Transit Bus Stop Pedestrian Warning Application

Acceptance Test Plan

www.its.dot.gov/index.htm
Final Report — October 14, 2016
FHWA-JPO-17-484

U.S. Department of Transportation

Produced by Battelle Memorial Institute
U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology
Federal Highway Administration
Federal Transit Administration

Notice

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-JPO-17-484		

4. Title and Subtitle	5. Report Date
Transit Bus Stop Pedestrian Warning Application: Acceptance Test Plan	October 14, 2016
	6. Performing Organization Code Battelle

7. Author(s)	8. Performing Organization Report No.
David Neumeister, Matthew Burns, Kristina Guspan, Greg Baumgardner, William Gibbs, Anthony Polinori, Ahmed Sedda	CON00024197; #107

9. Performing Organization Name And Address	10. Work Unit No. (TRAIS)
Battelle 505 King Avenue Columbus, Ohio 43201	11. Contract or Grant No. DTFH61-12-D-00040

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
United States Department of Transportation Federal Highway Administration 1200 New Jersey Avenue, SE Washington, DC 20590	Draft
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This document is the Acceptance Test Plan for the Transit Bus Stop Pedestrian Warning (TSPW) application. This report describes the test and demonstration plan to verify that the application meets its functional and performance requirements.

17. Key Words	18. Distribution statement
Transit; Pedestrian Warning; Connected Vehicle; V2I	Unlimited.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	227	

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

Table of Contents

List of Tables

List of Figures

Introduction

The Transit Bus Stop Pedestrian Warning (TSPW) system is a Connected Vehicle (CV) and Dynamic Mobility application sponsored by the United States Department of Transportation (U.S. DOT). The intent of the TSPW system is to utilize V2I communications to improve the situational awareness and ultimately the safety of pedestrians at transit stops. The TSPW system consists of several components and subsystems involving both components within a transit vehicle as well as roadside equipment at transit stops.

The TSPW system will be developed as an application to be combined with and leveraging the components and technologies developed under Enhanced Transit Safety Retrofit Package (E-TRP) system[1]. It will include additional capabilities to enhance and improve transit vehicle and pedestrian safety in an operational context. The combined E-TRP System and TSPW application (herein known as the TSPW system) will consist of two physically separate systems: an on-board, transit vehicle-based system and an infrastructure-based system at each of the selected transit stops. Both systems will share some common hardware and software subsystems, as well as have a unique subsystem to themselves.

The TSPW system will make use of the E-TRP In-Vehicle Subsystem platform, while deploying TSPW-specific subsystems on the roadside.

Document Identification

This document describes the verification test cases comprising the Acceptance Test Plan for the TSPW application, corresponding to Task 6 of the project. It details the plan to verify and demonstrate that the TSPW system has the functionality and performance capabilities necessary to deliver the features described in the TSPW Concept of Operations (ConOps) document [1] and that the system meets the functional and performance requirements described in the TSPW Requirements Document [2]. The design of the TSPW is described in the TSPW Architecture and Design document [3].

[1] The E-TRP project builds upon the prior development of a suite of transit-focused applications that allows transit vehicles to communicate using V2V and V2I technologies named TRP. The ultimate goal of TRP was to enhance both transit vehicle and pedestrian safety. E-TRP further enhances and refines the capabilities of the existing applications, customizes them for the urban transit operating environment, and deploys them in real world conditions. Enhancements include an improved pedestrian detection system, improved transit vehicle position accuracy, an improved transit vehicle operator interface, the integration of newer DSRC radios and on-board storage capabilities, and an enhanced design supportive of remote system management. For more details, reference the Enhanced Transit Safety Retrofit Package Acceptance Test Plan [4].

Participation

All functionality to be tested, as described within this document, was developed by Battelle. Verification tests in this document will be conducted by Battelle and demonstrated for and/or summarized to U.S. DOT. Phase 3 and Phase 4 verification test cases will be conducted using equipped Greater Cleveland Regional Transit Authority (GCRTA) transit buses and equipped infrastructure at bus stops. Separate from the verification tests comprising this Acceptance Test Plan, will be an independent evaluation of the TSPW system by the Volpe Center via data collected during GCRTA revenue service. Battelle and GCRTA will support the independent evaluation by providing input and review during evaluation planning and execution, as well as data to be used in the evaluation. GCRTA will additionally provide access to staff and drivers for surveys and interviews.

Document Organization

This document consists of the following chapters and content.

Chapter 2. **Referenced Documents** identifies the external documentation, specifications, and standards referenced within this document.

Chapter 3. **TSPW Functional Architecture and Design Overview** describes the TSPW sub-systems and interfaces that are to be established as part of the system. It describes the flow data and the information processing used by the system and its applications.

Chapter 4. **TSPW Acceptance Test Plan** describes the test phases and test cases planned for verification and demonstration of the functionality and performance of the TSPW system.

Appendix A. **TSPW Requirements Traceability Matrix** identifies the test cases wherein each requirement is verified.

Appendix B. **List of Acronyms and Abbreviations** defines acronyms and abbreviations used in the document and project.

Audience for the Document

The intended audiences for this document are developers and those responsible for deploying technology and systems for transit safety and connected vehicle systems.

Referenced Documents

Referenced Documentation

1. Transit Bus Stop Pedestrian Warning Application Concept of Operations, Final Battelle Report Document Number CON00024197 #86 Rev. B, February 4, 2015, FHWA-JPO-16-332.
2. Transit Bus Stop Pedestrian Warning Application Requirements Document, Final Battelle Report Document Number CON00024197 #88 Rev. C, June 13, 2016, FHWA-JPO-16-360.
3. Transit Bus Stop Pedestrian Warning Application Architecture and Design, Final Battelle Report Document Number CON00024197 #89 Rev. A, April 15, 2016, FHWA-JPO-16-401.
4. Enhanced Transit Safety Retrofit Package Acceptance Test Plan Document, Final Battelle Report Document Number 100064453-0024C, October 3, 2016.

Standards

Institute of Electrical and Electronics Engineers (IEEE)

IEEE 1609.2	Wireless Access in Vehicular Environments (WAVE) – Security Services for Applications and Management Messages
IEEE 802.11p	IEEE Standard for Information technology – Local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 6: Wireless Access in Vehicular Environments

Society of Automotive Engineers (SAE)

SAE J1113	Electromagnetic Compatibility Measurement Procedures and Limits for Components of Vehicles, Boats (up to 15 m), and Machines (Except Aircraft) (16.6 Hz to 18 GHz)
SAE J1211	Handbook for Robustness Validation of Automotive Electrical/Electronic Modules
SAE J1708	Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications
SAE J1850	Class B Data Communications Network Interface
SAE J1939	Serial Control and Communications Heavy Duty Vehicle Network, SAE International
SAE J2735	Dedicated Short-Range Communications (DSRC) Message Set Dictionary, SAE International

International Organization for Standardization

ISO 9141-2	Road vehicles -- Diagnostic systems -- Part 2: CARB requirements for interchange of digital information
ISO 11898	Road vehicles -- Controller area network (CAN)

ISO 14230-4	Road vehicles -- Diagnostic systems -- Keyword Protocol 2000 -- Part 4: Requirements for emission-related systems
ISO 15765-4	Road vehicles -- Diagnostic communication over Controller Area Network (DoCAN) -- Part 4: Requirements for emissions-related systems

Other

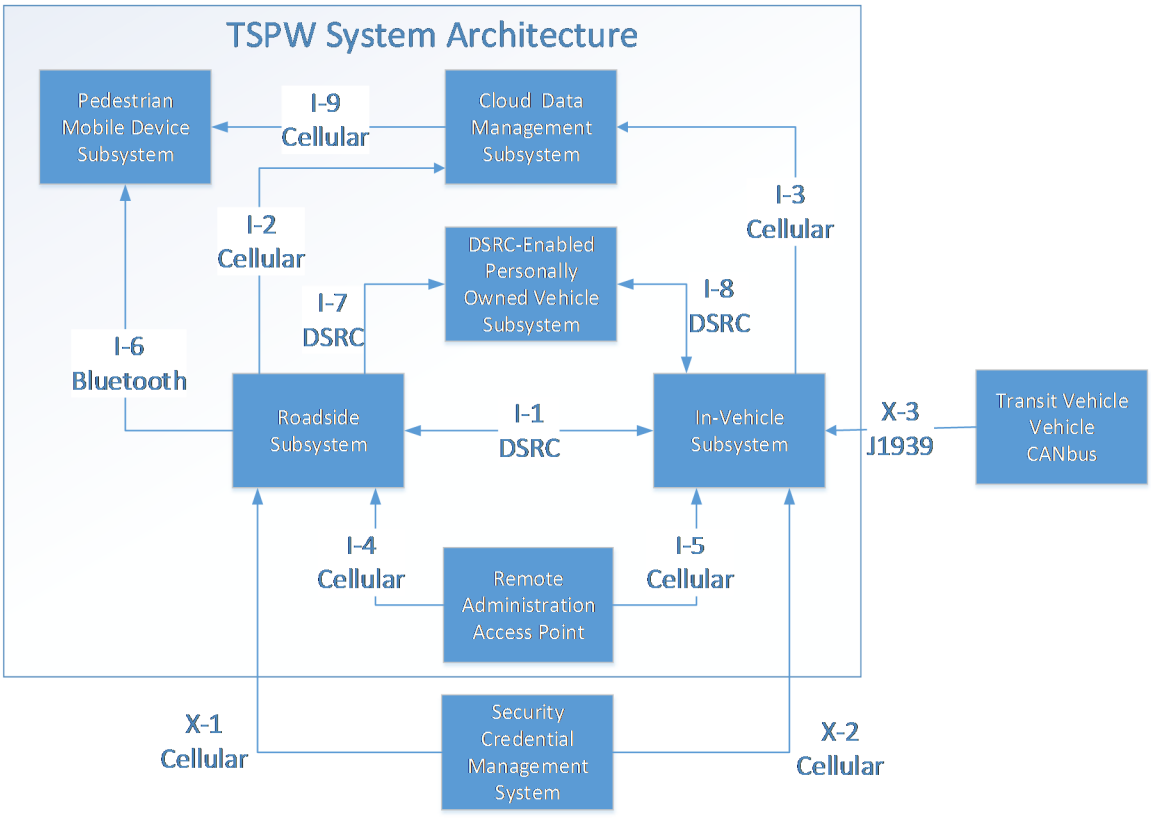
GMW3089	General Motors Local Area Network (GMLAN) Single Wire Controller Area Network (SWCAN) Physical and Data Link Layers Specification
ANSI/IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)

TSPW Functional Architecture and Design Overview

This chapter describes the functional architecture and design overview for the Transit Bus Stop Pedestrian Warning as it is implemented in this project. It provides the background description of TSPW that sets the stage for the verification test cases described in subsequent chapters.

Architecture Overview

A high level architectural view of the TSPW System is shown in Figure 1. There are several hardware and components that coordinate to fulfill the functional and performance requirements of the TSPW system.



Source: Battelle

Figure 1. TSPW Architecture

The TSPW system is made up of six main subsystems which work together to fulfill the requirements.

The **TSPW In-Vehicle Subsystem (IVS)** includes the hardware and software components installed within the transit vehicle. Included within the IVS is a Common Computing Platform (CCP), the heart of the IVS. The CCP is the central processor providing the cellular, Global Navigation Satellite System (GNSS) receiver and Dedicated Short-Range Communications (DSRC) radios serving as the low-latency wireless communications method between the IVS and Roadside Equipment. The IVS also hosts the in-vehicle portion of the software applications. The IVS hosts two Human Interface Subsystems (HIS). The Transit Vehicle Operator HIS is used by both the E-TRP and TSPW projects to alert the Transit Vehicle Operator. The TSPW project adds an additional HIS for pedestrians crossing in front of the transit vehicle. The Transit Vehicle Pedestrian HIS is external to the vehicle and will provide both a visual and aural alert to pedestrians at risk of being struck by either the transit vehicle or an oncoming DSRC equipped Personally-Owned Vehicle (POV).

The **TSPW Roadside Subsystem (RSE)** also contains a CCP hosting the DSRC and Cellular communication links, and the interface to the Pedestrian Detection System at the locations where the TSPW application is implemented. The **Pedestrian Detection System (PDS)** contains transit stop-based sensors to detect the presence of pedestrians inside a specified detection zone. The PDS contains its own processing and software capability, which would then communicate to the RSE when a pedestrian is detected. Unique to the TSPW project, the RSE also interfaces with a Roadside Pedestrian HIS which alerts pedestrians at a transit stop if they are at risk of being struck by a transit vehicle.

The **Cloud Data Management Subsystem (CDMS)** serves as the remote portal for the IVS and RSE collected data. It also serves as the monitoring point for all deployed fleet system health status (near real-time operational state dashboard).

The **Remote Administration Access Point (RAAP)** is an internet-connected access point into the system that will allow system administrators to perform support and maintenance tasks on the deployed equipment.

The **Pedestrian Mobile Device Subsystem (PMDS**) uses an application which allows communications with the Roadside Subsystem to alert pedestrians of locations where they are at risk of being struck by a transit vehicle.

The **DSRC-Enabled Personally Owned Vehicle Subsystem (POVS)** communicates with the Roadside Subsystem. The on-board Personally Owned Vehicle HIS alerts the driver of pedestrians near a transit vehicle at a transit stop that are at risk of being struck by the POV.

Finally, rather than deploying the U.S. DOT-sponsored Security Credential Management System (SCMS) Proof-of-Concept (PoC) to supply credentialing materials for DSRC communications (due to implementation timing differences between the two projects), the TSPW system will utilize long-term, pre-loaded certificates to sign DSRC messages used to enable the TSPW safety applications.

Figure 1 also summarizes the logical connectivity between internal and external TSPW subsystems. The software architecture and design described within this document will refer to these logical connections using the enumerators in Figure 1. Table 1 below lists out each of the logical interfaces connecting the diagramed subsystems as well as the connections made to external systems.

Table 1. TSPW System Logical Interfaces with Identifiers

Interface Identifier	Interface Type	Exchanged Information
I-1	DSRC	The Roadside Subsystem will send information to the In-Vehicle Subsystem about the location of pedestrian detection zones with respect to the roadway lanes where the transit vehicle will travel along with the actual status of pedestrian occupation of the pedestrian detection zones. This information will be sent as MAP and Personal Safety Message (PSM) messages via DSRC. The In-Vehicle Subsystem will announce its approach and position by broadcasting Basic Safety Messages (BSM).
I-2, I-3	Cellular	The Roadside and In-Vehicle Subsystems will upload information to the Cloud Data Management Subsystem regarding system health and performance.
I-4, I-5	Cellular	The TSPW System will have a remote administration capability which will be enabled by the Remote Administration Access Point. This remote administration will be performed over the cellular connection and allow both the Roadside and In-Vehicle Subsystems to be updated and configured remotely.
I-6	Bluetooth	The TSPW Roadside Subsystem will communicate with the Pedestrian Mobile Device Subsystem via a wireless Bluetooth communication protocol. This connection will provide the mobile devices information regarding approaching transit vehicles.
I-7	DSRC	The Roadside Subsystem will broadcast messages over DSRC to alert approaching Personally Owner Vehicles enabled with a DSRC radio that there are vulnerable pedestrians in the roadway.
I-8	DSRC	The TSPW Application on both the transit vehicle as well as the POV will use the BSM broadcast from the nearby vehicles to determine the appropriate notification messages to show the driver.
I-9	Cellular	The Cloud Data Management Subsystem will make available the appropriate pedestrian detection zones for each of the instrumented transit stops for use by the Pedestrian Mobile Device Subsystem.
X-1, X-2	Cellular	Both the In-Vehicle and Roadside Subsystems will receive security certificates from the Security Credential Management System. At this point in the design, this service is still being designed and developed. Long-term credentials will be provisioned to the devices via a secure cellular connection.
X-3	J1939 CAN	The TSPW applications require information to be acquired from the transit vehicle. Data such as vehicle speed, gear position, and brake status will be read from the vehicle CAN bus.

Source: Battelle

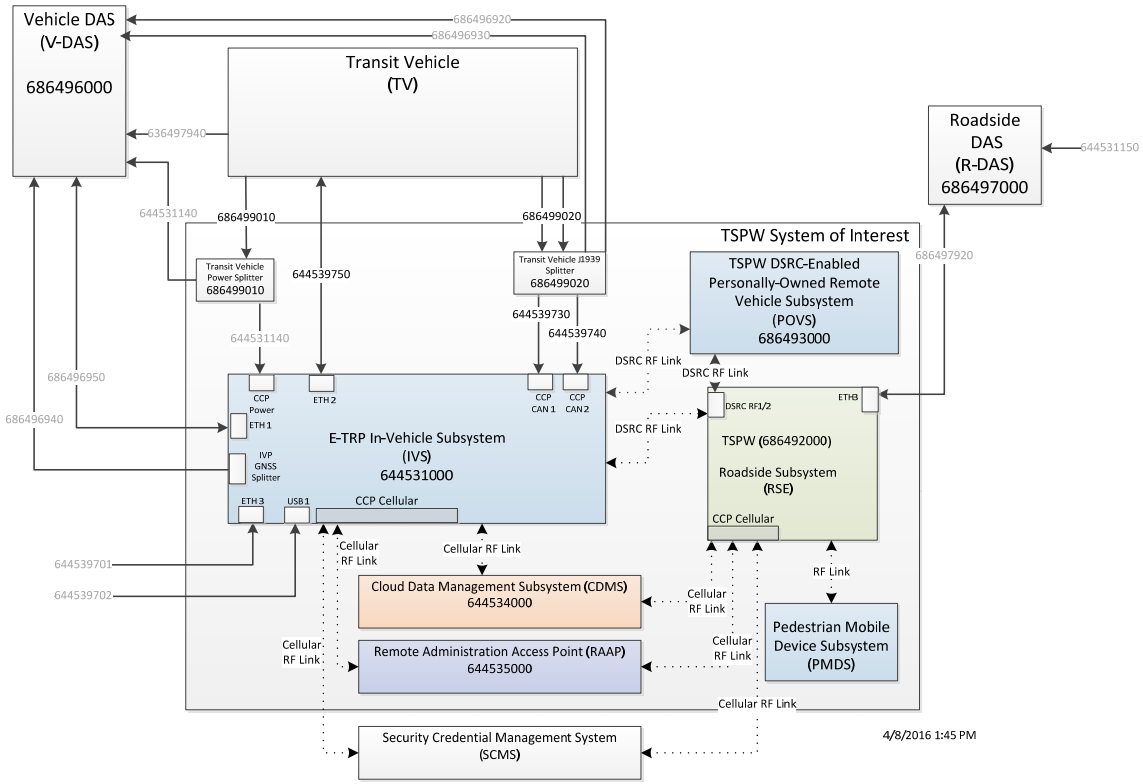
Design Overview

After performing functional analysis on the TSPW Architecture shown above in Figure 1, functional decomposition of the TSPW was performed to identify appropriate hardware and software boundaries.

The TSPW application will be fulfilled by the RSE, IVS, and the CDMS. The PMDS and the POVS will provide additional human interface platforms to warn pedestrians and non-transit vehicle operators of at-risk pedestrians. The RSE will be instrumental in providing information at the transit stop and the state of pedestrians in the enabled safety zones. The IVS is the link to the transit driver, warning them of pedestrians in the enabled safety zones. The CDMS provides a management and data repository function so the transit fleet may be monitored and managed. The PMDS provides a personalized warning on a user's mobile phone, and the POVS provides warnings to the driver of the DSRC-equipped personal vehicle behind the transit vehicle. The RAAP serves as a secure connection point into the TSPW system so that maintenance activities may be conducted. Additional details beyond the summaries provided here may be found in the TSPW Architecture and Design document [3].

Hardware Overview

A hardware block diagram for the TSPW and supporting equipment is shown in Figure 2. This figure identifies the main components and the associated interconnections that are required.



Source: Battelle

Figure 2. Hardware Block Diagram

A more in depth description of each subsystem and physical connection is described in sections 5.3.1 through 5.3.8 of the TSPW Architecture and Design document [3].

Software Overview

The software for the TSPW system will be developed for the IVS, RSE, PMDS, POVS and CDMS. Three of the subsystems, the RSE, IVS and POVS subsystems will be built on a common hardware platform. Because of this common hardware, much of the software platform can also be the same across these three subsystems. The CDMS will take advantage of modern advances and efficiencies in service hosting and data storage by leveraging a cloud provider. The PMDS will be constructed on the current mobile operating system for both the Android and Apple smartphones.

At the heart of the RSE, IVS and POVS will be a Common Computing Platform. This platform will run on a Linux operating system which will provide access to the underlying hardware components. The Roadside Subsystem software will be compliant with V2I Hub; however, this is limited to MAP messaging because, unlike for E-TRP, the TSPW Roadside Subsystem is not integrated with traffic signaling. The In-Vehicle Subsystem and Personally Owned Vehicle Subsystem utilize a platform similar to V2I Hub called the Transportation Message Exchange (TMX), which was originally developed as part of the Integrated V2I Prototype (IVP) project and was adapted to accommodate vehicle-based interfaces. TMX and V2I Hub will allow for rapid development of new features and applications while at the same time offering a convenient mechanism for re-using existing capabilities from not only the E-TRP project, but other connected vehicle projects concurrently being developed by Battelle.

The CDMS will be developed on a different computational platform and therefore be based on a different software stack than that of the RSE, IVS and POVS. The CDMS will be developed using Microsoft Azure Cloud Computing and Services. This platform follows the model where a customer pays for just the amount of computing and data storage services actually used. This is an advantageous model for new projects under development as well as fielded systems expecting to start small and potentially grow over time. Costs can be kept to a minimum and only increased when it is determined that the current capacity is insufficient.

The PMDS will be constructed on a mobile device operating system. In order to provide sufficient coverage of travelers, both major smartphone platforms will be targeted. A TSPW mobile application will be developed and made available to owners of both Android and Apple smartphones.

Additional details for the design of each of these five software systems can be found in sections 5.3.1 through 5.3.6 of the TSPW Architecture and Design document [3].

TSPW Input / Output Summary

The data inputs to the TSPW system are varied and each support one or more of the three primary notification areas of the system: Transit Driver, Roadside Pedestrian and Remote Personally Owned Vehicle Drivers. There are three main types of inputs to the system:

1. **Data transmitted via DSRC radio.** This includes messages, such as BSM and MAP Messages. These messages provide information about the infrastructure or other vehicles to the TSPW system.

2. **Data from the Transit Vehicle.** This information is gathered from the CAN bus to access data such as the vehicle speed and gear position. Needed data is accessed from the vehicle using the J1939 protocol.

3. **Global Navigation Satellite System position and time.** The need to know where the Transit and Personally Operated Vehicles are in relation to the transit stop structures is necessary to the TSPW application's ability to accurately notify the driver and pedestrian of any alert conditions. A detailed list of these inputs is available in Table 2 below.

While the TSPW system conceptually has the single output of a notification of a vulnerable pedestrian, there are four different platforms where this notification can occur. Each of these four platforms will have a specific variation of this output. The TSPW application will output Inform and Warn alerts based on pedestrian and vehicle circumstances. Additionally, each function generates data logs which will be persisted in the Cloud Data Management System. Data is not a tangible output that a user of the system will even be aware of, but it is very useful to administrators and evaluators.

Table 2. TSPW Inputs

Inputs	Source	Standard
GNSS Antenna Offset	Config File (Database)	N/A
Transit Vehicle's vehicle length	Config File (Database)	N/A
Vehicle Unique ID (for BSM) (stays with the vehicle, not with the device)	Config File (Database)	N/A
Transit Vehicle Route	Config File (Database)	N/A
Transit Vehicle's current GNSS heading	GNSS	N/A
Transit Vehicle's current GNSS position	GNSS	N/A
Transit Vehicle's current GNSS time	GNSS	N/A
Transit Stop Roadway Geometry MAP	Transit Stop RSE	J2735
Locations of Vulnerable Road Users (Personal Safety Message)	Transit Stop RSE	J2735
Remote Vehicle's Position	Other Vehicle BSM	J2735
Remote Vehicle's Heading	Other Vehicle BSM	J2735
Remote Vehicle's Length	Other Vehicle BSM	J2735
Transit Vehicle's speed	Vehicle CAN Bus	J1939
Transit Vehicle's gear position (PRNDL)	Vehicle CAN Bus	J1939
Transit Vehicle's brake status	Vehicle CAN Bus	J1939

Source: Battelle

TSPW Acceptance Test Plan

The objective of the verification testing comprising the TSPW Acceptance Test Plan is to verify and demonstrate that the TSPW system possesses the functionality and performance necessary to deliver the functions and benefits proposed for the system described in the TSPW ConOps [1]. Verification testing will also verify that the TSPW system meets the requirements documented in the Requirements Document [2].

