		

Requirement Text
The discretionary access control mechanisms of the host processor operating system shall be configured to specify the set of roles that can read data stored within the host processor boundary and which data can be read by those roles

Requirement Text (Comments/Changes)
<mark>Deleted</mark> per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				X

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

There are only certain processes that can read and decrypt the encrypted data, but other applications cannot (as part of mandatory control mechanism).

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-042	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The discretionary access control mechanisms of the host processor operating system shall be configured to specify the set of roles that can enter cryptographic keys.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				X

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

There are only certain processes that can read and decrypt the encrypted data, but other applications cannot (as part of mandatory control mechanism).

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-043	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The host processor OS shall allow processes that correspond to privileged applications to operate without explicit authentication by a user,

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU supports daemon processes.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-044	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The host processor OS shall allow processes that update private key material within the HSM to operate without explicit authentication by a user.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

An RSU process with sufficient permission is able to update private keys by generating a new key pair. However, it is not possible to read the private key.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-045	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The host processor OS shall allow processes to install new software or firmware if that software or firmware is signed by the original developer/manufacturer.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU will only install properly signed software.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-046	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The host processor OS shall not allow processes to write private key material to the HSM.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The HSM does not allow processes to write private keys.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-047	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The host processor OS shall require explicit authentication for processes that modify or inspect executing processes.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU supports process inspection privileges as a built-in Linux security feature.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-048	Con Ops			
Related Needs				
Parent Section	11.3.1			

Requirement Text
The OS shall not allow processes that read private cryptographic key material from the HSM.

Requirement Text (Comments/Changes)
 Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The HSM of the RSU does not allow reading any private key material.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-049	Con Ops			
Related Needs				
Parent Section	11.3.1			

Requirement Text
The host processor shall require that all software installed is signed

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU software update only accepts signed software.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-050	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The integrity of the verification key shall be protected by local hardware.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	X			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU software update only accepts signed software.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section					
THEA-SEC-051						
Related Needs						
Parent Section						

Requirement Text
The hardware protection shall be equivalent to FIPS 140-2 at the level appropriate to the device as a whole.

Requirement Text (Comments/Changes)
Deleted. This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-052	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
The host processor shall require that software be installed only by an authenticated user.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU software update can only be done from the browser UI after successful login.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SEC-053~~	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The update mechanism for the host processor shall include mechanisms to prevent updates from being rolled back. List of exception from comment

Requirement Text (Comments/Changes)

<mark>Deleted</mark> per SDD Walkthrough; part of RSU 4.1 Specification

Added 'List of exception from comment.'

Added Comment: "This requirement does not apply to a situation where an authorized user installs an older software revision. In other words, it shall still be possible to install a software release version prior to the currently installed software version."

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU software update allows installation of an older software version per exception list from requirement comment.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-054	Con Ops			
Related Needs				
Parent Section	11.3.1			

Requirement Text
If an update fails, the host processor shall notify the update mechanism of the failure.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

If the update fails the previous version is restored.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-055	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

If the update mechanism receives an update failure, it shall publish a notification of the failure and instruct the host processor to roll back.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

Removed 'request authorization to.'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			**X**	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

If the update fails the previous version is restored.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-056	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

All cryptographic software and firmware shall be developed and installed in a form that protects the software and firmware source and executable code from unauthorized disclosure and modification

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The cryptographic software and firmware is contained within the HSM where it is protected from unauthorized disclosure and modification.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments			

Requirement Group	Related Section
THEA-SEC-057	
Related Needs	
Parent Section	

Requirement Text

The HSM shall be certified by one of the approved certification entities or if they are not available the HSM shall be self-certified by the vendor at a minimum.

Requirement Text (Comments/Changes)

Deleted This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SEC-058~~	3.3 System Security: Table 3.1 Security Requirements
Related Needs	
Parent Section	

Requirement Text

A cryptographic mechanism using an approved integrity technique shall be applied to all cryptographic software and firmware components within the HSM.

Requirement Text (Comments/Changes)

<mark>Deleted</mark> This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-059	
Related Needs	
Parent Section	

Requirement Text

If the HSM itself calculates the Message Authentication Code when the software is installed using a secret key known only to the HSM, and uses this secret key to verify the software on boot or if the software provider has a unique shared key with each distinct device and uses this to authenticate the software, the message authentication code shall be us.