Verification Test Cases

Software and hardware testing is performed incrementally during Agile Scrum Sprints, which precede formal verification testing. Verification Testing will be performed incrementally in four phases:

- **Phase 1. Laboratory-Based Verification Testing** will be performed in the laboratory setting at Battelle (Columbus, Ohio) using simulated input data as needed. In addition to confirming basic functionality of the TSPW software application via test case #1.1.1, the unique hardware and functional requirements of the TSPW system (including security, water resistance, system modes, and system mode transitions) are confirmed in test cases #1.2.1-1.2.5. All four-digit test cases evaluate requirements shared by both E-TRP and TSPW and are presented for completeness, but are anticipated to be verified during E-TRP Acceptance Testing.
- **Phase 2. Garage / Controlled Parking Lot Verification Testing** will primarily focus on TSPW software application functionality performance via test cases #2.1.1-2.1.16. These test cases incorporate all of the scenarios defined in the TSPW ConOps document [1]. Each of these, except 2.1.16 (which exercises “cloaked mode”), will be performed in the garage setting on Battelle’s Columbus Ohio campus using simulated scripts. Test case 2.1.16 together with a select set of key scenarios/test cases will additionally be performed in controlled parking lot verification testing using an equipped or simulated bus stop in Columbus, Ohio. All four-digit test cases evaluate requirements shared by both E-TRP and TSPW and are presented for completeness, but are anticipated to be verified during E-TRP Acceptance Testing.

- **Phase 3. Live Environment Verification Testing** will be performed for E-TRP functionality in Cleveland, Ohio using equipped GCRTA transit vehicles, equipped infrastructure at bus stops, and supporting communications and management, such as the Cloud Data Management System and cellular communications, prior to the independent evaluation baseline period and revenue service period. No live environment testing is planned for the TSPW system; however, near the conclusion of live environment verification testing, a series of demonstrations to U.S. DOT will be conducted to illustrate both E-TRP and TSPW application functionality.
- **Phase 4. Post-fielding** is actually an analysis of the inherent availability and reliability (mean time to repair) of the deployed TSPW system during the revenue service period using remotely collected log files. Test case 4.1.1.0 of the E-TRP Acceptance Test Plan Document [4] is reproduced in Phase 4 of the TSPW Acceptance Test Plan as it addresses requirements 150 and 151, which are shared by both the E-TRP and TSPW systems. This test case is anticipated to be verified during E-TRP Acceptance Testing.

TSPW Verification Test Case Summary

Table 3 provides a summary list of the TSPW Verification Test Cases. The table identifies the Phases in which each test case will be performed, as well as the means by which the requirements are verified (I = inspect, T = test, D = demonstrate, and A = analyze). The following section provides a detailed description of each test case. **Note:** Three-digit test case numbering denotes test cases that exclusively verify TSPW requirements, while four-digit test case numbering denotes test cases that verify shared requirements for both E-TRP and TSPW. Four-digit number test cases are the same as those presented in the E-TRP Acceptance Test Plan [4]. Because not all test cases created to assess E-TRP requirements are included in the TSPW Acceptance Test Plan, the four-digit test cases are not numbered contiguously. As mentioned above, the four-digit test cases presented here are exactly the same as their representation in the E-TRP Acceptance Test Plan [4] with the exceptions that in Test Cases 1.9.2.6 and 1.9.2.7 some test configuration setup and procedures needed copied in as they referenced Test Cases not included in the TSPW Acceptance Test Plan. It should be noted that the four-digit test cases include requirements that are applicable only to E-TRP. This should not be of concern given it is anticipated that all four-digit test cases will be evaluated as part of E-TRP Acceptance Testing.

Table 3. Summary of TSPW Verification Test Cases and Associated Phase

Test Case No.	Test Case Title	Phase 1. Laboratory-Based Verification	Phase 2. Garage / Controlled Parking Lot Verification	Phase 3. Live Environment Verification	Phase 4. Post-Fielding
1.0	**Phase I (Laboratory-Based Verification)**				
1.1.1	TSPW Functionality: User Interface, Configurability, Logging	A,D,T,I			
1.2.1	Environmental – Water Resistance	I			

Table 3. Summary of TSPW Verification Test Cases and Associated Phase (Continued)

Test Case No.	Test Case Title	Phase 1. Laboratory-Based Verification	Phase 2. Garage / Controlled Parking Lot Verification	Phase 3. Live Environment Verification	Phase 4. Post-Fielding
1.2.2	System Maintenance Interfaces – Security	T			
1.2.3	TSPW Roadside Non-Operational Mode – Off	D			
1.2.4	TSPW Roadside Mode Transition: Degraded to Operational	D			
1.2.5	TSPW Roadside Mode Transition: Off to Operational	D			
1.4.1.0	Interface Testing – Power	T,D			
1.5.1.0	Supportability – Safety	I, A			
1.6.1.0	Interface Testing – Physical, Physical Characteristics, and Supportability – Maintainability and Security	T,I,D			
1.7.1.0	Interface Testing – Communications	T			
1.7.2.0	Performance Testing – Electromagnetic Radiation (SAE)	T			
1.7.3.0	Performance Testing – Electromagnetic Radiation (FCC)	T			
1.7.4.0	Performance Testing – Shock and Vibration	T			
1.7.5.0	Performance Testing – Temperature	T			
1.8.1.0	Software Maintainability	D			
1.8.2.0	Data Maintainability	D			
1.8.3.0	System Reset	D			
1.9.1.1	Non-Operational Mode – Maintenance	D			
1.9.1.2	Off Mode	D			
1.9.1.3	Maintenance-Standby Transition	D			
1.9.1.4	Mode Transition: Standby to Off	D			
1.9.2.2	E-PCW Roadside Mode Transition: Degraded to Operational	D			
1.9.2.4	Time Synchronization on mode transition	D			

Table 3. Summary of TSPW Verification Test Cases and Associated Phase (Continued)

Test Case No.	Test Case Title	Phase 1. Laboratory-Based Verification	Phase 2. Garage / Controlled Parking Lot Verification	Phase 3. Live Environment Verification	Phase 4. Post-Fielding
1.9.2.5	Time Synchronization – Periodicity	D			
1.9.2.6	Time	T			
1.9.2.7	Keep Configuration in all modes	D			
2.0	**Phase II (Garage / Controlled Parking Lot Verification)**				
2.1.1	Transit Vehicle Traverses Bus Stop with No Pedestrians Present		D		
2.1.2	Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Transit Shelter		D		
2.1.3	Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1)		D		
2.1.4	Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)		D		
2.1.5	Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		D		
2.1.6	Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop		D		
2.1.7	Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop		D		
2.1.8	Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s)		D		

Table 3. Summary of TSPW Verification Test Cases and Associated Phase (Continued)

Test Case No.	Test Case Title	Phase 1. Laboratory-Based Verification	Phase 2. Garage / Controlled Parking Lot Verification	Phase 3. Live Environment Verification	Phase 4. Post-Fielding
	Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop				
2.1.9	Transit Vehicle Stopped at Bus Stop with No Pedestrians Present or Present in a Non-Roadway Zone with an Oncoming DSRC/TSPW-Enabled POV		D		
2.1.10	Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Curb Zone (Zone 3) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		D		
2.1.11	Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Curb Zone (Zone 4) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		D		
2.1.12	Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		D		
2.1.13	Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Center Zone (Zone 6) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		D		
2.1.14	Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones		D		

Table 3. Summary of TSPW Verification Test Cases and Associated Phase (Continued)

Test Case No.	Test Case Title	Phase 1. Laboratory-Based Verification	Phase 2. Garage / Controlled Parking Lot Verification	Phase 3. Live Environment Verification	Phase 4. Post-Fielding
2.1.15	Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area		D		
2.1.16	TSPW Cloak Mode where Transit Vehicle is Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		D		
2.2.1	TSPW Roadside Operational and Degraded Modes		D		
2.1.1.4	Transit vehicle is traveling straight, signalized intersection, red light, and pedestrian within near side crosswalk		D		
2.1.1.5	Transit vehicle is traveling straight, non-signalized intersection, stop sign, and pedestrian within near side crosswalk		D		
2.1.1.18	Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk		D		
2.2.1.7	Vehicle is behind left of the transit vehicle, and intends to turn right		D		
2.4.1.1	Operational Mode		D		
2.4.1.2	Non-Operational Mode – Standby		D		
2.4.1.3	Operational Mode – Degraded		D		
2.4.1.6	Mode Transition: Off to Operational		D		
2.4.2.2	Data Log Storage		D		
2.4.3.1	Location Accuracy		T		
2.4.3.2	Calculate Location		D		
2.4.3.3	Calculate Speed		D		

Table 3. Summary of TSPW Verification Test Cases and Associated Phase (Continued)

Test Case No.	Test Case Title	Phase 1. Laboratory-Based Verification	Phase 2. Garage / Controlled Parking Lot Verification	Phase 3. Live Environment Verification	Phase 4. Post-Fielding
2.4.3.4	Calculate Heading		D		
2.4.3.5	DSRC Range		T		
3.0	**Phase III (Live Environment Verification)**				
None					
4.0	**Phase IV (Post-Fielding)**				
4.1.1.0	Supportability				A

Source: Battelle

TSPW Verification Test Case Descriptions

The test cases are provided in a tabular format, with each case containing the following details:

- Test Case Number and Title
- Verification Phase
- Test Objective
- Requirements Verified
- Brief Description
- Test Setup and Configuration
- Test Procedures / Script
- Test Case Pass/Fail
- Test Case Expected Results and Notes

The test cases which follow, as well as the test case summary presented in Table 3 above, includes tests performed as part of the E-TRP Acceptance Test Plan [4] that assess requirements listed in both the TSPW Requirements and E-TRP System Requirements documents with the same requirement number. These are represented by four-digit test case numbers.

A small number of TSPW Requirements are considered to be effectively assessed by E-TRP requirements/test cases and are also excluded even though they do not share the E-TRP requirement number (TSPW requirements #295, #296, #297, #310, and #346). In addition, TSPW requirement #261 is not captured in a test case because alerts will either deactivate prior to departure from the TSPW Enabled Area and/or it will be superseded by alerts caused by a DSRC-enabled Personally Owned Vehicle (POV) or different transit vehicle. Also, a test case is not presented to verify shared E-TRP/TSPW requirement #1. This requirement is referenced by 74 E-TRP test cases; however, it is recognized in the expected results of each that this requirement will be evaluated through surveying transit vehicle drivers during the deployment period. Because of this, and because the focus of those test cases covers numerous E-TRP only requirements, no test case is presented in the TSPW Acceptance Test Plan. Finally, test case 2.3.1.0 lists some shared E-TRP/TSPW requirements, but is excluded from this document because it is focused on E-TRP functionality and because all of the shared requirements it lists are effectively verified by other test cases already included in this plan.

The TSPW Requirements Traceability Matrix in Appendix A provides traceability to the Test Cases in which all unique requirements from the TSPW Requirements Document [2] are verified. These verification matrix rows possess a TSPW requirement number, but no E-TRP requirement number reference, and appear in red font for emphasis.

1.0 Phase 1 (Laboratory-Based Verification)

The controlled laboratory environment of Phase 1 affords a focus on testing subsystem components in isolation in advance of Phase 2 testing, which requires functionally integrated system/subsystem components and focuses on performance of the interfaces and exchanged data.

1.1 TSPW Functionality (Includes Detection, User Interface, Configurability, logging, and Functional Characteristics)

Test Case No. and Title	**1.1.1 TSPW Functionality: User Interface, Configurability, Logging**
Verification Phase	**I – Laboratory-Based Verification**

Test Objectives	**Primary Objectives:**
	• Confirm that the TSPW application detects applicable alerts that are activated, superseded, and deactivated for display to the Transit Vehicle Operator (TVO), Roadside Pedestrian (RP), Mobile Pedestrian (MP), On Transit Vehicle Pedestrian (OTVP), and DSRC-enabled Personally Owned Vehicle (POV) interfaces in accordance with the following ConOps Scenarios sequenced in Test Case #2.1.5.
	  ○ **Note:** using this test case will confirm detection in every detection zone except the roadway rear curb zone (Zone 4), the detection of which can be simulated separately or as part of a revised script, or it can be confirmed with Phase 2 scenario-based test cases (2.1.X). For this reason, requirement #268 is marked within parenthesis.
	• Confirm that the TSPW application assigns a unique identifier to each TSPW event.
	• Confirm that the TSPW In-Vehicle Application stores logs of alert activations and deactivations with required details, and uses UTC time as a reference.
	• Confirm that the TSPW Roadside Subsystem implements a logging service that:
	  ○ Records alerts that are synchronized with GNSS time and presented in UTC, and which are inclusive of required details.
	  ○ Logs RP HIS state transitions and MP alerts, and required details.
	  ○ Logs roadside subsystem operational mode changes and triggers.
	  ○ Transfers files to a remotely hosted Cloud data management subsystem when applicable.

Requirements Verified	205, 266, 267, (268), 269, 270, [logging: 344, 41, 153, 196, 298, 299, 345, 301, 300, 304, 197, 198]
Brief Description	In Iteration #1 of Test Case #2.1.5, the following will be simulated in a laboratory-based environment: As the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway forward curb zone (Zone 3), pulls up to and stops at the bus stop with no pedestrian(s) initially present, then dwells and departs the bus stop area with pedestrian(s) present in select roadway zones (Zone 3-6).

Test Case No. and Title	1.1.1 TSPW Functionality: User Interface, Configurability, Logging
Verification Phase	I – Laboratory-Based Verification
Test Setup and Configuration	• Configure the test CCP to run the TSPW plugin and associated simulations support plugins. • Open SQL Server Management Studio and run the script EtspwResultsFromLatestInteraction.sql
Test Procedure/Script	Refer to the Iteration #1 Sequence in Test Case #2.1.5 for test procedure details. Retrieve logged data collected by the logging service for this test case from the remotely hosted cloud management subsystem and compare logged details against manually captured/simulated scenario details, including by GNSS timestamp.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement] (Each Iteration)	Met?		Notes
	Y	N	
Confirm that the TSPW application detects the presence of pedestrians within the Danger Waiting Zone (Zone 2) which represents the area of the transit stop passenger waiting area where a part of a moving transit vehicle could traverse. [266]			
Confirm that the TSPW application detects the presence of pedestrians within the In Roadway Forward Curb Zone (Zone 3) which encompasses the roadway in the lane closest to the transit stop and roughly one-half the width (curb-side) of the transit vehicle and one-half of the total length of the transit stop waiting area near the front of a stopped transit vehicle. [267]			

Test Case No. and Title	1.1.1 TSPW Functionality: User Interface, Configurability, Logging		
Verification Phase	**I – Laboratory-Based Verification**		
Confirm that the TSPW application detects the presence of pedestrians within the In-Roadway Rear Curb Zone (Zone 4) which encompasses the roadway in the lane closest to the transit stop and roughly one-half of the total width (curb-side) of the transit vehicle and one-half of the total length of the transit waiting area to the rear of the stopped transit vehicle. [268*]			***Note:** This is not part of the set of scenarios in Test Case #2.1.5, so either the script can be modified, this condition tested separately during this test case, or requirement 268 can be confirmed in Phase 2 tests.
Confirm that the TSPW application detects the presence of pedestrians within the In Roadway Forward Center Zone (Zone 5) which encompasses the roadway in the lane closest to the transit stop starting laterally at the mid-point of the lane and extending to the mid-point of the adjacent lane, or further, if possible and longitudinally encompassing roughly one-half the length of the transit stop waiting area to the front of the transit vehicle. [269]			
Confirm that the TSPW application detects the presence of pedestrians within the In Roadway Rear Center Zone (Zone 6) which encompasses the roadway in the lane closest to the transit stop starting laterally at the mid-point of the lane and extending to the mid-point of the adjacent lane, or further, if possible and longitudinally encompassing roughly one-half the length of the transit stop waiting area to the rear of the transit vehicle. [270]			
Logged Details Assessment:			**Note: Confirm that logged details in the TMX Event Log match manually captured/simulated scenario details and meet requirements as follows.**

Test Case No. and Title	1.1.1 TSPW Functionality: User Interface, Configurability, Logging		
Verification Phase	**I – Laboratory-Based Verification**		
All triggered event data is logged by TSPW Roadside Subsystem logs, including TSPW alerts each of which includes a unique identifier. [298] [205]			
All TSPW Roadside Subsystem logs shall be associated with the date and time, synchronized to GNSS time, of the logged event. [299]			
Confirm that all TSPW In-Vehicle Subsystem log timestamps shall use Coordinated Universal Time (UTC) as a reference. [344]			
Confirm that all TSPW Roadside Subsystem log timestamps shall use Coordinated Universal Time (UTC) as a reference. [345]			
When an enabled transit vehicle is within the TSPW Enabled Area, confirm that an image and log entry for zone detections is captured and stored for every triggered TSPW pedestrian zone detection by the Roadside application. [301]			
Confirm that the TSPW Roadside application stores a log of all RP HIS state transitions, including pre-state, triggering alert ID, and post-state. [197]			

Test Case No. and Title	1.1.1 TSPW Functionality: User Interface, Configurability, Logging		
Verification Phase	**I – Laboratory-Based Verification**		
Confirm that the TSPW Roadside application stores a log of all alerts provided to the MP HIS for mobile application subscribers, including the triggering alert ID. [198]			
Logged details in the TMX Event Log were collected by the TSPW Roadside application and uploaded to the cloud database. [304] [300]			Note: A design decision was made to not log data in standby mode, as the subsystem is effectively "off". As such, the portion of requirement number 300 corresponding to standby mode is not tested. Req. 300: "The TSPW Roadside Subsystem shall transfer data files to a remotely hosted cloud management subsystem, when connected in both Operational and Standby modes such that no data files are lost, deleted or corrupted.."
Confirm that the TSPW In-Vehicle application stores a log of all state transitions of the OTVP HIS, including the pre-state and post-state. [196]			
All alert activations including alert type, alert ID and associated roadside location ID are logged by the TSPW In-Vehicle Application. [41]			
All alert deactivations including alert type, alert ID and associated roadside location ID are logged by the TSPW In-Vehicle Application. [153]			

All transit vehicle operator HIS state transitions including pre-state, Triggering Alert ID, and post state transitions are logged by the E-TRP In-Vehicle Subsystem. [158]			**Note:** Only TSPW-specific aspects not evaluated in E-TRP testing are evaluated.
All TMX Event data was logged in the In-Vehicle Subsystem in Operational and Standby modes for a minimum of 48 hours. [157]			**Note:** Only TSPW-specific aspects not evaluated in E-TRP testing are evaluated.

1.2 Interface Testing – Environmental and Security, and TSPW Roadside Subsystem Modes of Operation

Test Case No. and Title	**1.2.1 Environmental – Water Resistance**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that TSPW Roadside Subsystem components are at least NEMA 4-compliant.
Requirements Verified	346
Brief Description	This test case confirms that the TSPW Roadside Subsystem components are NEMA 4-compliant.
Test Setup and Configuration	Collect and organize documentation representative of environmental specifications for TSPW Roadside Subsystem components.
Test Procedure/Script	By inspection, verify in vendor documentation that each component used for the TSPW roadside subsystem are NEMA 4 compliant.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	

Test Case No. and Title	1.2.1 Environmental – Water Resistance		
Verification Phase	**I – Laboratory-Based Verification**		
The TSPW Roadside Subsystem components are at least NEMA 4 compliant [346]			

Test Case No. and Title	1.2.2 System Maintenance Interfaces – Security		
Verification Phase	**I – Laboratory-Based Verification**		
Test Objectives	Confirm that the E-TRP/TSPW system maintenance interface meets security requirements		
Requirements Verified	347		
Brief Description	Confirm that the maintenance communications channel is secure.		
Test Setup and Configuration	To test that management communications with the TSPW/E-TRP CCP is secure, configure the CCP for all means of communication, including: • Ensure that the necessary physical cables and power sources are present • Open and run the CVIS Management portal • Power on the E-TRP/TSPW CCPs • Ensure the Global Positioning System (GPS) simulation feed is connected and operating. • Ensure the Vehicle Controller Area Network (CAN) simulator is connected and operating. • Verify that all functions are operating normally, and the IVS Display is receiving/transmitting information using the DSRC Radio.		
Test Procedure/Script	• Verify that remote maintenance communications with the CCP are secure and cannot be compromised by establishing management communications using proper settings and document all indications that the communication link is secure. • Attempt to establish maintenance communications with the CCP using incorrect settings (e.g., ports) to ensure the communication link is not permitted. • Document the security method used and evidence that the protocols established by the method are established/followed.		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results	**Met?**		**Notes**
	Y	**N**	
The TSPW system maintenance interfaces are protected from unauthorized access. [347]			

Test Case No. and Title	**1.2.3 TSPW Roadside Non-Operational Mode – Off**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Demonstrate that the TSPW roadside subsystem implementation of a non-operational off mode.
Requirements Verified	307
Brief Description	Confirm the roadside subsystem can be powered off and will not respond to triggers or transition to other modes while powered off.
Test Setup and Configuration	• Ensure the CCP is powered off. • Trigger TVO-SRA and RP-TAM alert per ConOps scenario #1, as defined in test case 2.1.1. Note: this same approach will be used in test case 1.2.5.
Test Procedure/Script	• Confirm the CCP is off by checking to see if the lights on the housing are illuminated. • Trigger an TVO-SRA and RP-TAM with a simulated approaching transit vehicle and no detected pedestrians. • Verify no data was sent to the cloud management system after the alert(s) were triggered.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
No alerts were displayed after the conditions warranting a TVO-SRA and RP-TAM were triggered. [307]			
The TSPW roadside subsystem does not transition to another operational mode after the conditions warranting a TVO-SRA and RP-TAM were triggered. [307]			
No data were sent to the cloud management system during non-operational mode. [307]			

Test Case No. and Title	**1.2.4 TSPW Roadside Mode Transition: Degraded to Operational**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Demonstrate that the CCP used in the TSPW in-vehicle subsystem and roadside subsystem automatically attempts to recover from a fault, and transitions from degraded to an operational state.
Requirements Verified	308, 125
Brief Description	Verify the in-vehicle/roadside subsystem attempts to recover from a fault. If the recovery is successful, confirm the transition of the subsystem from degraded to operational state via the CVIS Management Portal.
Test Setup and Configuration	• Ensure that the necessary physical cables and power sources are present • Ensure that the PC is loaded with the TMX Admin Portal • Ensure the TMX Admin Portal is resident on the CCP • Power on the TSPW CCP • Ensure a real/physical GPS antenna is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Connect the PC to the remote external connector for the TSPW CCP
Test Procedure/Script	• Open the TMX Admin Page • Navigate to the Status for the Plugin reporting System Status • Observe that the current state is Operational • Disconnect the GNSS connection by disconnecting the GPS antenna • Observe that the state changes to Degraded • Re-establish the GNSS connection by re-connecting the GPS antenna • Observe that the state changes back to Operational
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
Subsystem attempted to recover from a fault. [125] [308]			
Subsystem successfully recovered from a fault. [125] [308]			

Test Case No. and Title	1.2.4 TSPW Roadside Mode Transition: Degraded to Operational		
Verification Phase	**I – Laboratory-Based Verification**		
Upon successful fault recovery, subsystem successfully transitioned from degraded to an operational state. [125] [308]			

Test Case No. and Title	**1.2.5 TSPW Roadside Mode Transition: Off to Operational**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	• Demonstrate that if power is lost while in operational mode, the TSPW roadside subsystem shall automatically transition from off to operational once power is restored.
Requirements Verified	309
Brief Description	Verify the mode transition of the roadside system when power is lost and restored via the CVIS Management Portal.
Test Setup and Configuration	• Connect the WebSwitch+ to a 12VDC power supply. • Connect the ignition switch to the power supply. • Confirm the WebSwitch+ is powered on by checking to see if the lights are illuminated on the housing of the CCP. • Connect the CCP to the WebSwitch+.
Test Procedure/Script	• Verify the WebSwitch+ is powered on by checking to see if the red light is illuminated. • Turn off the power supply. • Verify the WebSwitch+ and the CCP no longer have power by confirming neither of the lights are illuminated. • Turn on the power supply. • Verify the WebSwitch+ and CCP are now powered by confirming the lights on both pieces of hardware are illuminated. • Trigger TVO-SRA and RP-TAM alert per ConOps scenario #1, as defined in test case 2.1.1. Note: this same approach was used in test case 1.2.3. • Verify the data was sent to the cloud management system after the alert was triggered.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
When power is lost, the roadside subsystem automatically transitions from Off to Operational once the power was restored. [309]			

Common Phase 1 E-TRP / TSPW Test Cases

Test Case No. and Title	1.4.1.0 Interface Testing – Power
Verification Phase	I – Laboratory-Based Verification
Test Objectives	Confirm that the CCP accepts power and performs normally using the following input voltage amount and type: • 12VDC (transit vehicle power configuration) • 120VAC (roadside equipment configurations) Confirm that the CCP consumes no more than 10mA in standby mode.
Requirements Verified	070, 071, 132
Brief Description	Confirm that the CCP accepts and performs normally using transit vehicle and roadside equipment power, and that it consumes no more than the specified power in standby mode.
Test Setup and Configuration	**Phase I** • Prepare and configure CCP within a simulated transit vehicle configuration that includes power source and communication devices and interfaces as described in Section 1.0 under Laboratory-Based Verification Configuration details. • Prepare and configure CCP within a simulated traffic signal controller roadside unit configuration that includes power source and communication devices and interfaces as described in Section 1.0 under Laboratory-Based Verification Configuration details. • Prepare and configure CCP within a simulated transit bus stop roadside configuration that includes power source and communication devices and interfaces as described in Section 1.0 under Laboratory-Based Verification Configuration details.
Test Procedure/Script	**Phase I** • Configure the CCP in a simulated transit vehicle configuration (see above) o Supply 12VDC to the CCP and confirm the CCP performs normally with all external communication devices and interfaces operating. o Place the CCP in standby mode and measure the power consumption of the CCP. • Configure the CCP in a simulated traffic signal controller roadside configuration (see above) o Supply 120VAC @ 60 Hz to the CCP and connect 8 FLIR cameras. o Place the CCP in standby mode and measure the power consumption of the CCP. • Configure the CCP in a simulated transit bus stop roadside configuration (see above) o Supply 120VAC @ 60 Hz to the CCP and connect 3-4 FLIR cameras. o Place the CCP in standby mode and measure the power consumption of the CCP.

Test Case No. and Title	1.4.1.0 Interface Testing – Power		
Verification Phase	I – Laboratory-Based Verification		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results [requirement]	Met? Y	Met? N	Notes
CCP operates normally – simulated transit vehicle configuration [071] [132]			
CCP operates normally – simulated traffic signal controller roadside configuration [071] [132]			
CCP operates normally – simulated transit bus stop roadside configuration [071] [132]			
Confirm that the CCP consumes no more than 10mA in standby mode – simulated transit vehicle configuration [070]			
Confirm that the CCP consumes no more than 10mA in standby mode – simulated traffic signal controller roadside configuration [070]			
Confirm that the CCP consumes no more than 10mA in standby mode – simulated transit bus stop roadside configuration [070]			

Test Case No. and Title	1.5.1.0 Supportability – Safety
Verification Phase	**I – Laboratory-Based Verification**

Test Objectives	• Confirm that E-TRP In-Vehicle hardware complies with wireless communication interface protocols (including Bluetooth Classic, BLE, 4G, and DSRC 5.9 GHz), as well as vehicle communication interface protocols (including ISO, SAE, and GM and Ford OEM):
	  ○ CAN-ISO15765-4, GMLAN Single wire CAN (GMW3089) and Ford Medium Speed CAN (MS CAN) interface.
	  ○ ISO 14230-4 (Keyword Protocol 2000), ISO 9141-2 (Asian, European, Chrysler vehicles), ISO 15765, ISO 11898 (raw CAN) interface.
	  ○ SAE J1850 VPW (GM Vehicles), J1850 PWM (Ford Vehicles), J1939, temperatures consistent J1211 and J1708 interface.
	  ○ HSCAN + other protocol interface.
	• Confirm that the E-PCW roadside subsystem applies interfaces compliant with Roadside Unit specification 4.0
	• Confirm that the E-TRP In-Vehicle subsystem prevents electrical discharge damage to the host vehicle

Requirements Verified	056, 057, 058, 060, 061, 083, 084, 085, 086, 087, 088, 089, 090, 091, 092, 093, 094, 103, 128, 140, 155
Brief Description	This test case covers a series of checks to confirm that wireless and vehicle communication protocols used by the E-TRP In-Vehicle and Roadside subsystems are compliant with applicable standards, and that communications from an ISO 15765 bus and another source can be simultaneously received and processed. This includes confirming that the in-vehicle subsystem and roadside subsystem communications protocols are compliant with J1939 requirements. This test case also confirms that the E-TRP RSE is RSU v4.0 compliant and that its components are NEMA 4-compliant.
Test Setup and Configuration	• Ensure that the necessary physical cables and power sources are present • Ensure that the PC is loaded with the CVIS Management Portal • Power on the E-TRP CCP • Ensure GPS simulation feed is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Connect the PC to the remote external connector for the E-TRP CCP • Load the MAP message on the SPaT/Traffic Signal Controller Simulator. • Start the SPaT/Traffic Controller Simulator. • Enable SPaT messaging from SPaT/Traffic Signal Controller Simulator.

Test Case No. and Title	1.5.1.0 Supportability – Safety
Verification Phase	**I – Laboratory-Based Verification**

Test Procedure/Script	• By inspection, confirm that the E-TRP IVS CCP possesses the following antennas and interface(s) to communicate wirelessly:
	  ○ WIFI via internal antenna [56],
	  ○ Classic and Low Energy Bluetooth [57][58],
	  ○ 4G Cellular [60], and
	  ○ DSRC 5.9GHz interface [61].
	• By inspection, confirm that the E-TRP IVS CCP implements the vehicle communication interfaces:
	  ○ CAN (ISO15765-4, GMW3089, MS CAN) [83][90][91]
	  ○ ISO (14230-4, 9141-2, 15765, and 11898) interface [84][85][88][89]
	  ○ SAE (J1850VPW, 1850PWM, J1939 and J1708 [86][87][92][93]
	  ○ High Speed CAN.
	• Demonstrate that the E-TRP IVS CCP shall be able to simultaneously receive and process data from an ISO 15765 bus and another communication protocol source by running a script with simulated GPS feed, and using a vehicle simulator and confirming communications via CVIS management portal [94].
	  ○ Use the maintenance interface (CVIS Management Portal) to confirm that simulated CAN and GPS feed information are simultaneously received and processed in accordance with the simulated data feed [103]
	• Demonstrate that the E-TRP IVS can simultaneously receive and process data from two J1939 channels and that the IVS and RSE CCPs transmit/receive messages that are J1939-compliant by running a simulation script and confirming communications via CVIS management portal.
	  ○ Inspect logged data after the conclusion of the simulation to confirm that messages recorded by the E-TRP IVS and RSE confirm evidence of two simultaneously received J1939 channels of information (vehicle and OBU) [155]
	  ○ By inspection, confirm through vendor documentation that all parts used for the E-TRP/E-PCW roadside subsystem (RSE) are NEMA 4 compliant [128].
	  ○ By inspection, confirm the E-TRP/E-PCW RSE implements interfaces compliant with the RSU Specification v4.0

Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Test Case No. and Title	1.5.1.0 Supportability – Safety		
Verification Phase	I – Laboratory-Based Verification		
Expected Results	Met? Y	Met? N	Notes
The E-TRP IVS CCP possesses a Wi-Fi interface with internal antenna to communicate wirelessly [056]			
The E-TRP IVS CCP possesses a Bluetooth Classic interface to communicate wirelessly [057]			
The E-TRP IVS CCP possesses a Bluetooth Low Energy (BLE) interface to communicate wirelessly [058]			
The E-TRP IVS CCP possesses a 4G cellular interface to communicate wirelessly [060]			
The E-TRP IVS CCP possesses DSRC 5.9 GHz interface to communicate wirelessly [061]			
The E-TRP IVS CCP possesses an ISO 15765-4 (CAN) interface to support vehicle communications [083]			
The E-TRP IVS CCP possesses an ISO 14230-4 (Keyword Protocol 2000) interface to support vehicle communications [084]			
The E-TRP IVS CCP possesses an ISO 9141-2 (Asian, European, Chrysler vehicles) interface to support vehicle communications [085]			
The E-TRP IVS CCP possesses an SAE J1850 VPW (GM Vehicles) interface to support vehicle communications [086]			
The E-TRP IVS CCP possesses an SAE J1850 PWM (Ford Vehicles) interface to support vehicle communications [087]			
The E-TRP IVS CCP possesses an ISO 15765 interface to support vehicle communications [088]			

Test Case No. and Title	1.5.1.0 Supportability – Safety		
Verification Phase	**I – Laboratory-Based Verification**		
The E-TRP IVS CCP possesses an ISO 11898 (raw CAN) interface to support vehicle communications [089]			
The E-TRP IVS CCP possesses a GMLAN Single Wire CAN (GMW3089) interface to support vehicle communications [090]			
The E-TRP IVS CCP possesses a Ford Medium Speed CAN (MS CAN) interface to support vehicle communications [091]			
The E-TRP IVS CCP possesses an SAE J1939 bus interface to support vehicle communications [092]			
The E-TRP IVS CCP possesses an SAE J1708 interface to support vehicle communications [093]			
The E-TRP IVS CCP simultaneously receives and processes data from an ISO 15765 bus and another required protocol [094]			
The E-TRP IVS CCP implements an interface to extract data files from unit locally [103]			
The E-TRP/E-PCW RSE components housed external to the signal controller cabinet are at least NEMA 4 compliant [128]			
The E-TRP/E-PCW RSE DSRC RSE shall implement interfaces compliant with the RSU Specification v4.0 [140]			
Confirm the E-TRP in-vehicle subsystem is capable of simultaneously receiving and processing data from two SAE J1939 databus channels [155]			

Test Case No. and Title	**1.6.1.0 Interface Testing – Physical, Physical Characteristics, and Supportability – Maintainability and Security**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	**Phase I** • Confirm that the CCP design meets maintainability, design and construction, and security requirements • Demonstrate that the E-TRP IVS implements required physical indicators, and that the E-TRP IVS and RSE CCPs implement an interface permitting them to be remotely monitored. • Demonstrate that the E-TRP IVS implements a physical reset capability
Requirements Verified	**047, 048,** 062, 079, 080, **095, 096, 097, 098, 099, 100, 101, 102,** 105, 111, 113, 129, 193, 127, 143
Brief Description	This test covers the physical design for in vehicle and roadside system components. It covers functionality and size.
Test Setup and Configuration	**Phase I** To test the physical indicators of the E-TRP CCP, configure an E-TRP IVS CCP for all means of communication, including: • Ensure that the necessary physical cables and power sources are present • Ensure that the PC is loaded with the CVIS Management Portal • Open and run • Power on the E-TRP CCP • Load the MAP message on the SPaT/Traffic Signal Controller Simulator. • Start the SPaT/Traffic Controller Simulator. • Ensure a real/physical GPS antenna is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all E-TRP IVS CCP functions are operating normally and the IVS Display is receiving information from the DSRC Radio. • Enable SPaT messaging from SPaT/Traffic Signal Controller Simulator.

Test Case No. and Title	**1.6.1.0 Interface Testing – Physical, Physical Characteristics, and Supportability – Maintainability and Security**

Test Procedure/Script	**Phase I**
	• Confirm through simple inspection, test, and demonstration that the CCP design meets maintainability, design and construction, and security requirements, including:
	  ○ Inspect the E-TRP RSE and IVS CCP dimensions [47][48]
	  ○ Inspect access to the E-TRP IVS SIM card to confirm it is accessible via an access panel [62]
	  Note: it was decided in the design review process that a separate access door was not justifiable and that the end panel of the CCP can be considered an access panel as it is easily removed.
	  ○ Test the E-TRP in-vehicle subsystem computing platform for software maintainability by plugging a keyboard/mouse into the USB hardware connection and display into the HDMI hardware connection and ensuring that local terminal display (HDMI) and control (USB) functions are permitted by typing text. [80][79]
	  ○ Demonstrate that the external cabinet housing the E-TRP/E-PCW RSE can be pole-mounted external to the traffic signal controller cabinet (cabinet accepts a pole mount) [129]
	  ○ Inspect the E-TRP IVS CCP and equipment to ensure it can be secured physically to the host vehicle [113]
	  ○ Inspect the E-TRP system components to ensure they are resistant to tampering by unauthorized personnel as installed (i.e., transit vehicle and roadside cabinets in which E-TRP CCPs are installed are tamper resistant) [127]
	  ○ Inspect the power connector to the E-TRP IVS CCP and the E-TRP IVS CCP and iBoot Installation Plan to ensure that in the transit vehicle installations the E-TRP IVS electrical connections will be accessible for connection/disconnection without disassembly/dismounting the CCP [143]
	• Confirm through demonstration that the E-TRP IVS CCP implements the required physical indicators supporting status monitoring and that the indications match expected states by placing the E-TRP IVS CCP in the various states that can be distinguished for each indicator and confirming that the physical indications match the expected states on the physical indicators of the CCP as well as remotely, via the CVIS Management Portal [105]
	  ○ Disconnect/reconnect E-TRP IVS CCP power [95]
	  ○ Disconnect/reconnect the GNSS connection by disconnecting/reconnecting the GPS antenna [96][99]
	  ○ Disable/enable Bluetooth connectivity by disconnecting/reconnecting the Bluetooth antenna [97]
	  ○ Disable/enable DSRC connection by disconnecting/reconnecting the DSRC antenna [98]
	  ○ Disable/enable cellular connectivity by disconnecting/reconnecting the cellular antenna [100]
	  ○ Disable/enable Wi-Fi connection by disconnecting/reconnecting the Wi-Fi antenna101]
	  ○ Disable/enable simulated Vehicle CAN bus connection [102]
	  ○ Select the physical reset button on the E-TRP IVS CCP [111]
	• Inspect DSRC radio technical specifications to confirm the DSRC communications channels are protected from unauthorized modification [193]

Test Case No. and Title	1.6.1.0 Interface Testing – Physical, Physical Characteristics, and Supportability – Maintainability and Security		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results	Met? Y	Met? N	Notes
E-TRP RSE measures no longer than 5.5 inches tall (with respect to mounting service) by 11 inches x 8.5 inches [47]			Requirement says IVS but it is believed the intent was RSE when comparing requirements 047 and 048
E-TRP IVS measures no larger than 2 inches tall with respect to mounting surface by 8X4 inches [48]			
E-TRP IVS SIM card shall be accessible via and access panel [62]			
E-TRP implements an HDMI receptacle tor use for local terminal display for system maintenance [79]			
E-TRP IVS implements a USB receptacle for local keyboard for system maintenance [80]			
The E-TRP roadside subsystem housed external to the signal controller cabinet shall be pole-mountable [129]			
The E-TRP in-vehicle subsystem shall implement a method for secure physical attachment to the host vehicle [113]			
E-TRP system components should be packaged to be resistant to tampering by unauthorized personnel [127]			
E-TRP IVS electrical connections should be easy to disconnect and reconnect by maintenance without equipment disassembly our dismounting [143]			

Test Case No. and Title	1.6.1.0 Interface Testing – Physical, Physical Characteristics, and Supportability – Maintainability and Security		
Confirm that the E-TRP in-vehicle subsystem implements the following physical indicators supporting status monitoring and that the indications match expected states: • Power state of on-board computational platform [095] • System fault with fault group [096] • Operational state of Bluetooth connection [097] • Operational state of DSRC connection [098] • Operational state of GNSS connection [099] • Operational state of Cellular connection [100] • Operational state of Wi-Fi connection [101] • Operational state of vehicle data-bus connection [102]			
Confirm that the E-TRP in-vehicle subsystem implements an interface that allows remote status monitoring [105]			
E-TRP IVS shall implement physical reset capability [111]			
DSRC communication channel shall be protected from unauthorized modification [193]			

Test Case No. and Title	**1.7.1.0 Interface Testing – Communications**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that the in-vehicle subsystem and roadside subsystem communications protocols are compliant with SAE J2735 requirements.
Requirements Verified	144, 145
Brief Description	Message sets transmitted via DSRC by the E-TRP IVS and RSE subsystems will be verified to be compliant with SAE J2735 message set specifications.
Test Setup and Configuration	To demonstrate that message sets transmitted by DSRC, configure an E-TRP IVS CCP for all means of communication, including: • Ensure that the necessary physical cables and power sources are present • Open and run the CVIS Management portal • Power on the E-TRP CCPs • Load the MAP message on the SPaT/Traffic Signal Controller Simulator. • Start the SPaT/Traffic Controller Simulator. • Ensure the GPS simulation feed is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all E-TRP RSE and IVS CCP functions are operating normally, and the IVS Display is receiving/transmitting information using the DSRC Radio. • Enable SPaT messaging from SPaT/Traffic Signal Controller Simulator.
Test Procedure/Script	Demonstrate that the E-TRP IVS and RSE CCPs transmit/receive messages that are SAE J2735 by broadcasting MAP and SPAT messages from the RSE for receipt by the IVS (with SPAT messages sent vis SimulatedSpatPlugin) and BSMs are broadcast between the IVS and RSE (via SimulatedBsmPlugin). • Inspect logged data after the conclusion of the simulation to confirm that messages recorded by the E-TRP IVS and RSE are SAE J2735-compliant [144][145]
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Test Case No. and Title	1.7.1.0 Interface Testing – Communications		
Verification Phase	**I – Laboratory-Based Verification**		
Expected Results [requirement] (Each Iteration)	**Met?**		**Notes**
	Y	**N**	
Confirm E-TRP in-vehicle subsystem and E-PCW Roadside subsystem DSRC Messages transmitted comply with SAE J2735 [144][145].			

Test Case No. and Title	1.7.2.0 Performance Testing – Electromagnetic Radiation (SAE)
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that the E-TRP CCP integrated within vehicles and roadside units is compliant with the following SAE J1113 requirements: -2, -4, -11, -13, -21, -22, -26, -27, -41, and -42j
Requirements Verified	114, 116
Brief Description	A battery of tests will be conducted through third-party analysis to confirm that SAE J1113 requirements relating to electromagnetic radiation/compatibility of an operational CCP designed for use in the in E-TRP in vehicle and roadside subsystems are met.
Test Setup and Configuration	**Test setup to be performed and documented by third party vendor**.
Test Procedure/Script	Test procedures/script to be performed by third party vendor with support from Battelle. Results will be formally reported. The following parameters/methods are anticipated with the CCP in both standby and operational modes: • SAE J1113-2/ISO 11452-10 Immunity to Conducted Electromagnetic Fields, Power Leads – assume 30Hz – 250kHz • SAE J1113-4/ISO 11452-4 Conducted Immunity – Bulk Current Injection (BCI) • SAE J1113-11/ SAE J1113-42/ISO 7637-2 Immunity to Conducted Transients on Power Leads • SAE J1113-13/ ISO 10605 Immunity to Electrostatic Discharge – assume up to ±25kV • SAE J1113-21/ ISO 11452-2 Road Vehicles – Electrical Disturbances by Narrowband Radiated Electromagnetic Energy – Component Test Methods – Absorber Lined Chamber – assume 30MHz-18GHz • SAE J1113-22/ ISO 11452-8 Immunity to Radiated Magnetic Fields from Power Lines – assume 16.6Hz-50kHz • SAE J1113-26 Immunity to AC Power Line, Electric Fields – assume up to 15,000V/m (60Hz) • SAE J1113-27 Immunity to Radiated Electromagnetic Fields – Reverberation Chamber Method • SAE J1113-41/CISPR 25 Test Limits and Methods of Measurement of Radio Disturbance Characteristics from Vehicle Components and Modules, Narrowband – assume 150kHz to 2.5GHz

Test Case No. and Title	1.7.2.0 Performance Testing – Electromagnetic Radiation (SAE)		
Verification Phase	I – Laboratory-Based Verification		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results [requirement] (Each Iteration)	Met? Y	Met? N	Notes
Confirm the E-TRP CCP used in the in vehicle and roadside subsystems complies with SAE J1113 electromagnetic compatibility requirements [114]			
Confirm the E-TRP CCP used in the in vehicle prevents electrical discharge to protect against host vehicle damage (via J1113-13). [116]			

Test Case No. and Title	**1.7.3.0 Performance Testing – Electromagnetic Radiation (FCC)**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that the E-TRP CCP integrated within vehicles and roadside units is compliant with FCC Part 15 Subpart B requirements.
Requirements Verified	N/A
Brief Description	A battery of tests will be conducted through third-party analysis to confirm that FCC Part 15 Subpart B requirements relating to electromagnetic compatibility when transmitting/receiving DSRC 5.9GHz messages are met as a prerequisite for licensure and operation of the E-TRP subsystems. This includes separately testing the CCP and the CCP within the Roadside HIS enclosure, as necessary.
Test Setup and Configuration	**Test setup to be performed and documented by third party vendor**.
Test Procedure/Script	Test procedures/script to be performed by third party vendor with support from Battelle. Results will be formally reported. The following parameters/methods are anticipated: • For radiated emissions: 30 MHz-18GHz – class a limits • For conducted emissions: 150 kHz-30Mhz – class a limits
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement] (Each Iteration)	**Met?**		**Notes**
	Y	**N**	
Confirm the E-TRP CCP used in the in vehicle and roadside subsystems complies with FCC Part 15 Subpart B electromagnetic compatibility requirements [N/A]			
Confirm the E-TRP CCP used in the in roadside HIS configuration complies with FCC Part 15 Subpart B electromagnetic compatibility requirements [N/A]			

Test Case No. and Title	**1.7.4.0 Performance Testing – Shock and Vibration**		
Verification Phase	**I – Laboratory-Based Verification**		
Test Objectives	Confirm that the E-TRP CCP integrated within vehicles is compliant with SAE J1211 shock and vibration requirements.		
Requirements Verified	112		
Brief Description	A battery of tests will be conducted through third-party analysis to confirm that SAE J1211 requirements relating to shock and vibration are met for CCPs used in the E-TRP in vehicle subsystem.		
Test Setup and Configuration	**Test setup to be performed and documented by third party vendor**.		
Test Procedure/Script	• Test procedures/script to be performed by third party vendor with support from Battelle. Results will be formally reported. The following parameters/methods are anticipated: o Random vibration between 5 Hz to 500 Hz @ 5.0 $(m/s^2)^2/Hz$ o Five hours / axis		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results [requirement] (Each Iteration)	**Met?** Y	**Met?** N	**Notes**
Confirm the E-TRP in-vehicle subsystem system shall be resistant to permanent damage from shock and vibration consistent with SAE J1211 [112].			

Test Case No. and Title	**1.7.5.0 Performance Testing – Temperature**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that the E-TRP CCP integrated within vehicles and roadside units is compliant with SAE J1211 temperature requirements.
Requirements Verified	050, 130
Brief Description	A battery of tests will be conducted through third-party analysis to confirm that SAE J1211 requirements relating to temperature are met for CCPs used in the E-TRP in vehicle subsystem and roadside subsystems.
Test Setup and Configuration	**Test setup to be performed and documented by third party vendor**.
Test Procedure/Script	• Test procedures/script to be performed by third party vendor with support from Battelle. Results will be formally reported. The following parameters/methods are anticipated: o 24 hours at -40°C o 96 hours at +85°C
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement] (Each Iteration)	**Met?**		**Notes**
	Y	**N**	
Confirm the E-TRP in-vehicle subsystem system shall operate at automotive temperatures consistent with SAE J1211 interior-instrument panel-other (-40°C to +85°C) [050].			
Confirm the E-TRP roadside subsystem system shall operate at temperatures between -10°C to +60°C [130].			