Requirement Text (Comments/Changes)

<mark>Deleted</mark> This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-060	
Related Needs	
Parent Section	

Requirement Text

A Message Authentication Code shall not be used to protect the software unless the Message Authentication Code key is unique to the HSM.

Requirement Text (Comments/Changes)

Deleted This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-061	
Related Needs	
Parent Section	

Requirement Text

Cryptographic software and firmware, cryptographic keys, and control and status information shall be under the control of an operating system that meets the functional requirements specified in the Protection Profiles listed in FIPS 140-2 Annex B and is capable of evaluation at the CC evaluation assurance level EAL2, or an equivalent trusted operating system.

Requirement Text (Comments/Changes)

Deleted This is part of the overall SCMS requirements. See THEA-SEC-003

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?				
2	Is the requirement unambiguous?				
3	Is the requirement logically consistent with Parent(s), and sibling requirements?				
4	Is the requirement feasible?				
5	Is the requirement verifiable?				
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes		No/Rank	
1	Is the design unambiguous?				
2	Is the design logically consistent with Parent(s), and sibling design components?				
3	Is the design feasible?				
4	Is the design verifiable?				
5	Is the requirement fulfilled by the design?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-062	Con Ops
Related Needs	
Parent Section	11.3.2

Requirement Text

To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to specify the set of roles that can execute stored cryptographic software and firmware.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Permission is required and enforced by Linux OS for the user to perform operations on the HSM.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-063	Con Ops
Related Needs	
Parent Section	11.3.2

Requirement Text

To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to specify the set of roles that can modify (i.e., write, replace, and delete) the following cryptographic module software or firmware components stored within the cryptographic boundary: cryptographic programs, cryptographic data.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Permission is required and enforced by Linux OS for the user to perform operations on the HSM.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-064	Con Ops
Related Needs	
Parent Section	11.3.2

Requirement Text

To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to specify the set of roles that can read the cryptographic software components stored within the cryptographic boundary: cryptographic data.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

Removed 'following'

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		**X**		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Permission is required and enforced by Linux OS for the user to perform operations on the HSM.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-065	Con Ops			
Related Needs				
Parent Section	11.3.2			

Requirement Text

To protect plaintext data, cryptographic software and firmware, cryptographic keys, and authentication data, the discretionary access control mechanisms of the operating system shall be configured to: specify the set of roles that can execute stored cryptographic software and firmware.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

Replaced capitalized 'S' with lower case 's' in the word 'specify.'

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?			
2	Is the requirement unambiguous?			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?			
4	Is the requirement feasible?			
5	Is the requirement verifiable?			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		**X**		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Permission is required and enforced by Linux OS for the user to perform operations on the HSM.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-066	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The operating system shall prevent all operators without the appropriate permissions (i.e., system admin) and executing processes from modifying executing cryptographic processes (i.e., loaded and executing cryptographic program images).

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Permission is required and enforced by Linux OS for the user to perform operations on the HSM.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-067	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

The operating system shall prevent operators without the appropriate permissions (i.e., system admin) and executing processes from reading cryptographic software stored within the cryptographic boundary.

Requirement Text (Comments/Changes)

 Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The HSM of the RSU does not allow read operations.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-068	
Related Needs	
Parent Section	

Requirement Text

The HSM shall maintain two roles, User which can execute software and firmware, write and delete cryptographic keys, and install signed software and firmware and Security Officer which can install unsigned software and firmware in the event that specialized new software and/or firmware is being tested and troubleshot.

Requirement Text (Comments/Changes)

Deleted' Allowing installation of unsigned software, even when protected by a special user account, is a backdoor mechanism with the potential to compromise security. In the interest of security this should not be a mandatory requirement.