Test Case No. and Title	1.8.1.0 Software Maintainability
Verification Phase	I – Laboratory-Based Verification
Test Objectives	Confirm that software on the E-TRP CCP is maintainable, including: • E-TRP CCP possesses an interface for maintenance staff to remotely wake up and put the subsystem into standby mode for maintenance purposes. • All configurable software should be programmable remotely, over the air. • All configurable software and firmware components of the E-TRP system shall be programmable via an external connector.
Requirements Verified	081, 082, 118, 120
Brief Description	It is intended that, after deployment, E-TRP CCP software and firmware will be configured/re-configured remotely via secure cellular communications via an internet-connected Remote Administration Access Point (RAAP) when possible. The first iteration of this test will ensure that, as an alternate means when remote configuration is not possible, the E-TRP CCP can be locally programmed/configured via an external connector. The second iteration of this test will ensure that the E-TRP CCP can, as a primary means, be remotely woken up, programmed/configured, and placed in standby mode for maintenance purposes via a secure cellular connection (via RAAP).
Test Setup and Configuration	• Prepare a E-TRP CCP test software version and test firmware version that differs in version number(s) from the current versions of software/firmware and contains conspicuously different and visually confirmable features • Ensure that the PC is loaded with both the test version software and firmware, as well as the current version software and firmware • Ensure that the PC is loaded with the TMX Admin Portal • Ensure the TMX Admin Portal is resident on the CCP • Ensure that the necessary physical cables, power, and wireless communication nodes are present • Ensure the E-TRP CCP is loaded with the current software and firmware • Power on the E-TRP CCP.

Test Case No. and Title	1.8.1.0 Software Maintainability
Verification Phase	I – Laboratory-Based Verification
Test Procedure/Script	Iteration 1: • Connect the PC to the remote external connector for the E-TRP CCP and access the TMX Admin Page • Navigate to the Version Number for the Plugin • Press applicable button on the end plate of the CCP to put the CCP in maintenance mode. • Download and install the test version software and firmware onto the E-TRP CCP externally • Confirm that the test version software and firmware successfully loaded and the test version number is correct • Use the maintenance interface (CVIS Management Portal) to change the E-TRP CCP mode to standby • Disconnect external connector • Cycle power to the E-TRP CCP Iteration 2: • Connect the PC to the E-TRP CCP over a secure cellular connection (via RAAP) and access the TMX Admin Page • Navigate to the Version Number for the Plugin • Wake-up the E-TRP CCP, confirm the resident software and firmware are test version, and change the mode to maintenance mode • Download and install the current version software and firmware onto the E-TRP CCP remotely and wirelessly • Confirm the E-TRP CCP possesses the current build version software and firmware • Place the system into standby mode
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement] (Each Iteration)	Met?		Notes
	Y	N	
Confirm software and firmware updates are successful via the external connector [082].			
Confirm software and firmware updates are successful remotely via Wi-Fi [081]			
Confirm that the system can be remotely switched between maintenance and standby modes [118][120]			

Test Case No. and Title	**1.8.2.0 Data Maintainability**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that TMX Event Log files on the E-TRP CCP is retrievable, including via: • A Wi-Fi interface through which data files can be extracted locally. • A Cellular interface through which data files can be extracted remotely.
Requirements Verified	**104, 106**
Brief Description	Data backhaul from the IVS CCP is intended via Wi-Fi and from the Roadside (RSE) CCP is intended via cellular. The first iteration of this test will ensure data collected on the IVS CCP can be extracted through a wireless access point and the Cloud Data Management System (CDMS), while the second iteration of this test will ensure data collected on the RSE CCP can be extracted using cellular communications via the CDMS.
Test Setup and Configuration	Iteration 1: • Pre-populate the IVS CCP with TMX Event Log Files. This can be achieved by using simulated log data. Iteration 2: • Pre-populate the RSE CCP with TMX Event Log Files. This can be achieved by using simulated log data. Both Iterations: • Ensure that the necessary wireless communication nodes are present • Power on the E-TRP IVS or RSE CCP. • Power on the PC that will be used to communicate with the CCPs via CDMS
Test Procedure/Script	Iteration 1: • Establish communication between the IVS CCP and CDMS via Wi-Fi access point by moving the IVS CCP within range. • Once the files have been transmitted via the CloudInterfacePlugin, review TMX Event Log Files stored in the Azure SQL Server for completeness/accuracy relative to simulated event log details Iteration 2: • Establish communication between the RSE CCP and CDMS via a cellular connection by timing the connection • Once the files have been transmitted via the CloudInterfacePlugin, review TMX Event Log Files stored in the Azure SQL Server for completeness/accuracy relative to simulated event log details

Test Case No. and Title	1.8.2.0 Data Maintainability		
Verification Phase	I – Laboratory-Based Verification		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results [requirement] (Each Iteration)	Met? Y	Met? N	Notes
Confirm TMX Event Log files can be extracted locally via Wi-Fi (supporting IVS data backhaul) [104].			
Confirm TMX Event Log files can be extracted locally via cellular (supporting Roadside data backhaul) [106].			

Test Case No. and Title	**1.8.3.0 System Reset**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that E-TRP CCP can be remotely reset/rebooted via the following methods: • An implemented E-TRP interface permitting reset/reboot via Cellular. • An implemented E-TRP interface permitting reset/reboot via Wi-Fi for IVS CCPs.
Requirements Verified	**110, 109**
Brief Description	It is intended that the deployed E-TRP IVS and Roadside CCPs can be reset/rebooted remotely via secure cellular communications via an internet-connected RAAP when possible, and that the IVS CCP can be remotely reset/rebooted via Wi-Fi when applicable. The first iteration of this test will ensure that an E-TRP CCP (which will be named E-TRP RSE CCP) can be remotely reset/rebooted via a cellular connection via an internet-connected RAAP. The second iteration of this test will ensure that that the E-TRP IVS CCP can be reset/rebooted via a Wi-Fi connection.

Test Setup and Configuration	• Both Iterations:
	  ○ Ensure that the necessary wireless communication nodes are present, including the connection to iBoot
	  ○ Ensure that the CCP(s) are powered via iBoot
	  ○ Power on the E-TRP IVS or RSE CCP.
	  ○ Power on the PC that will be used to communicate with the CCPs via RAAP

Test Case No. and Title	1.8.3.0 System Reset
Verification Phase	I – Laboratory-Based Verification
Test Procedure/Script	System Reset: • Reset/reboot the E-TRP subsystem remotely via a cellular connection • Reset/reboot the E-TRP subsystem remotely via a Wi-Fi connection Iteration 1: • Establish communications range between the RSE CCP and CDMS via a cellular connection • Command a reset/reboot of the RSE CCP from the PC maintenance interface (CVIS Management Portal) • Confirm that the reset/reboot command is communicated to the RSE CCP and the RSE CCP is successfully rebooted and returns to standby mode. Iteration 2: • Establish communications range between the IVS CCP and CDMS via Wi-Fi access point • Command a reset/reboot of the IVS CCP from the PC maintenance interface (CVIS Management Portal) • Confirm that the reset/reboot command is communicated to the IVS CCP and the IVS CCP is successfully rebooted and returns to standby mode.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement] (Each Iteration)	Met?		Notes
	Y	N	
Confirm the E-TRP CCP can be reset/rebooted remotely using Cellular [110].			
Confirm the E-TRP CCP can be reset/rebooted remotely using Wi-Fi [109].			

Test Case No. and Title	1.9.1.1 Non-Operational Mode – Maintenance
Verification Phase	I – Laboratory-Based Verification
Test Objectives	Confirm that the E-TRP IVS implements a non-operational maintenance mode.
Requirements Verified	65
Brief Description	Confirm via the CVIS Management Portal that the E-TRP IVS implements a non-operational maintenance mode.

Test Case No. and Title	1.9.1.1 Non-Operational Mode – Maintenance		
Verification Phase	**I – Laboratory-Based Verification**		
Test Setup and Configuration	• Ensure that the necessary physical cables and power sources are present • Ensure that the PC is loaded with the CVIS Management Portal • Power on the E-TRP CCP • Ensure GPS simulation feed is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Connect the PC to the remote external connector for the E-TRP CCP		
Test Procedure/Script	• Locate the test CCP in the CVIS Management Portal • Confirm that it is currently in an Operational Mode • Press the button requesting the device be placed into Maintenance Mode **Note:** There is an approximately 2-3 minute delay for the mode command to be issued to the device and the status change to be displayed on the CVIS Management Portal.		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results	**Met?**		**Notes**
	Y	**N**	
Verify that the status on the CVIS Management Portal indicates that the mode has changed from Operational Mode to Maintenance Mode after the command has issued [65]			

Test Case No. and Title	**1.9.1.2 Non-Operational Mode – Off**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Confirm that the E-TRP IVS CCP implements a non-operational off mode
Requirements Verified	66
Brief Description	Confirm the in-vehicle subsystem can be powered off and will not respond to triggers or transition to other modes while powered off.
Test Setup and Configuration	• Ensure that the necessary physical cables and power sources are present • Power on the E-TRP CCP • Ensure GPS simulation feed is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Connect the PC to the remote external connector for the E-TRP CCP
Test Procedure/Script	• Power the CCP off and confirm the CCP is off by checking to see if the LED lights on the housing are illuminated. • Trigger an E-PCW warning with a pedestrian standing in a presence zone beneath a configured and active FLIR TrafiSense camera. • Verify no data was sent to the cloud management system after the alert was triggered.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
No data was collected after the E-PCW warning was triggered. [66]			
No data was sent to the cloud management system after the E-PCW warning was triggered. [66]			

Test Case No. and Title	1.9.1.3 Mode Transition: Maintenance-Standby
Verification Phase	I – Laboratory-Based Verification
Test Objectives	• Verify the in-vehicle subsystem can transition from Standby to Maintenance mode when triggered remotely by a maintainer. [119] • Verify the in-vehicle subsystem can transition from Maintenance to Standby mode when triggered remotely by a maintainer. [121]
Requirements Verified	119, 121
Brief Description	Demonstrate the in-vehicle subsystem can transition between different modes remotely via the CVIS Management Portal
Test Setup and Configuration	• Ensure that the necessary physical cables and power sources are present • Ensure that the PC is loaded with the CVIS Management Portal • Power on the E-TRP CCP • Ensure GPS simulation feed is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Connect the PC to the remote external connector for the E-TRP CCP
Test Procedure/Script	• Place the CCP into Standby Mode • Locate the CCP in the CVIS Management Portal • Confirm the CCP is currently in Standby Mode • Press the button requesting the device be placed into Maintenance Mode • Confirm via CVIS Management Portal that the mode changed from Standby to Maintenance **Note:** There is an approximately 30 minute delay for the mode command to be issued to the device and the status change from Standby to Maintenance to be displayed on the CVIS Management Portal because the system wakes infrequently to look for pending requests to process. • To return the device to Standby, press the button releasing the device from Maintenance Mode **Note:** There is an approximately 2-3 minute delay for the mode command to be issued to the device and the status change from Maintenance to Standby to be displayed on the CVIS Management Portal.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met? Y	Met? N	Notes
In-vehicle subsystem transitions from Standby to Maintenance mode when remotely triggered. [119]			

Test Case No. and Title	1.9.1.3 Mode Transition: Maintenance-Standby		
Verification Phase	**I – Laboratory-Based Verification**		
In-vehicle subsystem transitions from Maintenance to Standby mode when remotely triggered. [121]			

Test Case No. and Title	1.9.1.4 Mode Transition: Standby to Off
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Demonstrate the in-vehicle subsystem automatically transitioning to non-operational mode “Off” if the transit vehicle engine is off and the transit vehicle drops below a configurable value. [117]
Requirements Verified	117
Brief Description	Verify the in-vehicle subsystem automatically transitions to a non-operational mode “Off” if the transit vehicle engine is off and the transit vehicle battery drops below a configurable value via the CVIS Management Portal.
Test Setup and Configuration	• Ensure that the necessary physical cables and power sources are present, including a Variac or other means to adjust input voltage to the CCP • Power on the E-TRP CCP
Test Procedure/Script	• Observe based on the CCP LEDs that the device is in Standby Mode • Reduce the voltage being supplied to the CCP so that it is below the configured value • Confirm that the CCP transitions from Standby to Off based on the LED indicator lights
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met? Y	Met? N	Notes
In-vehicle subsystem automatically transitions to non-operational mode “off” it the transit vehicle engine is off and the transit vehicle battery drops below a configurable value. [117]			

Test Case No. and Title	**1.9.2.2 E-PCW Roadside Mode Transition: Degraded to Operational**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	Demonstrate that the CCP used in the in-vehicle subsystem and roadside subsystem automatically attempts to recover from a fault, and transitions from degraded to an operational state.
Requirements Verified	137, 125
Brief Description	Verify the in-vehicle/roadside subsystem attempt to recover from a fault. If the recovery is successful, confirm the transition of the subsystem from degraded to operational state via the CVIS Management Portal.
Test Setup and Configuration	• Ensure that the necessary physical cables and power sources are present • Ensure that the PC is loaded with the TMX Admin Portal • Ensure the TMX Admin Portal is resident on the CCP • Power on the E-TRP CCP • Ensure a real/physical GPS antenna is connected and operating. • Ensure the Vehicle CAN simulator is connected and operating. • Connect the PC to the remote external connector for the E-TRP CCP
Test Procedure/Script	• Open the TMX Admin Page • Navigate to the Status for the Plugin reporting System Status • Observe that the current state is Operational • Disconnect the GNSS connection by disconnecting the GPS antenna • Observe that the state changes to Degraded • Re-establish the GNSS connection by re-connecting the GPS antenna • Observe that the state changes back to Operational
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
Subsystem attempted to recover from a fault. [125] [137]			
Subsystem successfully recovered from a fault. [125] [137]			

Test Case No. and Title	1.9.2.2 E-PCW Roadside Mode Transition: Degraded to Operational		
Verification Phase	**I – Laboratory-Based Verification**		
Upon successful fault recovery, subsystem successfully transitioned from degraded to an operational state. [125] [137]			

Test Case No. and Title	1.9.2.4 Time Synchronization on mode transition
Verification Phase	I – Laboratory-Based Verification
Test Objectives	E-TRP system shall synchronize its system time with GNSS time upon transition from a non-operational to an operational mode.
Requirements Verified	77
Brief Description	Confirm the E-TRP system synchronizes its system time with GNSS time upon transition from a non-operational to an operational mode.
Test Setup and Configuration	• Simulate the transit vehicle transitioning between a non-operational to an operational mode. • Synchronize the time on the CCP to GNSS time. • Verify the time synchronization of the CCP after the mode transition.
Test Procedure/Script	• Power on the CCP. • Disable the Clock synchronization feature. • Change the system clock to the current date minus one year. • Re-enable the Clock synchronization feature. • Reboot the CCP • Verify the time on the CCP and compare it to the time on the GNSS server.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met?		Notes
	Y	N	
E-TRP system's time was synchronized with GNSS time in a non-operational mode.			
E-TRP system's time was synchronized with GNSS time during the transition from a non-operational to an operational mode. [77]			
E-TRP system's time was synchronized with GNSS time after the transition from a non-operational to an operational mode. [77]			

Test Case No. and Title	**1.9.2.5 Time Synchronization – Periodicity**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	E-TRP system shall synchronize its system time with GNSS time at a configurable interval between 1 and 1440 minutes.
Requirements Verified	78
Brief Description	Prove the E-TRP system synchronizes its system time with GNSS time at a configurable interval between 1 and 1440 minutes.
Test Setup and Configuration	• Power on the CCP. • Synchronize the system time of the CCP with GNSS time at the specified configurable interval.
Test Procedure/Script	• Power on the CCP. • Ensure the System Monitor Plugin is running by visiting the TMX Portal on the test device • Adjust the synchronization frequency to 1 minute • Check the time on the CCP and compare it to the time on the GNSS server. • Check the TMX Event Log to ensure that the clock synchronization was successful. • Repeat procedure with a frequency of 1440 minutes
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
E-TRP system synchronized its system time with GNSS time.			
E-TRP system synchronized its system time with GNSS time at a configurable interval between 1 and 1440 minutes. [78]			

Test Case No. and Title	**1.9.2.6 Time**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	E-TRP system shall maintain time in all operation and non-operational modes.
Requirements Verified	73
Brief Description	Validate the E-TRP system maintains time in all modes.

Test Setup and Configuration	Note: Prepare each test setup and operate each test procedure independently.
	• Refer to Test Case No. 2.4.1.1 for Test Setup and Configuration. Execute corresponding Test Procedure below.
	• Refer to Test Case No. 2.4.1.3 for Test Setup and Configuration. Execute corresponding Test Procedure below.
	• Refer to Test Case No. 2.4.1.2 for Test Setup and Configuration. Execute corresponding Test Procedure below.
	• Refer to Test Case No. 1.9.1.1 for Test Setup and Configuration. Execute corresponding Test Procedure below.
	• Refer to Test Case No. 1.9.1.2 for Test Setup and Configuration. Execute corresponding Test Procedure below.
	• Refer to Test Case No. 2.2.1 for Test Setup and Configuration. Execute corresponding Test Procedure below.
	• Follow E-TRP Test Case No. 1.9.2.1 Test Setup and Configuration:
	  ○ Ensure the CCP is powered off.
	  ○ Trigger an E-PCW warning.
	  ○ Execute corresponding Test Procedure 1.9.2.1 below.

Test Procedure/Script	• Repeat Test Procedure in Test Case No. 2.4.1.1 to verify time was maintained in the in-vehicle subsystem in operational mode. Verify time was maintained by comparing the real time of the computer with that of the logged data. • Repeat Test Procedure in Test Case No. 2.4.1.3 to verify time was maintained in the in-vehicle subsystem in an operational degraded mode. Verify time was maintained by comparing the real time of the computer with that of the logged data. • Repeat Test Procedure in Test Case No. 2.4.1.2 to verify time was maintained in the in-vehicle subsystem in a non-operational standby mode. Verify time was maintained by comparing the real time of the computer with that of the logged data. • Repeat Test Procedure in Test Case No. 1.9.1.1 to verify time was maintained in the in-vehicle subsystem in a non-operational maintenance mode. Verify time was maintained by comparing the real time of the computer with that of the logged data. • Repeat Test Procedure in Test Case No. 1.9.1.2 to verify time was maintained in the in-vehicle subsystem in a non-operational off mode. Verify time was maintained by comparing the real time of the computer with that of the logged data. • Repeat Test Procedure in Test Case No. 2.2.1 to verify time was maintained in the roadside subsystem in an operational mode. Verify time was maintained by comparing the real time of the computer with that of the logged data.

Test Case No. and Title	1.9.2.6 Time
Verification Phase	I – Laboratory-Based Verification
	• Follow Test Procedure from E-TRP Test Case No. 1.9.2.1 to verify time was maintained in the roadside subsystem in a non-operational off mode. Verify time was maintained by comparing the real time of the computer with that of the logged data: ○ Confirm the CCP is off by checking to see if the lights on the housing are illuminated. ○ Trigger an E-PCW warning with a pedestrian standing in a presence zone beneath a configured and active TrafiSense camera. ○ Verify no data was sent to the cloud management system after the alert was triggered.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met?		Notes
	Y	N	
Time was maintained in the in-vehicle subsystem in operational mode. [73]			
Time was maintained in the in-vehicle subsystem in operational degraded mode. [73]			
Time was maintained in the in-vehicle subsystem in non-operational standby mode. [73]			
Time was maintained in the in-vehicle subsystem in non-operational maintenance mode. [73]			
Time was maintained in the roadside subsystem in an operational mode. [73]			
Time was maintained in the roadside subsystem in an operational degraded mode. [73]			
Time was maintained in the roadside subsystem in a non-operational off mode. [73]			
Time was maintained in all operational and non-operational modes. [73]			

Test Case No. and Title	**1.9.2.7 Keep Configuration in All Modes**
Verification Phase	**I – Laboratory-Based Verification**
Test Objectives	E-TRP system shall maintain the system configuration in all operational and non-operational modes.
Requirements Verified	74
Brief Description	Verify the E-TRP system maintains the system configuration in all modes.
Test Setup and Configuration	Note: Prepare each test setup and operate each test procedure independently. • Refer to Test Case No. 2.4.1.1 for Test Setup and Configuration. Execute corresponding Test Procedure below. • Refer to Test Case No. 2.4.1.3 for Test Setup and Configuration. Execute corresponding Test Procedure below. • Refer to Test Case No. 2.4.1.2 for Test Setup and Configuration. Execute corresponding Test Procedure below. • Refer to Test Case No. 1.9.1.1 for Test Setup and Configuration. Execute corresponding Test Procedure below. • Refer to Test Case No. 1.9.1.2 for Test Setup and Configuration. Execute corresponding Test Procedure below. • Refer to Test Case No. 2.2.1 for Test Setup and Configuration. Execute corresponding Test Procedure below. • Follow E-TRP Test Case No. 1.9.2.1 Test Setup and Configuration: o Ensure the CCP is powered off. o Trigger an E-PCW warning. o Execute corresponding Test Procedure 1.9.2.1 below.
Test Procedure/Script	• Repeat Test Procedure in Test Case No. 2.4.1.1 to verify the system configuration was maintained in the in-vehicle subsystem in operational mode. Verify the system configuration was maintained by comparing the data available in the TMX Portal. • Repeat Test Procedure in Test Case No. 2.4.1.3 to verify the system configuration was maintained in the in-vehicle subsystem in an operational degraded mode. Verify the system configuration was maintained by the data available in the TMX Portal. • Repeat Test Procedure in Test Case No. 2.4.1.2 to verify the system configuration was maintained in the in-vehicle subsystem in a non-operational standby mode. Verify the system configuration was maintained by comparing the data available in the TMX Portal. • Repeat Test Procedure in Test Case No. 1.9.1.1 to verify the system configuration was maintained in the in-vehicle subsystem in a non-operational maintenance mode. Verify the system configuration was maintained by comparing the data available in the TMX Portal. • Repeat Test Procedure in Test Case No. 1.9.1.2 to verify the system configuration was maintained in the in-vehicle subsystem in a non-operational off mode. Verify the system configuration was maintained by comparing the data available in the TMX Portal.

Test Case No. and Title	1.9.2.7 Keep Configuration in All Modes
Verification Phase	I – Laboratory-Based Verification
	• Repeat Test Procedure in Test Case No. 2.2.1 to verify the system configuration was maintained in the roadside subsystem in an operational mode. Verify the system configuration was maintained by comparing the data available in the TMX Portal. • Follow Test Procedure from E-TRP Test Case No. 1.9.2.1 to verify time was maintained in the roadside subsystem in a non-operational off mode. Verify time was maintained by comparing the data available in the TMX Portal: o Confirm the CCP is off by checking to see if the lights on the housing are illuminated. o Trigger an E-PCW warning with a pedestrian standing in a presence zone beneath a configured and active TrafiSense camera. o Verify no data was sent to the cloud management system after the alert was triggered.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met?		Notes
	Y	N	
System configuration was maintained in the in-vehicle subsystem in operational mode. [74]			
System configuration was maintained in the in-vehicle subsystem in operational degraded mode. [74]			
System configuration was maintained in the in-vehicle subsystem in non-operational standby mode. [74]			
System configuration was maintained in the in-vehicle subsystem in non-operational maintenance mode. [74]			
System configuration was maintained in the roadside subsystem in an operational mode. [74]			
System configuration was maintained in the roadside subsystem in an operational degraded mode. [74]			

Test Case No. and Title	1.9.2.7 Keep Configuration in All Modes		
Verification Phase	**I – Laboratory-Based Verification**		
System configuration was maintained in the roadside subsystem in a non-operational off mode. [74]			
System configuration was maintained in all operational and non-operational modes. [74]			

2.0 Phase II (Garage / Controlled Parking Lot Verification)

The test cases in this phase do not distinguish whether testing will be conducted in a garage or controlled parking lot environment. The Test Setup and Configuration, and Test Procedures/Script, sections of test cases in this phase contain language assuming the garage environment. It is anticipated that all scenario-based test cases in section 2.1.X will be conducted in the simulated garage environment, though it is possible that select test cases – or portions thereof – may be repeated in the parking lot verification environment.