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?		
2	Is the requirement unambiguous?		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		
4	Is the requirement feasible?		
5	Is the requirement verifiable?		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

E

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-069	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

Activities carried out by the user role shall not be explicitly authenticated, once the user role has successfully logged in.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Once the user is logged in, the user can exercise activities granted by his role without further authentication

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-070	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

In a networked architecture which includes the host processor, other processors, and the HSM, the host processor shall authenticate itself to the HSM with an authentication mechanism based in hardware with the same physical security as the HSM.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?		X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The HSM and RSU form a "connected architecture". So this requirement doesn't apply.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-071	Con Ops; OBU Component Specification
Related Needs	
Parent Section	11.3.1; 4.9.1

Requirement Text

OBUs shall support security requirements identified in SAE J2945/1 V5, such as the BSM transmission and reception security profile.

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

OBUs have to conform to J2935/1 standards

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SEC-072	Con Ops; OBU Component Specification			
Related Needs				
Parent Section	11.3.1; 4.7.2			
Requirement Text				
All unused media ports shall be sealed with a removable tamper evident or better.				
Requirement Text (Comments/Changes)				

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	RSU port seals			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

The OBU shall provide evidence to detect tampering (e.g. opening of the case) through tamper-evident seals on all unused input ports and screw holes. RSU is delivered with tamper-evident seals on ports and enclosure.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SEC-073	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

OBU devices shall support the ability to reset default user names and passwords by users with Administrative functions (ENG, MRG, and DYNACAdmin).

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

OBUs do not support access via SSH or HTTP as there is no WiFi module

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
~~THEA-SEC-074~~	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
RSU devices shall meet the WAVE Service Advertisement (WSA) security profile covered in IEEE 1609.3 (2016)

Requirement Text (Comments/Changes)
 <mark>Deleted</mark> per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU complies with IEEE 1609.3 (2016).

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-075	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
RSU devices shall meet the SpaT, MAP and Traveler Information Message (TIM) security profiles covered in the COC system Functional and Performance Specification Version 0.4.0.

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements
RSU will implement security profiles agreed upon between CV pilot sites.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-076	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text

RSU devices shall support security requirements identified in SAE J2945/1 V5, such as the BSM transmission and reception security profile

Requirement Text (Comments/Changes)

Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU does not transmit BSMs. The RSU supports the BSM security profile for reception.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SEC-077	Con Ops
Related Needs	
Parent Section	11.3.1

Requirement Text
RSU devices shall support the ability to reset default user names and passwords by users with Administrative functions (ENG, MRG, and DYNACAdmin).

Requirement Text (Comments/Changes)
Deleted per SDD Walkthrough; part of RSU 4.1 Specification

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU supports installation of a provisioning file which resets passwords. Only authenticated user can perform this, i.e. via WebGUi.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-INM-001	Con Ops			
Related Needs				
Parent Section	11.3.2			

Requirement Text
The system shall protect participants' personal information including name, address, vehicle make/model, driver's license number at a minimum.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank	
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Collected data			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 Of particular concern during this process is any information part of BSMs which can be used as a unique identifier for a particular vehicle. For purpose of the study the BSM of all vehicles will contain a unique ID in the "id" field of the BSM coreData data frame. This field will be randomized in the public copy by PII Removal.
Data Log Archive

Design (Comments/Changes): Researchers correlate randomized ID outside of system

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-INM-002	Con Ops			
Related Needs				
Parent Section	11.3.2			

Requirement Text

Personal information collected when registering participants shall be electronically stored separately from connected vehicle data (i.e., BSMs, alerts).

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Stored data			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 This component removes Personally Identifiable Information (PII) in a nightly batch job. Data of the last 24 hours is read from the Protected Storage and transferred over to the Public Storage.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-INM-003	Con Ops			
Related Needs				
Parent Section	11.3.2			

Requirement Text
Personal data access shall require a login with password protection.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Login process			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 The ProtectedStorage is a directory structure on an encrypted file system. Only authorized users will have read access to the protected storage.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-INM-004	Con Ops			
Related Needs				
Parent Section	11.3.2			

Requirement Text
Data shall be removed of PII before being released to the Research Data Exchange (RDE).

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	RDE data			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.2.3 This component removes Personally Identifiable Information (PII) in a nightly batch job. Data of the last 24 hours is read from the Protected Storage and transferred over to the Public Storage.

Design (Comments/Changes): Only data from the public storage area is uploaded to the RDE.

	Design Criteria	Yes		No/Rank
1	Is the design unambiguous?	X		
2	Is the design logically consistent with Parent(s), and sibling design components?	X		
3	Is the design feasible?	X		
4	Is the design verifiable?	X		
5	Is the requirement fulfilled by the design?	X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SGD-001	Con Ops; OBU Component Specification			
Related Needs				
Parent Section	8; 4.11			
Requirement Text Data collected by Vehicles (i.e., OBUs) shall be stored on a storage device connected locally to the vehicle.				
Requirement Text (Comments/Changes)				

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				OBU storage

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 15: Secure Digital (SD) card port/reader, encrypted, will be used to provide software and firmware updates.

6 Requirements Traceability Matrix

The units must include a minimum of 8 GB SD or micro SD card with a slot for storage of data.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-SGD-002	Con Ops		
Related Needs			
Parent Section	8		

Requirement Text

Messages (i.e., alerts, SPAT, PSMs, TIMs, SSMs) transmitted and received (i.e. BSMs, SRMs) by RSUs shall be stored on a storage device connected locally to the RSU

Requirement Text (Comments/Changes)

Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				RSU storage

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Table 2: RSU Functions

Data Collector: Application responsible for collection of log data (e.g. BSMs, TIMs, alerts, etc.) and forwarding of that data to the backend server (COTS)

Design (Comments/Changes)

Design Criteria		Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SGD-003	Con Ops			
Related Needs				
Parent Section	8			

Requirement Text
Data locally stored on OBUs (OBU logs) shall be transmitted wirelessly to RSUs through a secure communications connection.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	OBU to RSU data			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.7.3 data log transfer

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA-SGD-004	Con Ops			
Related Needs				
Parent Section	8			

Requirement Text
Data locally stored on RSUs (RSU logs) shall be transmitted to the Master Server through a secure communications connection.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Security measure			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1 Concert communicates with connected RSUs via its OCIT-C interface for health monitoring and detector data collection as well as traveler information. NextConnect implements interfaces for the "RSU Log Data Archive" and the "TSP Request Interface".

3.2.2.6.2 The Data Collector creates batches of data logs from Flash Storage and sends them to the master server via XFER

Design (Comments/Changes): XFER is encrypted websocket layer, OCIT is protocol layer

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section
THEA-SGD-005	Con Ops
Related Needs	
Parent Section	8

Requirement Text

The frequency at which data locally stored on OBUs is transmitted to the Master Server shall be determined by the ability of those devices to wirelessly transmit the data.

Requirement Text (Comments/Changes)

Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

OBUs will transfer data logs to nearby RSUs whenever possible.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SGD-006	Con Ops
Related Needs	
Parent Section	8

Requirement Text

The frequency at which data locally stored on RSUs is transmitted to the Master Server shall be determined based on the RSUs' storage capacity and communication bandwidth to master server.

Requirement Text (Comments/Changes)

Deleted per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?			X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

The RSU Data Collector transmits all collected data to the master server via encrypted websocket connection (XFER). Data is transferred as fast as possible.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-SGD-007	Con Ops		
Related Needs			
Parent Section	8		

Requirement Text
The Master Server shall securely archive the system generated data (BSMs, TIMS, etc.) to protect and provide redundancy

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Archive			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.1 …the virtual machines hosted on a rack mount VMWare server with RAID hard disk array.

Figure 4: VMWare HA in order to provide failover of virtual machines.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA-SGD-008	Con Ops			
Related Needs				
Parent Section	11.3.1			

Requirement Text
Access to the Master Server shall require a login and password.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Login procedure			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.1.1 …the virtual machines hosted on a rack mount VMWare server with RAID hard disk array.

Design (Comments/Changes): VMWare login and password security

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-SGD-009	Con Ops		
Related Needs			
Parent Section	11.3.1		

Requirement Text
Access to the Master Server shall be limited to authorized personnel as defined in the published version of the SMOC.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Hierarchy			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes): VMWare login, passwords assigned by stakeholders per SMOC

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section		
THEA-MNT-001	Con Ops		
Related Needs			
Parent Section	9.5.2		

Requirement Text
RSU communication failures shall be responded to within one business day in accordance with the City of Tampa and THEA procedures.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Service policy			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-MNT-002	Con Ops		
Related Needs			
Parent Section	9.5.2		

Requirement Text
RSU communication shall be restored in accordance with the City of Tampa and THEA procedures..