In support of garage testing, as well as laboratory-based tests that leverage garage testing scenarios, a set of TMX Simulation scripts will be used to simulate vehicle(s) and pedestrian(s) details including locations relative to the TSPW Enabled Area and defined pedestrian zones, including the Roadway Zones in accordance with phased sequence details in the Test Procedures/Script section of each test case in this section. As with the E-TRP testing, a SQL script will be used as a tool to access the Azure DB following the execution completion of any test case. This script permits review of the data reported for the test case.

2.1 TSPW Functionality (Includes Detection, User Interface, Logging, and Functional Characteristics)

Test Case No. and Title	2.1.1 Transit Vehicle Traverses Bus Stop with No Pedestrians Present
Verification Phase	II - Garage / Controlled Parking Lot Verification

Test Objectives	**User Interface:**
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches, passes, and departs the bus stop area with no pedestrians present per the following sequence:
	  ○ Scenario #1 – transit vehicle approaching with no waiting pedestrians/riders,
	  ○ Scenario #9 – transit vehicle approaching and has entered the rear roadway zone with no waiting riders at the transit stop,
	  ○ Scenario #17 – transit vehicle stopped at the transit stop with no waiting riders or pedestrians,
	  ○ Scenario #25 – transit vehicle is departing but still in all four roadway zones and there are no waiting riders,
	  ○ Scenario #33 – transit vehicle is departing but is still in the forward roadway zones and there are no waiting riders,
	  ○ Scenario #41 – transit vehicle is departing and has cleared all roadway zones and there are no waiting riders
	• Confirm that the location where the TSPW application begins to provide alerts is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle.
	
	Functional:
	• The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Requirements Verified	215, 216, 226, 233, 247, 273, 274, 276, 286
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches, passes, and departs the bus stop area with no pedestrians present in any waiting zone or roadway zone.
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS).

Test Case No. and Title	2.1.1 Transit Vehicle Traverses Bus Stop with No Pedestrians Present
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration #1 Sequence:*** ConOps Scenario #1: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • No pedestrians are present or enter waiting/roadway zones ConOps Scenario #9: • Simulated Transit Vehicle continues approach and enters the rear roadway zones • No pedestrians are present or enter waiting/roadway zones ConOps Scenario #17: • Simulated Transit Vehicle stops such that it occupies all four roadway zones • No pedestrians are present or enter waiting/roadway zones ConOps Scenario #25: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • No pedestrians are present or enter waiting/roadway zones ConOps Scenario #33: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • No pedestrians are present or enter waiting/roadway zones ConOps Scenario #41:

Test Case No. and Title	2.1.1 Transit Vehicle Traverses Bus Stop with No Pedestrians Present
Verification Phase	II - Garage / Controlled Parking Lot Verification
	• Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • No pedestrians are present or enter waiting/roadway zones ***Iterations #2-3 Sequence:*** Following the conclusion of the sequenced scenarios for Iteration #1 above, two additional iterations of Scenario #1 are executed • Iteration #2 – the same configuration settings are used, but the transit vehicle approaches the TSPW-enabled area at a faster rate than in iteration #1 • Iteration #3 – the transit vehicle approaches the TSPW-enabled area at the same rate as in iteration #1, but the configured distance is lengthened from that used in iteration #1 ***Iteration #4 Sequence:*** to confirm that the RP-TAM-Approach deactivates [226] as the transit vehicle passes by the roadway zones rather than stopping in them, the following portions of iteration #1 are executed such that the sequence is ConOps Scenarios #1 - #9 - #25, where the transit vehicle does not stop within the roadway zones.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	Met?		Notes
	Y	N	
Scenario #1 (iteration #1 unless marked):			
Confirm that a TVO-SRA is provided when the transit vehicle enters the TSPW Enabled Area [215] [273]			
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			

Test Case No. and Title	2.1.1 Transit Vehicle Traverses Bus Stop with No Pedestrians Present		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Iterations 2-3: Confirm that the location where the TSPW application begins to provide alerts (TVO-SRA) is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle [276]			
Scenario #9:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215] [273]			
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Scenario #17:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Scenario #25 (iteration #1 & 4 unless marked):			

Test Case No. and Title	2.1.1 Transit Vehicle Traverses Bus Stop with No Pedestrians Present		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Iteration 1: Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			
Iteration 4: Confirm that the RP-TAM-Approach deactivates when the transit vehicle passes by the roadway zones [226] [274]			
Scenario #33:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Scenario #41:			
Confirm that the TVO-SRA deactivates after the transit vehicle departs the roadway zones [247]			

Test Case No. and Title	2.1.2 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Transit Shelter
Verification Phase	II - Garage / Controlled Parking Lot Verification
Test Objectives	**User Interface:** • Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches, passes, and departs the bus stop area with pedestrian(s) present only in the transit shelter, per the following sequence: o Scenario #2 – transit vehicle approaching with pedestrian(s) in transit shelter, o Scenario #10 – transit vehicle approaching and has entered the rear roadway zone with pedestrian(s) in transit shelter, o Scenario #18 – transit vehicle stopped at the transit stop with pedestrian(s) in transit shelter, o Scenario #26 – transit vehicle is departing but still in all four roadway zones and there are pedestrian(s) in transit shelter, o Scenario #34 – transit vehicle is departing but is still in the forward roadway zones and there are pedestrian(s) in transit shelter, o Scenario #42 – transit vehicle is departing and has cleared all roadway zones and there are pedestrian(s) in transit shelter o Transit vehicle exits the TSPW enabled area **Functional:** • The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped
Requirements Verified	215, 216, 217, 226, 228, 233, 247, 254, 273, 274, 286, 293, 311, 312
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches, passes, and departs the bus stop area with pedestrian(s) present only in the transit shelter. The transit vehicle continues beyond the TSPW Enabled Area.
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS).

Test Case No. and Title	2.1.2 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Transit Shelter
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration Sequence:*** ConOps Scenario #2: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • Simulated pedestrian(s) are present only in the transit shelter ConOps Scenario #10: • Simulated Transit Vehicle continues approach and enters the rear roadway zones • Simulated pedestrian(s) are present only in the transit shelter ConOps Scenario #18: • Simulated Transit Vehicle stops such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the transit shelter ConOps Scenario #26: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • Simulated pedestrian(s) are present only in the transit shelter ConOps Scenario #34: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the transit shelter

Test Case No. and Title	2.1.2 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Transit Shelter
Verification Phase	II - Garage / Controlled Parking Lot Verification
	• If practical, the simulated pedestrian/MP moves outside of the TSPW Enabled Area (to verify they do not receive MP-SRA) and moves back inside of the TSPW Enabled Area ConOps Scenario #42: • Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • Simulated pedestrian(s) are present only in the transit shelter Transit Vehicle Exits the TSPW Enabled Area.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	Met?		Notes
	Y	N	
Scenario #2:			
Confirm that a TVO-SRA is provided when the transit vehicle enters the TSPW Enabled Area [215] [273]			
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [217] [274] [273] [254] [293]			
Scenario #10:			

Test Case No. and Title	2.1.2 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Transit Shelter		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215] [273]			
Confirm that the RP-TAM-Approach including vehicle route number remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices in the TSPW Enabled Area when the transit vehicle is within any roadway zone and in motion [228] [274] [273] [254] [293]			
Scenario #18:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311] [274] [273]			
Scenario #26:			

Test Case No. and Title	2.1.2 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Transit Shelter		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			
Confirm that the MP-SRA continues to be provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311] [274]			
Scenario #34:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the MP-SRA continues to be provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311]			**Note:** The MP-SRA deactivates when the MP is outside of the TSPW Enabled Area.
Scenario #42:			
Confirm that the TVO-SRA deactivates after the transit vehicle departs the roadway zones [247]			
Transit Vehicle Exits the TSPW Enabled Area:			
Confirm that the MP-SRA to subscribed mobile devices within the TSPW Enabled Area deactivates when the transit vehicle departs the TSPW Enabled Area [312]			

Test Case No. and Title	2.1.3 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1)
Verification Phase	II - Garage / Controlled Parking Lot Verification
Test Objectives	**User Interface:** • Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches, passes, and departs the bus stop area with pedestrian(s) present only in the waiting safe zone (Zone 1), per the following sequence: o Scenario #3 – transit vehicle approaching with pedestrian(s) in the waiting safe zone (zone 1), o Scenario #11 – transit vehicle approaching and has entered the rear roadway zone with pedestrian(s) in the waiting safe zone (zone 1), o Scenario #19 – transit vehicle stopped at the transit stop with pedestrian(s) in the waiting safe zone (zone 1), o Scenario #27 – transit vehicle is departing but still in all four roadway zones and there are pedestrian(s) in the waiting safe zone (zone 1), o Scenario #35 – transit vehicle is departing but is still in the forward roadway zones and there are pedestrian(s) in the waiting safe zone (zone 1), o Scenario #43 – transit vehicle is departing and has cleared all roadway zones and there are pedestrian(s) in the waiting safe zone (zone 1) o Transit vehicle exits the TSPW enabled area **Functional:** • The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped
Requirements Verified	215, 216, 217, 226, 228, 233, 247, 254, 273, 274, 286, 293, 311, 312
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches, passes, and departs the bus stop area with pedestrian(s) present only in the waiting safe zone (zone 1). The transit vehicle continues beyond the TSPW Enabled Area.
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS).

Test Case No. and Title	2.1.3 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1)
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration Sequence:*** ConOps Scenario #3: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) ConOps Scenario #11: • Simulated Transit Vehicle continues approach and enters the rear roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) ConOps Scenario #19: • Simulated Transit Vehicle stops such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) ConOps Scenario #27: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) ConOps Scenario #35: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) ConOps Scenario #43:

Test Case No. and Title	2.1.3 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1)
Verification Phase	II - Garage / Controlled Parking Lot Verification
	• Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) Transit Vehicle Exits the TSPW Enabled Area.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	Met?		Notes
	Y	N	
Scenario #3:			
Confirm that a TVO-SRA is provided when the transit vehicle enters the TSPW Enabled Area [215] [273]			
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [217] [274] [273] [254] [293]			
Scenario #11:			
Confirm that the TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215] [273]			

Test Case No. and Title	2.1.3 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1)		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the RP-TAM-Approach including vehicle route number remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices in the TSPW Enabled Area when the transit vehicle is within any roadway zone and in motion [228] [274] [273] [254] [293]			
Scenario #19:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311] [274] [273]			
Scenario #27:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			

Test Case No. and Title	2.1.3 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1)		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			
Confirm that the MP-SRA continues to be provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311] [274]			
Scenario #35:			
Confirm that a TVO-SRA remains after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the MP-SRA continues to be provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311]			
Scenario #43:			
Confirm that the TVO-SRA deactivates after the transit vehicle departs the roadway zones [247]			
Transit Vehicle Exits the TSPW Enabled Area:			
Confirm that the MP-SRA to subscribed mobile devices within the TSPW Enabled Area deactivates when the transit vehicle departs the TSPW Enabled Area [312]			

Test Case No. and Title	2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)
Verification Phase	II - Garage / Controlled Parking Lot Verification
Test Objectives	**User Interface:** • Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches, passes, and departs the bus stop area with pedestrian(s) present only in the waiting danger zone (Zone 2), per the following sequence: ○ Scenario #4 – transit vehicle approaching with pedestrian(s) in the waiting danger zone (zone 2), ○ Scenario #12 – transit vehicle approaching and has entered the rear roadway zone with pedestrian(s) in the waiting danger zone (zone 2), ○ Scenario #20 – transit vehicle stopped at the transit stop with pedestrian(s) in the waiting danger zone (zone 2), ○ Scenario #28 – transit vehicle is departing but still in all four roadway zones and there are pedestrian(s) in the waiting danger zone (zone 2), ○ Scenario #36 – transit vehicle is departing but is still in the forward roadway zones and there are pedestrian(s) in the waiting danger zone (zone 2), ○ Scenario #44 – transit vehicle is departing and has cleared all roadway zones and there are pedestrian(s) in the waiting danger zone (zone 2) • Confirm that the location where the TSPW application begins to provide alerts is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle (Note: 2.1.1 is used to confirm TVO-SRA and RP-TAM-Approach, while this test case is used to confirm TVO-IA, RP-IA, and MP-IA. Test case 2.1.5 will be used to confirm TVO-WA, RP-WA, and MP-TAM-Approach). **Functional:** • The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped
Requirements Verified	215, 216, 218, 219, 220, 224, 226, 229, 230, 231, 233, 236, 237, 238, 242, 243, 244, 248, 254, 257, 258, 264, 273, 274, 276, 279, 281, 282, 283, 284, 285, 286, 287, 289, 292, 293, 311, 336

Test Case No. and Title	**2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches, passes, and departs the bus stop area with pedestrian(s) present only in the waiting danger zone (zone 2).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration #1 Sequence:*** ConOps Scenario #4: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2) ConOps Scenario #12: • Simulated Transit Vehicle continues approach and enters the rear roadway zones • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2) ConOps Scenario #20: • Simulated Transit Vehicle stops such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2) ConOps Scenario #28: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2)

Test Case No. and Title	2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)
Verification Phase	II - Garage / Controlled Parking Lot Verification
	ConOps Scenario #36: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2) ConOps Scenario #44: • Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2) ***Iterations #2-3 Sequence:*** Following the conclusion of the sequenced scenarios for Iteration #1 above, two additional iterations of Scenario #1 are executed • Iteration #2 – the same configuration settings are used, but the transit vehicle approaches the TSPW-enabled area at a faster rate than in iteration #1 • Iteration #3 – the transit vehicle approaches the TSPW-enabled area at the same rate as in iteration #1, but the configured distance is lengthened from that used in iteration #1 ***Iteration #4 Sequence:*** to confirm that the TVO-IA [248], RP-IA [257], and MP-IA alerts deactivate as the waiting pedestrian moves from zone 2 to zone 1, iteration #1 is repeated through Scenario #36 (excluding Scenario #44) with noted additions for pedestrian movement.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	Met?		Notes
	Y	N	
Scenario #4 (All iterations unless marked):			
Confirm that a TVO-IA is provided when the transit vehicle enters the TSPW Enabled Area [219] [274] [273] [231] [289]			

Test Case No. and Title	2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an OTVP-WA is NOT provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that a RP-IA is provided when the transit vehicle enters the TSPW Enabled Area [218] [274] [273]			
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Confirm that an MP-IA is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [220] [274] [273] [254] [293]			
Iterations 2-3 only: Confirm that the location where the TSPW application begins to provide alerts (TVO-IA, RP-IA, RP-TAM-Approach, and MP-IA) is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle [276]			
Scenario #12 (Iterations #1 & #4):			
Confirm that a TVO-IA remains after the transit vehicle is within the TSPW Enabled Area [224] [274] [273] [231] [289]			

Test Case No. and Title	2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an OTVP-WA is NOT provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that a RP-IA remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [230] [274] [273]			
Confirm that the RP-TAM-Approach including vehicle route number remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that an MP-IA is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [229] [274] [273] [254] [293]			
Scenario #20 (Iterations #1 & #4):			
Confirm that a TVO-SRA is provided after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts (TVO-IA would otherwise) apply [215] [279]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and no DSRC-enabled POVs are approaching [283] [274] [273]			
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			

Test Case No. and Title	2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that an RP-IA or RP-WA is NOT provided when the vehicle is stopped within the roadway zones [287] [274] [273]			
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and other alerts are NOT displayed which (MP-IA would otherwise) supersede it [311] [274] [273] [292]			
Scenario #28 (Iterations #1 & #4):			
Confirm that a TVO-IA is provided after the transit vehicle is in motion and still within the forward and rear roadway zones [236] [274] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the roadway zones and the front of the vehicle has departed the forward roadway zones [284] [274]			
Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			
Confirm that a RP-IA is provided after the transit vehicle is in motion and still within the forward and rear roadway zones [237] [274]			

Test Case No. and Title	2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an MP-IA is provided to subscribed mobile devices when the transit vehicle is in motion and still within the forward and rear roadway zones [238] [274] [254] [293]			
Scenario #36 (iteration #1 & 4 unless noted):			
Confirm that a TVO-IA remains after the transit vehicle is in motion and within the forward roadway zones [242] [274] [231] [289]			
Iteration 4 only: Confirm that the TVO-IA deactivates when the transit vehicle is in motion and within the forward roadway zones, but the pedestrian(s) moves to the waiting safe zone (zone 1) [248]			**Note:** The TVO-IA should be re-issued/provided when the pedestrian(s) moves back into the waiting danger zone (zone 2) – prior to the transit vehicle departure from the forward roadway zones.
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the forward roadway zones, but with the front of the vehicle beyond the forward zones [285] [274]			
Confirm that a RP-IA is provided when the transit vehicle is in motion and within the forward roadway zones [243] [274]			
Iteration 4 only: Confirm that the RP-IA deactivates when the transit vehicle is in motion and within the forward roadway zones, but the pedestrian(s) moves to the waiting safe zone (zone 1) [257]			**Note:** The RP-IA should be re-issued/provided when the pedestrian(s) moves back into the waiting danger zone (zone 2) – prior to the transit vehicle departure from the forward roadway zones.
Confirm that an MP-IA remains a provided alert to subscribed mobile devices when the transit vehicle is in motion and within the forward roadway zones [244] [274] [254] [293]			

Test Case No. and Title	2.1.4 Transit Vehicle Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Danger Zone (Zone 2)		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Iteration 4 only: Confirm that the MP-IA deactivates when the transit vehicle is in motion and within the forward roadway zones, but the pedestrian(s) moves to the waiting safe zone (zone 1) [258]			**Note:** The MP-IA should be re-issued/provided when the pedestrian(s) moves back into the waiting danger zone (zone 2) – prior to the transit vehicle departure from the forward roadway zones.
Scenario #44 (Iteration #1 only):			
Confirm that the TVO-SRA deactivates after the transit vehicle departs the roadway zones [282]			
Confirm that the RP-IA deactivates once the transit vehicle departs the roadway zones [336]			
Confirm that the MP-IA to subscribed mobile devices within the TSPW Enabled Area deactivates when the transit vehicle departs the roadway zones [264]			

Test Case No. and Title	**2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Objectives	**User Interface:** • Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway forward curb zone (Zone 3), pulls up to and stops at the bus stop with no pedestrian(s) initially present, then dwells and departs the bus stop area with pedestrian(s) present in select roadway zones (Zone 3-6), per the following sequence: o Scenario #5 – transit vehicle approaching with pedestrian(s) in the roadway forward curb zone (zone 3), o Scenario #13 – transit vehicle approaching and has entered the rear roadway zone with pedestrian(s) in the roadway forward curb zone (zone 3); **Note:** the transit vehicle will move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway forward curb zone (zone 3) to confirm OTVP-WA conditions, o As the transit vehicle pulls up to and stops at the bus stop, there are no pedestrians in any detection zone. While the bus is stopped, pedestrian movements occur as follows: ▪ Scenario #21 – transit vehicle stopped at the transit stop with pedestrian(s) in the forward curbside zone (zone 3), ▪ Scenario #23 – transit vehicle stopped at the transit stop with pedestrian(s) in the forward center zone - in front of the transit vehicle (zone 5) o As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in rear center zone (zone 6), as follows: ▪ Scenario #32 – transit vehicle is departing but still in all four roadway zones and there are pedestrian(s) in the rear center zone (zone 6), ▪ Scenario #40 – transit vehicle is departing but is still in the forward roadway zones and there are pedestrian(s) in the rear center zone (zone 6), ▪ Scenario #48 – transit vehicle is departing and has cleared all roadway zones and there are pedestrian(s) in the rear center zone (zone 6)

Test Case No. and Title	**2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Confirm that the location where the TSPW application begins to provide alerts is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle (Note: test case 2.1.1 is used to confirm TVO-SRA and RP-TAM-Approach, test case 2.1.4 is used to confirm TVO-IA, RP-IA, and MP-IA. This test case is used to confirm TVO-WA, RP-WA, and MP-TAM-Approach). **Functional:** • The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped **Logging:** • Confirm that logging requirements are met and that details match manually captured/simulated scenario details, including by GNSS timestamp.
Requirements Verified	215, 216, 217, 221, 222, 223, 225, 226, 227, 231, 232, 233, 234, 235, 239, 240, 254, 260, 273, 274, 276, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 293, 334, 335, 337 [logging: 205, 41, 153, 196, 298, 301, 300, 302, 303, 304, 214, 180, 197, 198]
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway forward curb zone (Zone 3), pulls up to and stops at the bus stop with no pedestrian(s) initially present, then dwells with pedestrian(s) present in the roadway forward curb zone (Zone 3) followed by the roadway forward center zone (Zone 5), and departs the bus stop area with pedestrian(s) present in the roadway rear center zone (Zone 6).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating.

Test Case No. and Title	**2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Verify that all systems are operating and communicating normally. • Open SQL Server Management Studio and run the script TspwResultsFromLatestInteraction.sql
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration #1 Sequence:*** ConOps Scenario #5: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • Simulated pedestrian(s) are present only in the roadway forward curb zone (zone 3) ConOps Scenario #13: • Simulated Transit Vehicle continues approach and enters the rear roadway zones • Simulated pedestrian(s) are present only in the roadway forward curb zone (zone 3) • **Note:** After the pedestrian is detected in the roadway forward curb zone (zone 3), the transit vehicle will continue to move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway forward curb zone (zone 3) As the transit vehicle pulls up to and stops at the bus stop, there are no pedestrians in any detection zone. While the bus is stopped, pedestrian movements occur as follows: ConOps Scenario #21: • Simulated Transit Vehicle is stopped such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the forward curbside zone (zone 3) ConOps Scenario #23: • Simulated Transit Vehicle remains stopped such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the forward center zone - in front of the transit vehicle (zone 5)

Test Case No. and Title	**2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in rear center zone (zone 6), as follows: ConOps Scenario #32: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • Simulated pedestrian(s) are present only in the rear center zone (zone 6) ConOps Scenario #40: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the rear center zone (zone 6) ConOps Scenario #48: • Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • Simulated pedestrian(s) are present only in the rear center zone (zone 6) Retrieve logged data collected by the logging service for this test case from the remotely hosted cloud management subsystem and compare logged details against manually captured/simulated scenario details, including by GNSS timestamp. ***Iterations #2-3 Sequence:*** Following the conclusion of the sequenced scenarios for Iteration #1 above, two additional iterations of Scenario #1 are executed (data need not be logged in these iterations) • Iteration #2 – the same configuration settings are used, but the transit vehicle approaches the TSPW-enabled area at a faster rate than in iteration #1 • Iteration #3 – the transit vehicle approaches the TSPW-enabled area at the same rate as in iteration #1, but the configured distance is lengthened from that used in iteration #1

Test Case No. and Title	**2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	Iteration #4 Sequence: To confirm that the TVO-WA does not activate when pedestrians appear in the rear roadway zones (zone 4/6) [280], iteration #1 is repeated through Scenario #40 where instead of the transit vehicle proceeding to the forward roadway zones with the pedestrian(s) remaining in zone 6 per iteration #1 (to confirm the TVO-WA deactivates, in Iteration #4, prior to Scenario #40, the pedestrian disappears from zone 6 and then appears in zone 6 once the vehicle has departed the rear roadway zones during scenario #40 to confirm the TVO-WA does not activate. Data need not be logged in this iteration.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #5 (All iterations unless marked):			
Confirm that a TVO-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [223] [274] [273] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that a RP-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [222] [274] [273]			

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [217] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Iterations 2-3 only: Confirm that the location where the TSPW application begins to provide alerts (TVO-WA, RP-WA, RP-TAM-Approach, and MP-TAM-Approach) is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle [276]			
Scenario #13 (Iterations #1 & #4):			
Confirm that the TVO-WA remains after the transit vehicle enters the TSPW Enabled Area, in motion, and in the rear roadway zones [225] [274] [273] [231] [289]			
Confirm that an OTVP-WA is provided when the transit vehicle is within any roadway zone and is in motion [232] [274] [273]			

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the provided OTVP-WA is deactivated when the transit vehicle continues very slow movement in the rear roadway zones and pedestrian(s) moves to the waiting danger zone (zone 2) [260] [274] [273]			**Note:** the pedestrian movement to the waiting danger zone (zone 2) is brief (just long enough to confirm this requirement) before moving back to the roadway forward curb zone (zone 3) – while the transit vehicle is moving very slowly
Confirm that a RP-WA remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [227] [274] [273]			
Confirm that the RP-TAM-Approach including vehicle route number remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that the MP-TAM-Approach including vehicle route number remains provided to subscribed mobile devices as the transit vehicle continues movement and is within any roadway zone [228] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #21 (Iterations #1 & #4):			
Confirm that a TVO-SRA is provided when the transit vehicle is at the transit stop and no other TVO alerts (TVO-WA does not) apply [215] [335]			