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Service policy			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-MNT-003	Con Ops		
Related Needs			
Parent Section	9.5.2		

Requirement Text
RSU hardware failures shall be addressed in accordance with the City of Tampa and THEA procedures.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Service policy			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-MNT-004	Con Ops		
Related Needs			
Parent Section	9.5.2		

Requirement Text
RSU application issues shall be responded in accordance with the City of Tampa and THEA procedures.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Service policy			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-MNT-005	Con Ops		
Related Needs			
Parent Section	9.5.2		
Requirement Text Planned RSU maintenance shall be scheduled in accordance with the City of Tampa and THEA procedures.			
Requirement Text (Comments/Changes)			

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Service policy			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-MNT-006	Con Ops			
Related Needs				
Parent Section	9.5.2			

Requirement Text
Planned RSU maintenance shall be performed during off peak hours of the Pilot's operation.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	Maintenance plan			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-MNT-007	Con Ops; OBU Component Specification			
Related Needs				
Parent Section	9.5.2; 4.12.1.5			

Requirement Text
OBU failures shall be logged at the time they are reported.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	OBU logs			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

The operating platform shall be able to reload and restart the failed process and shall make an entry in a log indicating that this action took place.

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-MNT-008	Con Ops			
Related Needs				
Parent Section	9.5.2			

Requirement Text
OBUs shall alert the participant, if possible, of a failure.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes			No/Rank
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				OBU failure alert

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

There is a heartbeat in HMI that will let the participant know if there is something wrong with the system

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section		
THEA-MNT-009	Con Ops; Participant Training and Stakeholder Education Plan		
Related Needs			
Parent Section	9.5.2; 3.7		

Requirement Text
In order to diagnose OBU failures, an appointment to bring the vehicle into the support facility shall be made at the participant's convenience, but no more than seven business days out.

Requirement Text (Comments/Changes)

	Requirement Criteria		Yes	No/Rank
1	Is the requirement well-formed?		X	
2	Is the requirement unambiguous?		X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?		X	
4	Is the requirement feasible?		X	
5	Is the requirement verifiable?		X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Appointment

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section		
THEA-MNT-010	Con Ops		
Related Needs			
Parent Section	9.5.2		

Requirement Text

When a participant brings in their vehicle because of an OBU failure, the unit shall be exchanged in order to minimize the time the participant is in the facility or if feasible, the device is replaced at the participant's choice of location.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Replace OBU

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section		
THEA-MNT-011	Con Ops		
Related Needs			
Parent Section	9.5.2		

Requirement Text
When a PID issue is identified, the participant shall follow the instructions for attempting to address the issue before contacting support.

Requirement Text (Comments/Changes)
Deleted, this is a participant responsibility

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				X

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?		
2	Is the design logically consistent with Parent(s), and sibling design components?		
3	Is the design feasible?		
4	Is the design verifiable?		
5	Is the requirement fulfilled by the design?		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section		
THEA-MNT-012	Con Ops		
Related Needs			
Parent Section	9.5.2		

Requirement Text
Support staff shall be trained to troubleshoot and diagnose RSU, OBU, and PID issues.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Troubleshooting

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA-MNT-013	Con Ops			
Related Needs				
Parent Section	9.5.2			

Requirement Text
A set of support, diagnostic and troubleshooting procedures shall be developed to guide the support staff.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				Diag. procedure

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA-MNT-014	Con Ops			
Related Needs				
Parent Section	9.5.2			

Requirement Text
The CoT shall maintain the RSUs installed in signal cabinets.

Requirement Text (Comments/Changes)
<mark>Deleted</mark> per the SDD Walkthrough

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?				X

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

Organizational Requirement

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section
THEA-SRL-001	Con Ops; OBU Component Specification
Related Needs	
Parent Section	5.3, 1.4, 4.9, & 5

Requirement Text
RSUs, and OBUs shall meet the latest published specification as of September 2016 at a minimum.

Requirement Text (Comments/Changes)
Deleted duplicate of THEA-UC2-007, THEA-UC2-008, and THEA-UC3-002

	Requirement Criteria	Yes	No/Rank
1	Is the requirement well-formed?	X	
2	Is the requirement unambiguous?	X	
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X	
4	Is the requirement feasible?	X	
5	Is the requirement verifiable?	X	

		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	X			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

"OBUs shall conform to latest specs at the time of document release
The RSU complies with USDOT RSU spec v4.1"

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved	Modify	Implement Later	Drop X
Comments				

Requirement Group	Related Section			
THEA-SRL-002	Con Ops			
Related Needs				
Parent Section	8			

Requirement Text

RSUs shall not delete or rollover the data until it has confirmed the data has been successfully transmitted to the master Server and properly stored unless the local storage device has reached 90% capacity.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes	No/Rank		
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	RSU data logs			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.2 The Data Collector creates batches of data logs from Flash Storage and sends them to the master server via XFER.

6 Requirements Traceability Matrix

OBUs transfer data logs to nearby RSUs via the Data Log Transfer protocol. Data may only be deleted / overwritten if it has been transferred successfully or if free space on the storage medium runs out. The RSU Data Collector transmits all collected data to the master server via encrypted websocket connection (XFER). Data may only be deleted / overwritten if it has been transferred successfully or if free space on the storage medium runs out.

ICD 23015, 23030"

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

Requirement Group	Related Section			
THEA-SRL-003	Con Ops			
Related Needs				
Parent Section	8			

Requirement Text
OBUs shall not delete or rollover the data until it has confirmed the data has been successfully transmitted to the master Server and properly stored unless the local storage device has reached 90% capacity.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank	
1	Is the requirement well-formed?	X			
2	Is the requirement unambiguous?	X			
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X			
4	Is the requirement feasible?	X			
5	Is the requirement verifiable?	X			
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	OBU data logs			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.2.6.1 Due to the fact that OBUs aren't always in radio range of an RSU the log data is stored on the OBU until it can be sent.

6 Requirements Traceability Matrix

OBUs transfer data logs to nearby RSUs via the Data Log Transfer protocol. Data may only be deleted / overwritten if it has been transferred successfully or if free space on the storage medium runs out. The RSU Data Collector transmits all collected data to the master server via encrypted websocket connection (XFER). Data may only be deleted / overwritten if it has been transferred successfully or if free space on the storage medium runs out.

ICD 2301, 23030

Design (Comments/Changes)

	Design Criteria	Yes	No/Rank
1	Is the design unambiguous?	X	
2	Is the design logically consistent with Parent(s), and sibling design components?	X	
3	Is the design feasible?	X	
4	Is the design verifiable?	X	
5	Is the requirement fulfilled by the design?	X	

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify		Implement Later	Drop
Comments					

Requirement Group	Related Section			
THEA- PAR-001	Con Ops			
Related Needs				
Parent Section	5.3			

Requirement Text
The RSUs shall obtain proper licensing from FDOT and the FCC to broadcast using DSRC.

Requirement Text (Comments/Changes)

	Requirement Criteria	Yes		No/Rank
1	Is the requirement well-formed?	X		
2	Is the requirement unambiguous?	X		
3	Is the requirement logically consistent with Parent(s), and sibling requirements?	X		
4	Is the requirement feasible?	X		
5	Is the requirement verifiable?	X		
		Insp.	Anal.	Test	Demo.
6	If feasible and verifiable, by which method?	FCC license site			

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Requirement Text' section.

Related Design Elements

3.2.1 It is a commercial off-the-shelf (COTS) product which is compliant to the USDOT RSU Specification and fulfills the specific requirements of the pilot.

6 Requirements Traceability Matrix

Organizational Requirement

Design (Comments/Changes): RSU spec requires FCC certification. Users must register RSUs.

	Design Criteria	Yes		No/Rank
1	Is the design unambiguous?	X		
2	Is the design logically consistent with Parent(s), and sibling design components?	X		
3	Is the design feasible?	X		
4	Is the design verifiable?	X		
5	Is the requirement fulfilled by the design?	X		

Note: An answer of no requires a comment or change in the Comments/Change field of the 'Design Text' section.

Final Resolution	Approved X	Modify	Implement Later	Drop
Comments				

U.S. Department of Transportation