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an OTVP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and no DSRC-enabled POVs are approaching [283] [274] [273]			
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that an RP-IA or RP-WA is NOT provided when the vehicle is stopped within the roadway zones [287] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #23 (Iterations #1 & #4):			**Note:** Pedestrian(s) moves to the roadway forward center zone (zone 5) from the roadway forward curb zone (zone 3), while the transit vehicle remains stopped at the bus stop, prior to the start of this scenario.
Confirm that a TVO-IA is provided with the transit vehicle stopped at the bus stop, within the roadway zones, and with pedestrian(s) in zone 5/6 [235] [274] [273] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and no DSRC-enabled POVs are approaching [283] [274] [273]			

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an RP-IA is provided when the vehicle is stopped within the roadway zones with pedestrian(s) in zone 5/6 [234] [274] [273]			
Confirm that the RP-TAM-Approach remains inactive while the transit vehicle remains stopped within the roadway zones [226] [274] [273]			
Confirm that the RP-TAM-Stop including vehicle route number remains active while the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #32 (Iterations #1 & #4):			**Note:** Pedestrian(s) moves to the roadway rear center zone (zone 6) from the roadway forward center zone (zone 5) prior to the start of this scenario.
Confirm that a TVO-WA is provided when the transit vehicle is departing, and is in motion in both the forward and rear roadway zones [240] [274] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the roadway zones and the front of the vehicle has departed the forward roadway zones [284] [274]			
Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a RP-WA is provided after the transit vehicle is in motion and still within the forward and rear roadway zones with pedestrian(s) in roadway zone [239] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #40 (iteration #1 & 4 unless noted):			**Iteration #4 Note**: Prior to this scenario, the pedestrian disappears from zone 6 (rather than remaining there from scenario #32 as in Iteration #1). The pedestrian then appears in zone 6 once the vehicle has departed the rear roadway zones.
Iteration #1: Confirm that the TVO-WA deactivates and a TVO-SRA is provided when the transit vehicle is departing but still in the forward roadway zone as no other alerts apply [215] [334]			
Iteration #4: Confirm that a TVO-WA is NOT provided when the transit vehicle has departed the rear roadway zones and a pedestrian appears in the roadway rear center zone (zone 6); and, because no other alerts apply, the TVO-SRA is provided [215] [280]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the forward roadway zones, but with the front of the vehicle beyond the forward zones [285] [274]			

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an RP-IA or RP-WA is NOT provided when the vehicle has departed the rear roadway zones with a pedestrian(s) in the rear roadway zones (zone 4/6) [288] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #48 (Iteration #1 only):			
Confirm that the TVO-SRA deactivates after the transit vehicle departs the roadway zones [282]			
Confirm that the RP-WA deactivates once the transit vehicle departs the roadway zones where pedestrian(s) are present [337]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Logged Details Assessment (Iteration #1 only):			**Note:** Confirm that logged details in the TMX Event Log match manually captured/simulated scenario details and meet requirements as follows.
All triggered event data is logged by TSPW Roadside Subsystem logs, including TSPW alerts each of which includes a unique identifier. [298] [205]			
A unique roadside identification ID for each TSPW pedestrian detection is found in the TMX event log. [301]			

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop			
Verification Phase	**II - Garage / Controlled Parking Lot Verification**			
Confirm that the TSPW roadside subsystem captured all TSPW system generated DSRC messages transmitted by and received by the TSPW roadside subsystem. [302] [303]				
When an enabled transit vehicle is within the TSPW Enabled Area, confirm that an image and log entry for zone detections is captured and stored for every triggered TSPW pedestrian zone detection by the Roadside application. [180] [214] [301]				
Confirm that the TSPW Roadside application stores a log of all RP HIS state transitions, including pre-state, triggering alert ID, and post-state. [197]				
Confirm that the TSPW Roadside application stores a log of all alerts provided to the MP HIS for mobile application subscribers, including the triggering alert ID. [198]				
Logged details in the TMX Event Log were collected by the TSPW Roadside application and uploaded to the cloud database. [304] [300]				**Note:** A design decision was made to not log data in standby mode, as the subsystem is effectively “off”. As such, the portion of requirement number 300 corresponding to standby mode is not tested. Req. 300: “The TSPW Roadside Subsystem shall transfer data files to a remotely hosted cloud management subsystem, when connected in both Operational and Standby modes such that no data files are lost, deleted or corrupted.”

Test Case No. and Title	2.1.5 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) and with Pedestrian(s) Present in Roadway Rear Center Zone (Zone 6) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the TSPW In-Vehicle application stores a log of all state transitions of the OTVP HIS, including the pre-state and post-state. [196]			
All alert activations including alert type, alert ID and associated roadside location ID are logged by the TSPW In-Vehicle Application. [41]			
All alert deactivations including alert type, alert ID and associated roadside location ID are logged by the TSPW In-Vehicle Application. [153]			

Test Case No. and Title	**2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Objectives	**User Interface:** • Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway rear curb zone (Zone 4), pulls up to and stops at the bus stop with pedestrian(s) in Zone 6, then dwells and departs the bus stop area with pedestrian(s) present in the roadway rear curb zone (Zone 4), per the following sequence: o Scenario #6 – transit vehicle approaching with pedestrian(s) in the roadway rear curb zone (Zone 4), o Scenario #14 – transit vehicle approaching and has entered the rear roadway zone with pedestrian(s) in the roadway rear curb zone (Zone 4); **Note:** the transit vehicle will move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway rear curb zone (Zone 4) to confirm OTVP-WA conditions, o As the transit vehicle pulls up to stop and remains stopped at the bus stop, pedestrian positions are as follows: ▪ Scenario #22 – transit vehicle stopped at the transit stop with pedestrian(s) in the roadway rear curb zone (Zone 4), ▪ Scenario #24 – transit vehicle stopped at the transit stop with pedestrian(s) in the roadway rear center zone (zone 6) o As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in roadway rear curb zone (Zone 4), as follows: ▪ Scenario #30 – transit vehicle is departing but still in all four roadway zones and there are pedestrian(s) in the roadway rear curb zone (Zone 4), ▪ Scenario #38 – transit vehicle is departing but is still in the forward roadway zones and there are pedestrian(s) in the roadway rear curb zone (Zone 4), ▪ Scenario #46 – transit vehicle is departing and has cleared all roadway zones and there are pedestrian(s) in the roadway rear curb zone (Zone 4) **Functional:**

Test Case No. and Title	**2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped
Requirements Verified	215, 216, 217, 221, 222, 223, 225, 226, 227, 231, 232, 233, 234, 235, 239, 240, 254, 260, 273, 274, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 293, 334, 335, 337
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway rear curb zone (Zone 4), pulls up to and stops at the bus stop pedestrian(s) initially present in zone 4, dwells with pedestrian(s) within the roadway rear center zone (Zone 6), and finally departs the bus stop area with pedestrian(s) present in the roadway rear curb zone (Zone 4).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration #1 Sequence:*** ConOps Scenario #6: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • Simulated pedestrian(s) are present only in the roadway rear curb zone (zone 4) ConOps Scenario #14: • Simulated Transit Vehicle continues approach and enters the rear roadway zones

Test Case No. and Title	**2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Simulated pedestrian(s) are present only in the roadway rear curb zone (zone 4) • **Note:** After the pedestrian is detected in the roadway rear curb zone (zone 4), the transit vehicle will continue to move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway rear curb zone (zone 4) As the transit vehicle pulls up to stop and remains stopped at the bus stop, pedestrian positions are as follows: ConOps Scenario #22: • Simulated Transit Vehicle is stopped such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the roadway rear curb zone (zone 4) ConOps Scenario #24: • Simulated Transit Vehicle remains stopped such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the roadway rear center zone (zone 6) As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in roadway rear curb zone (zone 4), as follows: ConOps Scenario #30: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • Simulated pedestrian(s) are present only in the roadway rear curb zone (zone 4) ConOps Scenario #38: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the roadway rear curb zone (zone 4) ConOps Scenario #46: • Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • Simulated pedestrian(s) are present only in the roadway rear curb zone (zone 4)

Test Case No. and Title	**2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	Iteration #2 Sequence: to confirm that the TVO-WA does not activate when pedestrians appear in the rear roadway zones (zone 4/6) [280], iteration #1 is repeated through Scenario #38 where instead of the transit vehicle proceeding to the forward roadway zones with the pedestrian(s) remaining in zone 4 per iteration #1 (to confirm the TVO-WA deactivates, in Iteration #2, prior to Scenario #38, the pedestrian disappears from zone 4 and then appears in zone 4 once the vehicle has departed the rear roadway zones during scenario #38 to confirm the TVO-WA does not activate.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #6 (Iterations #1 & #2):			
Confirm that a TVO-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [223] [274] [273] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that a RP-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [222] [274] [273]			

Test Case No. and Title	2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [217] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #14 (Iterations #1 & #2):			
Confirm that the TVO-WA remains after the transit vehicle enters the TSPW Enabled Area, in motion, and in the rear roadway zones [225] [274] [273] [231] [289]			
Confirm that an OTVP-WA is provided when the transit vehicle is within any roadway zone and is in motion [232] [274] [273]			
Confirm that the provided OTVP-WA is deactivated when the transit vehicle continues very slow movement in the rear roadway zones and pedestrian(s) moves to the waiting danger zone (zone 2) [260] [274] [273]			**Note:** the pedestrian movement to the waiting danger zone (zone 2) is brief (just long enough to confirm this requirement) before moving back to the roadway rear curb zone (zone 4) – while the transit vehicle is moving very slowly

Test Case No. and Title	2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a RP-WA remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [227] [274] [273]			
Confirm that the RP-TAM-Approach including vehicle route number remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that the MP-TAM-Approach including vehicle route number remains provided to subscribed mobile devices as the transit vehicle continues movement and is within any roadway zone [228] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #22 (Iterations #1 & #2):			
Confirm that a TVO-SRA is provided when the transit vehicle is at the transit stop and no other TVO alerts (TVO-WA does not) apply [215] [335]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and no DSRC-enabled POVs are approaching [283] [274] [273]			

Test Case No. and Title	2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that an RP-IA or RP-WA is NOT provided when the vehicle is stopped within the roadway zones [287] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #24 (Iterations #1 & #2):			**Note:** Pedestrian(s) moves to the roadway rear center zone (zone 6) from the roadway rear curb zone (zone 4), while the transit vehicle remains stopped at the bus stop, prior to the start of this scenario.
Confirm that a TVO-IA is provided with the transit vehicle stopped at the bus stop, within the roadway zones, and with pedestrian(s) in zone 5/6 [235] [274] [273] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and no DSRC-enabled POVs are approaching [283] [274] [273]			
Confirm that an RP-IA is provided when the vehicle is stopped within the roadway zones with pedestrian(s) in zone 5/6 [234] [274] [273]			

Test Case No. and Title	2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the RP-TAM-Approach remains inactive while the transit vehicle remains stopped within the roadway zones [226] [274] [273]			
Confirm that the RP-TAM-Stop including vehicle route number remains active while the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #30 (Iterations #1 & #2):			**Note:** Pedestrian(s) moves to the roadway rear curb zone (zone 4) from the roadway rear center zone (zone 6) prior to the start of this scenario.
Confirm that a TVO-WA is provided when the transit vehicle is departing, and is in motion in both the forward and rear roadway zones [240] [274] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the roadway zones and the front of the vehicle has departed the forward roadway zones [284] [274]			
Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			

Test Case No. and Title	2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a RP-WA is provided after the transit vehicle is in motion and still within the forward and rear roadway zones with pedestrian(s) in roadway zone [239] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #38 (iteration #1 & 2 unless noted):			**Iteration #2 Note**: Prior to this scenario, the pedestrian disappears from zone 4 (rather than remaining there from scenario #32 as in Iteration #1). The pedestrian then appears in zone 4 once the vehicle has departed the rear roadway zones.
Iteration #1: Confirm that the TVO-WA deactivates and a TVO-SRA is provided when the transit vehicle is departing but still in the forward roadway zone as no other alerts apply [215] [334]			
Iteration #2: Confirm that a TVO-WA is NOT provided when the transit vehicle has departed the rear roadway zones and a pedestrian appears in the roadway rear curb zone (zone 4); and, because no other alerts apply, the TVO-SRA is provided [215] [280]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the forward roadway zones, but with the front of the vehicle beyond the forward zones [285] [274]			

Test Case No. and Title	2.1.6 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) and with Pedestrian(s) Present in the Roadway Rear Curb Zone (Zone 4) as the Transit Vehicle Departs the Bus Stop			
Verification Phase	**II - Garage / Controlled Parking Lot Verification**			
Confirm that an RP-IA or RP-WA is NOT provided when the vehicle has departed the rear roadway zones with a pedestrian(s) in the rear roadway zones (zone 4/6) [288] [274]				
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]				
Scenario #46 (Iteration #1 only):				
Confirm that the TVO-SRA deactivates after the transit vehicle departs the roadway zones [282]				
Confirm that the RP-WA deactivates once the transit vehicle departs the roadway zones where pedestrian(s) are present [337]				
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]				

Test Case No. and Title	**2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**

Test Objectives	**User Interface:**
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway forward center zone (Zone 5), pulls up to and stops at the bus stop with pedestrian(s) in the waiting danger zone (Zone 2), then departs the bus stop area with pedestrian(s) present in the roadway forward curb zone (Zone 3), per the following sequence:
	  ○ Scenario #7 – transit vehicle approaching with pedestrian(s) in the roadway forward center zone (Zone 5),
	  ○ Scenario #15 – transit vehicle approaching and has entered the rear roadway zone with pedestrian(s) in the roadway forward center zone (Zone 5); **Note:** the transit vehicle will move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway forward center zone (Zone 5) to confirm OTVP-WA conditions,
	  ○ Scenario #20 – transit vehicle stopped at the transit stop with pedestrian(s) in the waiting danger zone (zone 2),
	  ○ As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in roadway forward curb zone (Zone 3), as follows:
	  ▪ Scenario #29 – transit vehicle is departing but still in all four roadway zones and there are pedestrian(s) in the roadway forward curb zone (Zone 3),
	  ▪ Scenario #37 – transit vehicle is departing but is still in the forward roadway zones and there are pedestrian(s) in the roadway forward curb zone (Zone 3),
	  ▪ Scenario #45 – transit vehicle is departing and has cleared all roadway zones and there are pedestrian(s) in the roadway forward curb zone (Zone 3)
	
	Functional:
	• The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Test Case No. and Title	**2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Requirements Verified	215, 216, 217, 221, 222, 223, 225, 226, 227, 228, 231, 232, 233, 239, 240, 241, 245, 246, 254, 260, 273, 274, 279, 281, 283, 285, 286, 287, 289, 290, 292, 293, 311, 333, 334, 337, 338
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway forward center zone (Zone 5), pulls up to and stops at the bus stop with pedestrian(s) present in zone 2, and then departs the bus stop area with pedestrian(s) present in the roadway forward curb zone (Zone 3).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration Sequence:*** ConOps Scenario #7: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • Simulated pedestrian(s) are present only in the roadway forward center zone (zone 5) ConOps Scenario #15: • Simulated Transit Vehicle continues approach and enters the rear roadway zones • Simulated pedestrian(s) are present only in the roadway forward center zone (zone 5) • **Note:** After the pedestrian is detected in the roadway forward center zone (zone 5), the transit vehicle will continue to move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway forward center zone (zone 5)

Test Case No. and Title	**2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	ConOps Scenario #20: • Simulated Transit Vehicle is stopped such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2) As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in roadway forward curb zone (zone 3), as follows: ConOps Scenario #29: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • Simulated pedestrian(s) are present only in the roadway forward curb zone (zone 3) • **Note:** the transit vehicle waits, as needed, for pedestrian(s) to clear the path of the vehicle. Pedestrian(s) move out of pedestrian detection zones. ConOps Scenario #37: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the roadway forward curb zone (zone 3) • **Note:** the detected pedestrian(s) location is behind the transit vehicle. ConOps Scenario #45: • Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • Simulated pedestrian(s) are present/remain only in the roadway forward curb zone (zone 3)
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #7:			

Test Case No. and Title	2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [223] [274] [273] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that a RP-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [222] [274] [273]			
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [217] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #15:			

Test Case No. and Title	2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the TVO-WA remains after the transit vehicle enters the TSPW Enabled Area, in motion, and in the rear roadway zones [225] [274] [273] [231] [289]			
Confirm that an OTVP-WA is provided when the transit vehicle is within any roadway zone and is in motion [232] [274] [273]			
Confirm that the provided OTVP-WA is deactivated when the transit vehicle continues very slow movement in the rear roadway zones and pedestrian(s) moves to the waiting danger zone (zone 2) [260] [274] [273]			**Note:** the pedestrian movement to the waiting danger zone (zone 2) is brief (just long enough to confirm this requirement) before moving back to the roadway forward center zone (zone 5) – while the transit vehicle is moving very slowly
Confirm that a RP-WA remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [227] [274] [273]			
Confirm that the RP-TAM-Approach including vehicle route number remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that the MP-TAM-Approach including vehicle route number remains provided to subscribed mobile devices as the transit vehicle continues movement and is within any roadway zone [228] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Scenario #20:			
Confirm that a TVO-SRA is provided after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts (TVO-WA would otherwise) apply [215] [279]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and no DSRC-enabled POVs are approaching [283] [274] [273]			
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that an RP-IA or RP-WA is NOT provided when the vehicle is stopped within the roadway zones [287] [274] [273]			
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and other alerts are NOT displayed which (MP-WA would otherwise) supersede it [311] [274] [273] [292]			
Scenario #29:			**Note:** Pedestrian(s) moves to the roadway forward curb zone (zone 3) from the waiting danger zone (zone 2) prior to the start of this scenario.

Test Case No. and Title	2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-WA is provided when the transit vehicle is departing, and is in motion in both the forward and rear roadway zones [240] [274] [231] [289]			
Confirm that an OTVP-WA is provided when the transit vehicle is in motion and within the roadway zones and the front of the vehicle has not yet departed the forward roadway zones [241] [274]			**Note:** requirement 284 (the OTVP-WA is not/no longer provided when the front of the transit vehicle has departed the forward roadway zones) may once again be confirmed once the RP-TAM-Stop is deactivated [286].
Confirm that the provided OTVP-WA is deactivated when the transit vehicle continues very slow movement in the rear roadway zones and pedestrian(s) moves to the waiting danger/safe zone (zone 2/1) [260] [274]			**Note:** the pedestrian movement to the waiting danger/safe zone (zone 2/1) is brief (just long enough to confirm requirement 260) before momentarily moving to the forward curb zone (zone 3) to re-establish the OTVP-WA and then moving to the roadway rear curb zone (zone 4) in the next item, to confirm requirement 290 – while the transit vehicle is moving very slowly
Confirm that the provided OTVP-WA (which is re-established by pedestrian(s) movement from zone 2/1 to zone 3 to zone 4) deactivates as the transit vehicle completely departs the roadway rear curb zone (Zone 4) [290] [274]			
Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			
Confirm that a RP-WA is provided after the transit vehicle is in motion and still within the forward and rear roadway zones with pedestrian(s) in roadway zone [239] [274]			

Test Case No. and Title	2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #37:			
Confirm that the TVO-WA remains active when the transit vehicle is departing but is still in the forward roadway zone with a pedestrian(s) detected in a forward roadway zone (zone 3 or 5) [246] [274] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the forward roadway zones, but with the front of the vehicle beyond the forward zones [285] [274]			
Confirm that the provided TVO-WA is deactivated when the transit vehicle continues very slow movement in the forward roadway zones and pedestrian(s) disappears from zone 3 [333] [274]			**Note:** the pedestrian disappearance from any detection zone is brief (just long enough to confirm requirement 333) before returning to the forward curb zone (zone 3) to re-establish the OTVP-WA – while the transit vehicle is moving very slowly
Confirm that an RP-WA remains provided/active when the transit vehicle is in motion and within the forward roadway zones, and a pedestrian(s) is detected in the forward zones (zone 3 or 5) [245] [274]			
Confirm that the provided RP-WA is deactivated when the transit vehicle continues very slow movement in the forward roadway zones and pedestrian(s) move from zone 3 or zone 5 [338] [274]			**Note:** the pedestrian movement from zone 3 outside of the detection zones to any other detection zone than zone 5 is brief (just long enough to confirm requirement 338) before returning to the forward curb zone (zone 3) to re-establish the OTVP-WA – while the transit vehicle is moving very slowly

Test Case No. and Title	2.1.7 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) and with Pedestrian(s) Present in the Roadway Forward Curb Zone (Zone 3) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #45:			
Confirm that the TVO-WA deactivates after the transit vehicle departs the roadway zones where pedestrian(s) are present [334]			
Confirm that the RP-WA deactivates once the transit vehicle departs the roadway zones where pedestrian(s) are present [337]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	**2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**

Test Objectives	**User Interface:**
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway rear center zone (Zone 6), pulls up to and stops at the bus stop with pedestrian(s) in the waiting danger zone (Zone 2), then departs the bus stop area with pedestrian(s) present in the roadway forward center zone (Zone 5), per the following sequence:
	  ○ Scenario #8 – transit vehicle approaching with pedestrian(s) in the roadway rear center zone (Zone 6),
	  ○ Scenario #16 – transit vehicle approaching and has entered the rear roadway zone with pedestrian(s) in the roadway rear center zone (Zone 6); **Note:** the transit vehicle will move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway rear center zone (Zone 6) to confirm OTVP-WA conditions
	  ○ Scenario #20 – transit vehicle stopped at the transit stop with pedestrian(s) in the waiting danger zone (zone 2),
	  ○ As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in roadway forward center zone (Zone 5), as follows:
	  ▪ Scenario #31 – transit vehicle is departing but still in all four roadway zones and there are pedestrian(s) in the roadway forward center zone (Zone 5),
	  ▪ Scenario #39 – transit vehicle is departing but is still in the forward roadway zones and there are pedestrian(s) in the roadway forward center zone (Zone 5),
	  ▪ Scenario #47 – transit vehicle is departing and has cleared all roadway zones and there are pedestrian(s) in the roadway forward center zone (Zone 5)
	
	Functional:
	• The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Test Case No. and Title	**2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Requirements Verified	215, 216, 217, 221, 222, 223, 225, 226, 227, 228, 231, 232, 233, 239, 240, 241, 245, 246, 254, 260, 273, 274, 279, 281, 283, 285, 286, 287, 289, 292, 293, 311, 334, 337
Brief Description	After entering the TSPW Equipped Area, the transit vehicle approaches the bus stop area with pedestrian(s) present only in the roadway rear center zone (Zone 6), pulls up to and stops at the bus stop with pedestrian(s) present in zone 2, and then departs the bus stop area with pedestrian(s) present in the roadway forward center zone (Zone 5).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration Sequence:*** ConOps Scenario #8: • Simulated Transit Vehicle approaches and enters TSPW-enabled area heading toward the transit stop • Simulated pedestrian(s) are present only in the roadway rear center zone (zone 6) ConOps Scenario #16: • Simulated Transit Vehicle continues approach and enters the rear roadway zones • Simulated pedestrian(s) are present only in the roadway rear center zone (zone 6) • **Note:** After the pedestrian is detected in the roadway rear center zone (zone 6), the transit vehicle will continue to move very slowly as part of this scenario and the pedestrian(s) will momentarily move to the waiting danger zone (zone 2) before moving back to the roadway rear center zone (zone 6)

Test Case No. and Title	**2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	ConOps Scenario #20: • Simulated Transit Vehicle is stopped such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting danger zone (zone 2) As the transit vehicle then pulls away from the bus stop, pedestrian(s) are and remain in roadway forward center zone (zone 5), as follows: ConOps Scenario #31: • Simulated Transit Vehicle begins departure from the transit stop but still occupies all four roadway zones • Simulated pedestrian(s) are present only in the roadway forward center zone (zone 5) • **Note:** the transit vehicle waits, as needed, for pedestrian(s) to clear the path of the vehicle. Pedestrian(s) move out of pedestrian detection zones. ConOps Scenario #39: • Simulated Transit Vehicle continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the roadway forward center zone (zone 5) • **Note:** the transit vehicle waits, as needed, for pedestrian(s) to clear the path of the vehicle. Pedestrian(s) move out of pedestrian detection zones. ConOps Scenario #47: • Simulated Transit Vehicle continues departure from the transit stop, clearing all roadway zones • Simulated pedestrian(s) are present/remain only in the roadway forward center zone (zone 5)
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #8:			

Test Case No. and Title	2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [223] [274] [273] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that a RP-WA is provided when the transit vehicle enters the TSPW Enabled Area, in motion, and approaching the roadway zones [222] [274] [273]			
Confirm that a RP-TAM-Approach including vehicle route number is provided when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [216] [274] [273]			
Confirm that a MP-TAM-Approach including vehicle route number is provided to subscribed mobile devices when the transit vehicle is within the TSPW Enabled Area, in motion, and approaching the roadway zones [217] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #16:			

Test Case No. and Title	2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the TVO-WA remains after the transit vehicle enters the TSPW Enabled Area, in motion, and in the rear roadway zones [225] [274] [273] [231] [289]			
Confirm that an OTVP-WA is provided when the transit vehicle is within any roadway zone and is in motion [232] [274] [273]			
Confirm that the provided OTVP-WA is deactivated when the transit vehicle continues very slow movement in the rear roadway zones and pedestrian(s) moves to the waiting danger zone (zone 2) [260] [274] [273]			**Note:** the pedestrian movement to the waiting danger zone (zone 2) is brief (just long enough to confirm this requirement) before moving back to the roadway rear center zone (zone 6) – while the transit vehicle is moving very slowly
Confirm that a RP-WA remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [227] [274] [273]			
Confirm that the RP-TAM-Approach including vehicle route number remains when the transit vehicle is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that the MP-TAM-Approach including vehicle route number remains provided to subscribed mobile devices as the transit vehicle continues movement and is within any roadway zone [228] [274] [273] [254] [293]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Scenario #20:			
Confirm that a TVO-SRA is provided after the transit vehicle is within the TSPW Enabled Area and no other TVO alerts (TVO-WA would otherwise) apply [215] [279]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and no DSRC-enabled POVs are approaching [283] [274] [273]			
Confirm that the RP-TAM-Approach deactivates when the transit vehicle stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including vehicle route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that an RP-IA or RP-WA is NOT provided when the vehicle is stopped within the roadway zones [287] [274] [273]			
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and other alerts are NOT displayed which (MP-WA would otherwise) supersede it [311] [274] [273] [292]			
Scenario #31:			**Note:** Pedestrian(s) moves to the roadway forward center zone (zone 5) from the waiting danger zone (zone 2) prior to the start of this scenario.

Test Case No. and Title	2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-WA is provided when the transit vehicle is departing, and is in motion in both the forward and rear roadway zones [240] [274] [231] [289]			
Confirm that an OTVP-WA is provided when the transit vehicle is in motion and within the roadway zones and the front of the vehicle has not yet departed the forward roadway zones [241] [274]			**Note:** requirement 284 (the OTVP-WA is not/no longer provided when the front of the transit vehicle has departed the forward roadway zones) may once again be confirmed once the RP-TAM-Stop is deactivated [286].
Confirm that the provided OTVP-WA is deactivated when the transit vehicle continues very slow movement in the rear roadway zones and pedestrian(s) moves to the waiting danger/safe zone (zone 2/1) [260] [274]			**Note:** the pedestrian movement to the waiting danger/safe zone (zone 2/1) is brief (just long enough to confirm requirement 260) before momentarily moving to the forward center zone (zone 5) to re-establish the OTVP-WA – while the transit vehicle is moving very slowly
Confirm that the RP-TAM-Stop deactivates when the front of the transit vehicle moves out of the forward roadway zones [286] [274]			
Confirm that a RP-WA is provided after the transit vehicle is in motion and still within the forward and rear roadway zones with pedestrian(s) in roadway zone [239] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #39:			

Test Case No. and Title	2.1.8 Transit Vehicle Approaches Bus Stop with Pedestrian(s) Present in the Roadway Rear Center Zone (Zone 6) and with Pedestrian(s) Present in the Roadway Forward Center Zone (Zone 5) as the Transit Vehicle Departs the Bus Stop		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the TVO-WA remains active when the transit vehicle is departing but is still in the forward roadway zone with a pedestrian(s) detected in a roadway forward zone (zone 3 or 5) [246] [274] [231] [289]			
Confirm that an OTVP-WA is NOT provided when the transit vehicle is in motion and within the forward roadway zones, but with the front of the vehicle beyond the forward zones [285] [274]			
Confirm that an RP-WA remains provided/active when the transit vehicle is in motion and within the forward roadway zones, and a pedestrian(s) is detected in the forward zones (zone 3 or 5) [245] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #47:			
Confirm that the TVO-WA deactivates after the transit vehicle departs the roadway zones where pedestrian(s) are present [334]			
Confirm that the RP-WA deactivates once the transit vehicle departs the roadway zones where pedestrian(s) are present [337]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	**2.1.9 Transit Vehicle Stopped at Bus Stop with No Pedestrians Present or Present in a Non-Roadway Zone with an Oncoming DSRC/TSPW-Enabled POV**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Objectives	**User Interface:** • Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle is stopped at a bus stop and the DSRC/TSPW-Enabled POV approaches from behind the transit vehicle per the following sequence: o Scenario #49 – transit vehicle stopped at bus stop with POV approaching from behind with no waiting pedestrians/riders, o Scenario #50 – transit vehicle stopped at bus stop with POV approaching from behind with pedestrian(s) waiting in the transit shelter, o Scenario #51 – transit vehicle stopped at bus stop with POV approaching from behind with pedestrian(s) in the waiting safe zone (Zone 1), o Scenario #52 – transit vehicle stopped at bus stop with POV approaching from behind with pedestrian(s) in the waiting danger zone (Zone 2), **Functional:** • The TSPW application detects DSRC-enabled vehicles entering the TSPW Enabled Area • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped
Requirements Verified	215, 311
Brief Description	With the transit vehicle stopped at the bus stop, the DSRC/TSPW-enabled POV approaches the transit vehicle from behind with pedestrian(s) not detected or detected within a waiting zone (shelter, waiting – safe, or waiting – danger zone).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, and DSRC-enabled POV equipment, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, MP HIS, and POV HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle and POV will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests).

Test Case No. and Title	**2.1.9 Transit Vehicle Stopped at Bus Stop with No Pedestrians Present or Present in a Non-Roadway Zone with an Oncoming DSRC/TSPW-Enabled POV**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	With the simulated transit vehicle stopped at the bus stop, and with the DSRC/TSPW-equipped POV approaching the transit vehicle behind, a pedestrian progressively moves from an area outside of the detection zones through the waiting zones to the Waiting – Danger zone (Zone 2), as follows: ***Iteration Sequence:*** ConOps Scenario #49: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • No pedestrians are present within any waiting/roadway zone ConOps Scenario #50: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • Pedestrian(s) are present within the transit shelter ConOps Scenario #51: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • Pedestrian(s) are present within the waiting – safe zone (Zone 1) ConOps Scenario #52: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • Pedestrian(s) are present within the waiting – danger zone (Zone 2)

Test Case No. and Title	2.1.9 Transit Vehicle Stopped at Bus Stop with No Pedestrians Present or Present in a Non-Roadway Zone with an Oncoming DSRC/TSPW-Enabled POV		
Verification Phase	II - Garage / Controlled Parking Lot Verification		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #49:			
Confirm that a TVO-SRA is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches from behind [215] [271] [274]			
Scenario #50:			
Confirm that a TVO-SRA is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches from behind [215] [271] [274]			
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311] [274] [271]			
Scenario #51:			
Confirm that a TVO-SRA is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches from behind [215] [271] [274]			

Test Case No. and Title	2.1.9 Transit Vehicle Stopped at Bus Stop with No Pedestrians Present or Present in a Non-Roadway Zone with an Oncoming DSRC/TSPW-Enabled POV		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311] [274] [271]			
Scenario #52:			
Confirm that a TVO-SRA is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches from behind [215] [271] [274]			
Confirm that a MP-SRA is provided to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within the TSPW Enabled Area and no alerts supersede it [311] [274] [271]			

Test Case No. and Title	**2.1.10 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Curb Zone (Zone 3) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**

Test Objectives	**User Interface:**
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle is stopped at a bus stop and the DSRC/TSPW-Enabled POV approaches from behind and passes the transit vehicle per the following sequence:
	  ○ Scenario #53 – transit vehicle stopped at bus stop with POV approaching from behind with pedestrian(s) waiting in the roadway forward curb zone (Zone 3),
	  ○ Scenario #57 – transit vehicle stopped at bus stop with POV passing the transit vehicle and with pedestrian(s) waiting in the roadway forward curb zone (Zone 3)
	
	Functional:
	• The TSPW application detects DSRC-enabled vehicles entering the TSPW Enabled Area
	• The TSPW application detects which lane approaching DSRC-enabled POVs occupy – the Approach Lane or Passing Lane,
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Requirements Verified	215, 221, 271, 272, 274, 287, 335
Brief Description	With the transit vehicle stopped at the bus stop, the DSRC/TSPW-enabled POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway forward curbside zone (Zone 3).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, and DSRC-enabled POV equipment, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, MP HIS, and POV HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle and POV will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.

Test Case No. and Title	**2.1.10 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Curb Zone (Zone 3) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Procedure/Script	With the simulated transit vehicle stopped at the bus stop, and with the DSRC/TSPW-equipped POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway forward curbside zone (Zone 3), as follows: ***Iteration Sequence:*** ConOps Scenario #53: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • Pedestrian(s) are present within the roadway forward curb zone (Zone 3) ConOps Scenario #57: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV passes the transit vehicle at the transit stop • Pedestrian(s) remain within the roadway forward curb zone (Zone 3)
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #53:			
Confirm that a TVO-SRA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear curbside zones (zone 3 or 4) [215] [335] [271] [272] [274]			

Test Case No. and Title	2.1.10 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Curb Zone (Zone 3) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an RP-IA or RP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 2, 3, or 4 [287] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Scenario #57:			
Confirm that a TVO-SRA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear curbside zones (zone 3 or 4) [215] [335] [271] [272] [274]			
Confirm that an RP-IA or RP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 2, 3, or 4 [287] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	**2.1.11 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Curb Zone (Zone 4) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**

Test Objectives	**User Interface:**
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle is stopped at a bus stop and the DSRC/TSPW-Enabled POV approaches from behind and passes the transit vehicle per the following sequence:
	  ○ Scenario #54 – transit vehicle stopped at bus stop with POV approaching from behind with pedestrian(s) waiting in the roadway rear curb zone (Zone 4),
	  ○ Scenario #58 – transit vehicle stopped at bus stop with POV passing the transit vehicle and with pedestrian(s) waiting in the roadway rear curb zone (Zone 4)
	• Confirm that the location where the TSPW application begins to provide alerts is configurable based on the distance a POV is from entering a TSPW pedestrian detection zone and the speed of the POV.
	
	Functional:
	• The TSPW application detects DSRC-enabled vehicles entering the TSPW Enabled Area
	• The TSPW application detects which lane approaching DSRC-enabled POVs occupy – the Approach Lane or Passing Lane,
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Requirements Verified	215, 221, 251, 252, 256, 271, 272, 274, 287, 294, 335, 340, 341, 343
Brief Description	With the transit vehicle stopped at the bus stop, the DSRC/TSPW-enabled POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway rear curbside zone (Zone 4).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, and DSRC-enabled POV equipment, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, MP HIS, and POV HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle and POV will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.

Test Case No. and Title	**2.1.11 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Curb Zone (Zone 4) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Procedure/Script	With the simulated transit vehicle stopped at the bus stop, and with the DSRC/TSPW-equipped POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway rear curbside zone (Zone 4), as follows: ***Iteration #1 Sequence:*** ConOps Scenario #54: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • Pedestrian(s) are present within the roadway rear curb zone (Zone 4) ConOps Scenario #58: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV passes the transit vehicle at the transit stop • Pedestrian(s) remain within the roadway rear curb zone (Zone 4) The equipped POV continues to pass the transit vehicle and departs the TSPW Enabled Area ***Iterations #2-3 Sequence:*** Following the conclusion of the sequenced scenarios for Iteration #1 above (though POV-WA issuance / requirement 251), two additional iterations of Scenario #1 are executed • Iteration #2 – the same configuration settings are used, but the equipped POV approaches the TSPW-enabled area at a faster rate than in iteration #1 • Iteration #3 – the equipped POV approaches at the same rate as in iteration #1, but the configured distance is lengthened from that used in iteration #1 ***Iteration #4 Sequence:*** to confirm that the POV-WA is prioritized above the POV-IA [256, 294], iteration #1 is repeated with a pedestrian(s) additionally located in the roadway forward center zone (Zone 5).

Test Case No. and Title	**2.1.11 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Curb Zone (Zone 4) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #54 (Iteration #1 unless marked):			
Confirm that a TVO-SRA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear curbside zones (zone 3 or 4) [215] [335] [271] [272] [274]			
Confirm that an RP-IA or RP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 2, 3, or 4 [287] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Confirm that a POV-WA is provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the same lane, and a pedestrian is located in rear roadway zones (zone 4 or 6) [251] [271] [272] [274]			
Confirm that the POV-WA is de-activated when the equipped POV continues to approach very slowly and pedestrian(s) moves to the waiting danger zone (zone 2) or roadway forward curb zone (zone 3) [341] [271] [272] [274]			**Note:** the pedestrian movement to zone 2 or 3 is brief (just long enough to confirm requirement 341) before momentarily moving back to zone 4

Test Case No. and Title	2.1.11 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Curb Zone (Zone 4) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the POV-WA is de-activated when the equipped POV completely passes the roadway rear curb zone (Zone 4) [343] [271] [272] [274]			
Iterations 2-3: Confirm that the location where the TSPW application begins to provide alerts (POV-WA) is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle [340]			
Iteration 4: Confirm when pedestrians are located in zone 5 and zone 6 and an equipped POV approaches a transit vehicle stopped at a bus stop, the POV-WA alert is issued [256] [294]			
Scenario #58:			
Confirm that a TVO-SRA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear curbside zones (zone 3 or 4) [215] [335] [271] [272] [274]			
Confirm that an RP-IA or RP-WA is NOT provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 2, 3, or 4 [287] [274] [273]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	2.1.11 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Curb Zone (Zone 4) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a POV-WA remains provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the adjacent-left lane, and a pedestrian is located in roadway zones 4, 5, or 6 [252] [271] [272] [274]			

Test Case No. and Title	2.1.12 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle
Verification Phase	**II - Garage / Controlled Parking Lot Verification**

Test Objectives	**User Interface:**
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle is stopped at a bus stop and the DSRC/TSPW-Enabled POV approaches from behind and passes the transit vehicle per the following sequence:
	  o Scenario #55 – transit vehicle stopped at bus stop with POV approaching from behind with pedestrian(s) waiting in the roadway forward center zone (Zone 5),
	  o Scenario #59 – transit vehicle stopped at bus stop with POV passing the transit vehicle and with pedestrian(s) waiting in the roadway forward center zone (Zone 5)
	• Confirm that the location where the TSPW application begins to provide alerts is configurable based on the distance a POV is from entering a TSPW pedestrian detection zone and the speed of the POV.
	
	Functional:
	• The TSPW application detects DSRC-enabled vehicles entering the TSPW Enabled Area
	• The TSPW application detects which lane approaching DSRC-enabled POVs occupy – the Approach Lane or Passing Lane,
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Test Case No. and Title	**2.1.12 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Requirements Verified	221, 231, 234, 235, 249, 250, 252, 259, 260, 271, 272, 274, 289, 340, 342
Brief Description	With the transit vehicle stopped at the bus stop, the DSRC/TSPW-enabled POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway forward center zone (Zone 5).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, and DSRC-enabled POV equipment, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, MP HIS, and POV HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle and POV will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	With the simulated transit vehicle stopped at the bus stop, and as the DSRC/TSPW-equipped POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway forward center zone (Zone 5), as follows: ***Iteration #1 Sequence:*** ConOps Scenario #55: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • Pedestrian(s) are present within the roadway forward center zone (Zone 5) ConOps Scenario #59: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV passes the transit vehicle at the transit stop • Pedestrian(s) remain within the roadway forward center zone (Zone 5) ***Iterations #2-3 Sequence:*** Following the conclusion of the sequenced scenarios for Iteration #1 above (though POV-IA issuance / requirement 250), two additional iterations of Scenario #1 are executed

Test Case No. and Title	**2.1.12 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Iteration #2 – the same configuration settings are used, but the equipped POV approaches the TSPW-enabled area at a faster rate than in iteration #1 • Iteration #3 – the equipped POV approaches at the same rate as in iteration #1, but the configured distance is lengthened from that used in iteration #1
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #55 (Iteration #1 unless marked):			
Confirm that a TVO-IA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear center zones (zone 5 or 6) [235] [231] [289] [271] [272] [274]			
Confirm that an RP-IA is provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 5 or 6 [234] [271] [272] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Confirm that a POV-IA is provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the same lane, and a pedestrian is located in roadway forward center zone (zone 5) [250] [271] [272] [274]			

Test Case No. and Title	2.1.12 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that the POV-IA is de-activated when the equipped POV continues to approach very slowly and pedestrian(s) moves to the waiting danger zone (zone 2) [259] [271] [272] [274]			**Note:** the pedestrian movement to zone 2 is brief (just long enough to confirm requirement 259) before momentarily moving back to zone 5
Confirm that the POV-IA is de-activated when the equipped POV completely passes the roadway forward center zone (Zone 5) [342] [271] [272] [274]			
Iterations 2-3: Confirm that the location where the TSPW application begins to provide alerts (POV-IA) is configurable based on the distance the transit vehicle is from entering a TSPW pedestrian detection zone and the speed of the transit vehicle [340]			
Scenario #59:			
Confirm that a TVO-IA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear center zones (zone 5 or 6) [235] [231] [289] [271] [272] [274]			
Confirm that an RP-IA is provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 5 or 6 [234] [271] [272] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	2.1.12 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a POV-WA remains provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the adjacent-left lane, and a pedestrian is located in roadway zones 4, 5, or 6 [252] [271] [272] [274]			
Confirm that a OTVP-WA is provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the adjacent-left lane, and a pedestrian is located in roadway forward center zone (Zone 5) [249] [271] [272] [274]			
Confirm that the OTVP-WA is de-activated when the equipped POV continues to approach very slowly and pedestrian(s) moves to the roadway forward curbside zone (zone 3) [260] [271] [272] [274]			**Note:** the pedestrian movement to zone 3 is brief (just long enough to confirm requirement 260) before momentarily moving back to zone 5

Test Case No. and Title	**2.1.13 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Center Zone (Zone 6) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**

Test Objectives	**User Interface:**
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle is stopped at a bus stop and the DSRC/TSPW-Enabled POV approaches from behind and passes the transit vehicle per the following sequence:
	  ○ Scenario #56 – transit vehicle stopped at bus stop with POV approaching from behind with pedestrian(s) waiting in the roadway rear center zone (Zone 6),
	  ○ Scenario #60 – transit vehicle stopped at bus stop with POV passing the transit vehicle and with pedestrian(s) waiting in the roadway rear center zone (Zone 6)
	
	Functional:
	• The TSPW application detects DSRC-enabled vehicles entering the TSPW Enabled Area
	• The TSPW application detects which lane approaching DSRC-enabled POVs occupy – the Approach Lane or Passing Lane,
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Requirements Verified	221, 231, 234, 235, 251, 252, 271, 272, 274, 289
Brief Description	With the transit vehicle stopped at the bus stop, the DSRC/TSPW-enabled POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway rear center zone (Zone 6).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, and DSRC-enabled POV equipment, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, MP HIS, and POV HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle and POV will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.

Test Case No. and Title	**2.1.13 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Center Zone (Zone 6) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Procedure/Script	With the simulated transit vehicle stopped at the bus stop, and as the DSRC/TSPW-equipped POV approaches the transit vehicle from behind and passes it with pedestrian(s) detected in the roadway rear center zone (Zone 6), as follows: ***Iteration Sequence:*** ConOps Scenario #56: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV enters TSPW-enabled area heading toward the transit stop • Pedestrian(s) are present within the roadway rear center zone (Zone 6) ConOps Scenario #60: • Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV passes the transit vehicle at the transit stop • Pedestrian(s) remain within the roadway rear center zone (Zone 6)
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #56:			
Confirm that a TVO-IA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear center zones (zone 5 or 6) [235] [231] [289] [271] [272] [274]			

Test Case No. and Title	2.1.13 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Center Zone (Zone 6) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that an RP-IA is provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 5 or 6 [234] [271] [272] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			
Confirm that a POV-WA is provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the same lane, and a pedestrian is located in a roadway rear zone (zone 4 or 6) [251] [271] [272] [274]			
Scenario #60:			
Confirm that a TVO-IA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear center zones (zone 5 or 6) [235] [231] [289] [271] [272] [274]			
Confirm that an RP-IA is provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 5 or 6 [234] [271] [272] [274]			
Confirm that any MP alert is NOT provided to subscribed mobile devices within any roadway zone (Zone 3-6) [221]			

Test Case No. and Title	2.1.13 Transit Vehicle Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Rear Center Zone (Zone 6) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a POV-WA is provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the adjacent-left lane, and a pedestrian is located in roadway zone (zone 4, 5, or 6) [252] [271] [272] [274]			

Test Case No. and Title	**2.1.14 Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Objectives	**User Interface:** **Note:** This test case (the focus of which is ConOps scenario #73) begins with a similar sequence of scenarios as test case 2.1.3 for transit vehicle #1 from ConOps scenario #11 through scenario #35, during which transit vehicle #2 enters the TSPW Enabled Area as follows: • Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches, passes, and departs the bus stop area with pedestrian(s) present only in the waiting safe zone (Zone 1), per the following sequence: o Scenario #11 – transit vehicle #1 is approaching and has entered the rear roadway zone with pedestrian(s) in the waiting safe zone (zone 1), o Scenario #19 – transit vehicle #1 stops at the transit stop with pedestrian(s) in the waiting safe zone (zone 1), during which time transit vehicle #2 enters the TSPW Enabled Area o Scenario #27 – transit vehicle #1 is departing but still in all four roadway zones and there are pedestrian(s) in the waiting safe zone (zone 1), while transit vehicle #2 continues its approach toward the bus stop o Scenario #35 – transit vehicle #1 is departing but is still in the forward roadway zones and there are pedestrian(s) in the waiting safe zone (zone 1), and (Scenario #73) transit vehicle #2 continues its approach toward the bus stop **Functional:** • The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped
Requirements Verified	215, 216, 226, 228, 233, 254, 255, 273, 274, 286, 293, 339

Test Case No. and Title	**2.1.14 Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Brief Description	Transit vehicle #1 approaches the rear roadway zone, stops at the transit stop, during which time transit vehicle #2 enters the TSPW Enabled Area. Transit vehicle #1 begins the initial departure from the roadway zones to the point it has not yet departed the forward roadway zones, while transit vehicle #2 continues its approach to the bus stop. During this entire time, pedestrian(s) are present only in the waiting safe zone (Zone 1).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration Sequence:*** ConOps Scenario #11: • Simulated Transit Vehicle #1 approaches the bus stop and enters the rear roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) ConOps Scenario #19: • Simulated Transit Vehicle #1 stops such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) • Simulated Transit Vehicle #2 enters the TSPW Enabled Area a few moments after transit vehicle #1 stops ConOps Scenario #27: • Simulated Transit Vehicle #1 begins departure from the transit stop but still occupies all four roadway zones

Test Case No. and Title	**2.1.14 Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) • Simulated Transit Vehicle #2 continues its approach toward the bus stop ConOps Scenario #35 / Scenario #73: • Simulated Transit Vehicle #1 continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) • Simulated Transit Vehicle #2 continues its approach toward the bus stop
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #11:			
Confirm that the TVO-SRA is provided/remains to transit vehicle #1 after it is within the TSPW Enabled Area and no other TVO alerts apply [215] [273]			
Confirm that the RP-TAM-Approach including vehicle route number is provided/remains when transit vehicle #1 is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			

Test Case No. and Title	2.1.14 Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a MP-TAM-Approach including transit vehicle #1 route number is provided to subscribed mobile devices in the TSPW Enabled Area when transit vehicle #1 is within any roadway zone and in motion [228] [274] [273] [254] [293]			
Scenario #19:			
Confirm that the TVO-SRA remains for transit vehicle #1 after it is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Approach deactivates when transit vehicle #1 stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including transit vehicle #1 route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that the RP-TAM-Stop with transit vehicle #1 details remains and supersedes the RP-TAM-Approach with transit vehicle #2 details when transit vehicle #2 enters the TSPW Enabled Area [339] [255]			
Confirm that the TVO-SRA is provided for transit vehicle #2 after it enters the TSPW Enabled Area and no other TVO alerts apply [215]			

Test Case No. and Title	2.1.14 Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a MP-TAM-Approach including transit vehicle #2 route number is provided to subscribed mobile devices in the TSPW Enabled Area when transit vehicle #1 is stopped within the four roadway zones and transit vehicle #2 is within the TSPW Enabled Area and is in motion approaching the bus stop [228] [274] [273] [254] [293]			
Scenario #27:			
Confirm that a TVO-SRA remains for transit vehicle #1 while the transit vehicle remains within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the TVO-SRA remains for transit vehicle #2 while it remains within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Stop deactivates for transit vehicle #1 and is replaced by an RP-TAM-Approach including vehicle route number for transit vehicle #2 when the front of transit vehicle #1 moves out of the forward roadway zones and transit vehicle #2 continues its approach [286] [216] [274] [273]			

Test Case No. and Title	2.1.14 Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a MP-TAM-Approach including transit vehicle #2 route number remains provided to subscribed mobile devices in the TSPW Enabled Area when transit vehicle #1 begins its departure from the roadway zones and transit vehicle #2 is within the TSPW Enabled Area and is in motion and continues its approach toward the bus stop [228] [274] [273] [254] [293]			
Scenario #35 / #73:			
Confirm that a TVO-SRA remains for transit vehicle #1 while the transit vehicle remains within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the TVO-SRA remains for transit vehicle #2 while it remains within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Approach including vehicle route number for transit vehicle #2 remains when transit vehicle #1 continues its departure but remains in the forward roadway zones and transit vehicle #2 continues its approach [216] [274] [273]			

Test Case No. and Title	2.1.14 Transit Vehicle #1 Traverses Bus Stop with Pedestrian(s) Present Only in the Waiting Safe Zone (Zone 1), and Transit Vehicle #2 enters the TSPW Enabled Area as Transit Vehicle #1 is departing the Roadway Forward Zones		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a MP-TAM-Approach including transit vehicle #2 route number remains provided to subscribed mobile devices in the TSPW Enabled Area when transit vehicle #1 continues its departure from the roadway zones and transit vehicle #2 is within the TSPW Enabled Area and is in motion and continues its approach toward the bus stop [228] [274] [273] [254] [293]			

Test Case No. and Title	**2.1.15 Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**

Test Objectives	**User Interface:**
	
	Note: This test case (the focus of which is ConOps scenario #74) begins with a similar sequence of scenarios as test case 2.1.3 for transit vehicle #1 from ConOps scenario #11 through scenario #35, during which transit vehicle #2 enters the TSPW Enabled Area as follows:
	
	• Confirm that applicable alerts required are issued (or not issued), prioritized, and ended to the TVO, RP, MP, OTVP, and POV interfaces in accordance with the following ConOps Scenarios as the transit vehicle approaches, passes, and departs the bus stop area with pedestrians present in the waiting safe zone (Zone 1) and in the roadway rear curb zone (Zone 4), per the following sequence:
	  ○ Scenario #11 – transit vehicle #1 is approaching and has entered the rear roadway zone with two pedestrians in the waiting safe zone (zone 1),
	  ○ Scenario #19 – transit vehicle #1 stops at the transit stop with 2 pedestrians in the waiting safe zone (zone 1), during which time transit vehicle #2 enters the TSPW Enabled Area
	  ○ Scenario #27 – transit vehicle #1 is departing but still in all four roadway zones and the two pedestrians are now in the waiting safe zone (zone 1) and in the roadway rear curb zone (zone 4), while transit vehicle #2 continues its approach toward the bus stop
	  ○ Scenario #35 – transit vehicle #1 is departing but is still in the forward roadway zones and the pedestrians remain in zones 1 and 4, while (Scenario #74) transit vehicle #2 continues its approach toward the bus stop
	
	Functional:
	• The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones
	• The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped

Requirements Verified	215, 216, 221, 222, 225, 226, 228, 231, 233, 254, 255, 273, 274, 280, 281, 286, 289, 291, 293, 339

Test Case No. and Title	**2.1.15 Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Brief Description	Transit vehicle #1 approaches the rear roadway zone, stops at the transit stop, during which time transit vehicle #2 enters the TSPW Enabled Area. Transit vehicle #1 begins the initial departure from the roadway zones to the point it has not yet departed the forward roadway zones, while transit vehicle #2 continues its approach to the bus stop. Pedestrians are present only in the waiting safe zone (Zone 1) while transit vehicle #1 approaches and stops at the bus stop, but one of the two pedestrians moved to the roadway rear curb zone (Zone 4) as transit vehicle #1 departs the bus stop.
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, TSPW-enabled mobile device, including all display interfaces (RP HIS, TVO HIS, OTVP HIS, and MP HIS). • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally.
Test Procedure/Script	Simulate transit vehicle position relative to the equipped transit stop and TSPW Enabled Area (the transit vehicle is in motion unless specified), and pedestrian position relative to waiting/roadway zones in the following phased sequence, while simultaneously controlling specified variables: ***Iteration Sequence:*** ConOps Scenario #11: • Simulated Transit Vehicle #1 approaches the bus stop and enters the rear roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) ConOps Scenario #19: • Simulated Transit Vehicle #1 stops such that it occupies all four roadway zones • Simulated pedestrian(s) are present only in the waiting safe zone (zone 1) • Simulated Transit Vehicle #2 enters the TSPW Enabled Area a few moments after transit vehicle #1 stops ConOps Scenario #27: • Simulated Transit Vehicle #1 begins departure from the transit stop but still occupies all four roadway zones

Test Case No. and Title	**2.1.15 Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Simulated pedestrian(s) are present in the waiting safe zone (zone 1) and the roadway rear curb zone (zone 4) • Simulated Transit Vehicle #2 continues its approach toward the bus stop ConOps Scenario #35 / Scenario #74: • Simulated Transit Vehicle #1 continues departure from the transit stop and still occupies forward roadway zones • Simulated pedestrian(s) remain in the waiting safe zone (zone 1) and the roadway rear curb zone (zone 4) • Simulated Transit Vehicle #2 continues its approach toward the bus stop
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #11:			
Confirm that the TVO-SRA is provided/remains to transit vehicle #1 after it is within the TSPW Enabled Area and no other TVO alerts apply [215] [273]			
Confirm that the RP-TAM-Approach including vehicle route number is provided/remains when transit vehicle #1 is within the TSPW Enabled Area, in motion, and in the rear roadway zone [216] [274] [273]			
Confirm that a MP-TAM-Approach including transit vehicle #1 route number is provided to subscribed mobile devices in the TSPW Enabled Area when transit vehicle #1 is within any roadway zone and in motion [228] [274] [273] [254] [293]			

Test Case No. and Title	2.1.15 Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Scenario #19:			
Confirm that the TVO-SRA remains for transit vehicle #1 after it is within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the RP-TAM-Approach deactivates when transit vehicle #1 stops within the roadway zones [226] [274] [273]			
Confirm that a RP-TAM-Stop including transit vehicle #1 route number is provided when the transit vehicle is stopped within the roadway zones [233] [274] [273]			
Confirm that the RP-TAM-Stop with transit vehicle #1 details remains and supersedes the RP-TAM-Approach with transit vehicle #2 details when transit vehicle #2 enters the TSPW Enabled Area [339] [255]			
Confirm that the TVO-SRA is provided for transit vehicle #2 after it enters the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that a MP-TAM-Approach including transit vehicle #2 route number is provided to subscribed mobile devices in the TSPW Enabled Area when transit vehicle #1 is stopped within the four roadway zones and transit vehicle #2 is within the TSPW Enabled Area and is in motion approaching the bus stop [228] [274] [273] [254] [293]			
Scenario #27:			

Test Case No. and Title	2.1.15 Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-SRA remains for transit vehicle #1 while the transit vehicle remains within the TSPW Enabled Area and no other TVO alerts apply; it is not superseded by a TVO-WA for the pedestrian in Zone 4 as it has departed the roadway rear zones [215] [280] [273]			
Confirm that the TVO-WA is provided for transit vehicle #2 as it continues within the TSPW Enabled Area toward the bus stop [225] [231] [289] [274] [273]			
Confirm that an OTVP-WA is NOT provided when transit vehicle #2 is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that the RP-TAM-Stop deactivates for transit vehicle #1 and is replaced by an RP-TAM-Approach including vehicle route number for transit vehicle #2 when the front of transit vehicle #1 moves out of the forward roadway zones and transit vehicle #2 continues its approach [286] [216] [274] [273]			
Confirm that a RP-WA is provided when transit vehicle #2 is within the TSPW Enabled Area, in motion, and approaching the roadway zones with a pedestrian in the roadway rear curb zone (zone 4) [222] [274] [273] [255] [291]			

Test Case No. and Title	2.1.15 Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a MP-TAM-Approach including transit vehicle #2 route number remains provided to the mobile device subscriber remaining in the waiting safe zone (Zone 1) when transit vehicle #1 begins its departure from the roadway zones and transit vehicle #2 is within the TSPW Enabled Area and is in motion and continues its approach toward the bus stop [228] [274] [273] [254] [293]			
Confirm that MP alerts are NOT provided to subscribed mobile devices within any roadway zone (i.e., Zone 4) [221]			
Scenario #35 / #74:			
Confirm that a TVO-SRA remains for transit vehicle #1 while the transit vehicle remains within the TSPW Enabled Area and no other TVO alerts apply [215]			
Confirm that the TVO-WA remains for transit vehicle #2 while it continues its approach to the bus stop [225] [231] [289] [274] [273]			
Confirm that an OTVP-WA is NOT provided when transit vehicle #2 is within the TSPW Enabled Area, in motion, and approaching the roadway zones [281] [274] [273]			
Confirm that the RP-TAM-Approach including vehicle route number for transit vehicle #2 remains as it continues its approach [216] [274] [273]			

Test Case No. and Title	2.1.15 Transit Vehicle #1 Departs the Bus Stop with Pedestrians Present in the Waiting Safe Zone (Zone 1) and in the Roadway Rear Curb Zone (Zone 4), while Transit Vehicle #2 enters the TSPW Enabled Area		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a RP-WA continues to be provided when transit vehicle #2 is within the TSPW Enabled Area, in motion, and approaching the roadway zones with a pedestrian in the roadway rear curb zone (zone 4) [222] [274] [273] [255] [291]			
Confirm that a MP-TAM-Approach including transit vehicle #2 route number remains provided to subscribed mobile devices in the TSPW Enabled Area as transit vehicle #2 continues its approach toward the bus stop [228] [274] [273] [254] [293]			
Confirm that MP alerts are NOT provided to subscribed mobile devices within any roadway zone (i.e., Zone 4) [221]			

Test Case No. and Title	**2.1.16 TSPW Cloak Mode where Transit Vehicle is Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
Test Objectives	**User Interface:** • Confirm that applicable alerts required are displayed or not displayed on the TVO, RP, and OTVP interfaces when applicably configured in accordance with iterations of ConOps Scenario #59, where the transit vehicle is stopped at a bus stop and a DSRC/TSPW-Enabled POV passing the transit vehicle. **Note:** Since they will already be confirmed in Scenario #59, MP and POV display alerts are not confirmed in this test case since they are not impacted by the selected state of "cloaked mode" on the other display interfaces. **Functional:** • The TSPW application detects the location of approaching TSPW-enabled transit vehicles relative to the TSPW Enabled area and pedestrian detection zones • The TSPW application detects whether a TSPW-enabled transit vehicle is moving or stopped
Requirements Verified	159, 200, 201, 231, 234, 235, 249, 271, 272, 274, 289
Brief Description	With the TVO, RP, and OTVP HIS separately configured to not provide alerts ("cloaked mode") in separate iterations, the transit vehicle stopped at the bus stop, a DSRC/TSPW-enabled POV passes the transit vehicle with pedestrian(s) located in the roadway forward center zone (Zone 5).
Test Setup and Configuration	• Power on the TSPW RSE, transit vehicle IVS, and DSRC-enabled POV equipment, including the following display interfaces: RP HIS, TVO HIS, and OTVP HIS. • Ensure GPS feeds are connected and operating (**note:** GPS position for the transit vehicle and POV will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating and communicating normally. • Configure "cloak mode" (i.e., do not display) as specified per the procedures below.
Test Procedure/Script	ConOps Scenario #59 is executed in three iterations with the following "Cloaked Mode" settings as follows: ***ConOps Scenario #59 Sequence:***

Test Case No. and Title	**2.1.16 TSPW Cloak Mode where Transit Vehicle is Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle**
Verification Phase	**II - Garage / Controlled Parking Lot Verification**
	• Simulated Transit Vehicle remains stopped at the transit stop • DSRC/TSPW-enabled POV passes the transit vehicle at the transit stop • Pedestrian(s) remain within the roadway forward center zone (Zone 5) ***Iteration #1:*** TVO HIS is set to "Cloaked Mode" ON (do not provide alerts) and all other HIS are set to "Cloaked Mode" OFF (display alerts). ***Iteration #2:*** OTVP HIS is set to "Cloaked Mode" ON (do not provide alerts) and all other HIS are set to "Cloaked Mode" OFF (display alerts). ***Iteration #3:*** RP HIS is set to "Cloaked Mode" ON (do not provide alerts) and all other HIS are set to "Cloaked Mode" OFF (display alerts.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Scenario #59 Iteration #1:			
Confirm that no TVO alerts (including TVO-IA) are provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV passes from behind with pedestrian(s) in forward/rear center zones (zone 5 or 6) [159]			
Confirm that an RP-IA is provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 5 or 6 [234] [271] [272] [274]			

Test Case No. and Title	2.1.16 TSPW Cloak Mode where Transit Vehicle is Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a OTVP-WA is provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the adjacent-left lane, and a pedestrian is located in roadway forward center zone (Zone 5) [249] [271] [272] [274]			
Scenario #59 Iteration #2:			
Confirm that a TVO-IA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear center zones (zone 5 or 6) [235] [231] [289] [271] [272] [274]			
Confirm that an RP-IA is provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 5 or 6 [234] [271] [272] [274]			
Confirm that a no TVO alerts (including OTVP-WA) are provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the adjacent-left lane, and a pedestrian is located in roadway forward center zone (Zone 5) [200]			
Scenario #59 Iteration #3:			

Test Case No. and Title	2.1.16 TSPW Cloak Mode where Transit Vehicle is Stopped at Bus Stop with Pedestrian(s) Present Only in the Roadway Forward Center Zone (Zone 5) with an Oncoming DSRC/TSPW-Enabled POV that Passes the Transit Vehicle		
Verification Phase	**II - Garage / Controlled Parking Lot Verification**		
Confirm that a TVO-IA (rather than a TVO-WA) is provided when the transit vehicle is stopped at the bus stop and the DSRC/TSPW-Enabled POV approaches/passes from behind with pedestrian(s) in forward/rear center zones (zone 5 or 6) [235] [231] [289] [271] [272] [274]			
Confirm that no RP alerts (including RP-IA) are provided when the transit vehicle is stopped within the roadway zones and pedestrian(s) are present in zones 5 or 6 [201]			
Confirm that a OTVP-WA is provided when the transit vehicle is stopped within the roadway zones, a DSRC-enabled POV is approaching from behind the transit vehicle in the adjacent-left lane, and a pedestrian is located in roadway forward center zone (Zone 5) [249] [271] [272] [274]			

2.2 TSPW Functional Characteristics

Test Case No. and Title	2.2.1 TSPW Roadside Operational and Degraded Modes
Verification Phase	II – Garage / Controlled Parking Lot Verification
Test Objectives	Validate TSPW roadside subsystem implementation of an operational mode. Validate TSPW roadside subsystem implementation of an operational degraded mode.
Requirements Verified	305, 306
Brief Description	Demonstrate the TSPW roadside subsystem running without degradation, while the transit vehicle is operating. Prove the roadside subsystem runs with some functionality degraded in operational degraded mode, while the transit vehicle is operating.
Test Setup and Configuration	• Simulate roadside subsystem by connecting the CCP to a 12VDC power supply. • Connect the CCP to the WebSwitch+. • Connect the ignition switch to the power supply. • Mount the TrafiSense cameras in accordance with the TrafiSense Installation Plan. • Connect the end of the BPL cable extending from the cameras to the screw terminals on the TI X-stream rack. • Power on the TI X-stream rack. • Configure the TrafiSense settings in accordance with the TrafiSense Installation Plan.
Test Procedure/Script	• Confirm the CCP is powered on by checking to see if the lights are illuminated on the housing of the CCP. • Execute the simulation script or otherwise simulate the conditions for test case 2.1.4 to generate some RP-IA alerts (as well as TAM-Approach alerts. • Verify data was sent to the cloud management system after the alert was triggered. • Verify the WebSwitch+ is powered on by checking to see if the green light is illuminated. • Visit the WebSwitch+ remote control website (10.30.100.18, SUBJECT TO CHANGE). • On the WebSwitch+ remote control website, click the “ON” button to turn on the CCP that is connected. • Verify the CCP is in operating mode by making sure the lights on the housing are illuminated. • Verify the operational degraded mode by having the CCP run without the cellular chip.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Test Case No. and Title	2.2.1 TSPW Roadside Operational and Degraded Modes		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Expected Results	**Met?**		**Notes**
	Y	**N**	
Roadside subsystem is operational while the transit vehicle is operating [305]			
Roadside subsystem operates in operational degraded mode with some functionality of the system degraded, while transit vehicle is operating [306]			

Common Phase 2 E-TRP / TSPW Test Cases

Test Case No. and Title	**2.1.1.4 Transit vehicle is traveling straight, signalized intersection, red light, and pedestrian within near side crosswalk**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Objectives	**Primary Objectives:** • Confirm that an **E-PCW Warn Alert** is displayed/annunciated for ConOps Scenario #9, featuring pedestrian crosswalk detection. **Secondary Objectives:** • Confirm that an **E-PCW Ready** Alert is displayed/annunciated prior to the Warn Alert with the transit vehicle in the E-PCW area. • Confirm that no E-PCW alerts are displayed/annunciated (i.e., **Alert End**) as the pedestrian clears the near-side crosswalk.
Requirements Verified	**7,** 3, 142, 26, 131
Brief Description	The transit vehicle approaches a signalized intersection with a green/yellow signal and with the intention of travelling straight through the intersection (no turn signal). It enters the equipped E-PCW area with no pedestrians in or with intent to enter any crosswalk. As the transit vehicle continues to approach, the signal changes to red and a pedestrian enters the near-side crosswalk prior to the transit vehicle reaching the near-side crosswalk. While the signal is red, the pedestrian clears the crosswalk. Subsequently, the intersection remains clear and the signal changes to green, the transit vehicle continues through the intersection and departs the E-PCW area.
Test Setup and Configuration	**Phase II** • Power on the E-TRP RSE and IVS, including the HIS. • Load the MAP message on the SPaT/Traffic Signal Controller Simulator. • Start the SPaT/Traffic Controller Simulator. • Ensure GPS feed is connected and operating (**note:** GPS position will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating normally and the IVS Display is receiving information from the DSRC Radio. • Enable SPaT messaging from SPaT/Traffic Signal Controller Simulator.

Test Case No. and Title	**2.1.1.4 Transit vehicle is traveling straight, signalized intersection, red light, and pedestrian within near side crosswalk**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Procedure/Script	**Phase II** Simulate transit vehicle position relative to the equipped intersection in the following phased sequence, while simultaneously controlling variables as specified (all pedestrian and transit vehicle zones physically marked): Phase A: • Simulated Transit Vehicle is physically approaching the intersection and enters the PCW area • Vehicle CAN simulator outputs are Gear = Forward and Turn Signal = None • Traffic signal simulator = Green/Yellow • No pedestrians enter or show intent to enter (no pushbutton or movement near) any crosswalk Phase B: • Simulated Transit Vehicle continues approach to the intersection within the PCW • Vehicle CAN simulator Gear and Turn Signal outputs remain unchanged • Traffic signal simulator = Red • A pedestrian enters the near-side crosswalk Phase C: • Traffic signal simulator = Red • Simulated Transit Vehicle stops at the intersection • Vehicle CAN simulator Gear and Turn Signal outputs remain unchanged • After some time elapses, the pedestrian clears the near-side crosswalk Phase D: • Pedestrian(s) remain clear of the near-side crosswalk (and far-side crosswalk). • Traffic signal simulator = Green • Simulated Transit Vehicle proceeds through the intersection and exits the PCW area
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Test Case No. and Title	2.1.1.4 Transit vehicle is traveling straight, signalized intersection, red light, and pedestrian within near side crosswalk		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Prior to display of E-PCW Warn Alert, confirm that an **E-PCW Ready Alert** is displayed/annunciated when the transit vehicle is within the enabled E-PCW area and other alerts do not yet apply. [3]			
Confirm that an **E-PCW Warn Alert** is displayed/annunciated when the transit vehicle is within the enabled E-PCW area, the signal is red, and a pedestrian is detected in the near-side crosswalk. [7] [26] [131]			
Confirm that no E-PCW alerts are displayed/annunciated (i.e., **Alert End**) as the pedestrian clears the near-side crosswalk, and that no alerts are displayed/annunciated as the transit vehicle departs the E-PCW area. [142]			

Test Case No. and Title	**2.1.1.5 Transit vehicle is traveling straight, non-signalized intersection, stop sign, and pedestrian within near side crosswalk**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Objectives	**Primary Objectives:** • Confirm that an **E-PCW Warn Alert** is displayed/annunciated for ConOps Scenario #13, featuring pedestrian crosswalk detection. **Secondary Objectives:** • Confirm that an **E-PCW Ready** Alert is displayed/annunciated prior to the Warn Alert with the transit vehicle in the E-PCW area. • Confirm that no E-PCW alerts are displayed/annunciated (i.e., **Alert End**) as the pedestrian clears the near-side crosswalk.
Requirements Verified	**7,** 3, 142, 26
Brief Description	The transit vehicle approaches a non-signalized intersection with a stop sign and with the intention of travelling straight through the intersection (no turn signal). It enters the equipped E-PCW area with no pedestrians in or with intent to enter any crosswalk. As the transit vehicle continues to approach, a pedestrian enters the near-side crosswalk prior to the transit vehicle reaching the near-side crosswalk. While the transit vehicle is stopped at the intersection, the pedestrian clears the crosswalk after which the intersection remains clear and the transit vehicle continues through the intersection and departs the E-PCW area.
Test Setup and Configuration	**Phase II** • Power on the E-TRP RSE and IVS, including the HIS. • Load the MAP message on the SPaT/Traffic Signal Controller Simulator. • Start the SPaT/Traffic Controller Simulator. • Ensure GPS feed is connected and operating (**note:** GPS position will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating normally and the IVS Display is receiving information from the DSRC Radio. • Enable SPaT messaging from SPaT/Traffic Signal Controller Simulator.

Test Case No. and Title	**2.1.1.5 Transit vehicle is traveling straight, non-signalized intersection, stop sign, and pedestrian within near side crosswalk**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Procedure/Script	**Phase II** Simulate transit vehicle position relative to the equipped intersection in the following phased sequence, while simultaneously controlling variables as specified (all pedestrian and transit vehicle zones physically marked): Phase A: • Simulated Transit Vehicle is physically approaching the intersection and enters the PCW area • Vehicle CAN simulator outputs are Gear = Forward and Turn Signal = None • Traffic signal simulator = Stop Sign • No pedestrians enter or show intent to enter (no pushbutton or movement near) any crosswalk Phase B: • Simulated Transit Vehicle continues approach to the intersection within the PCW • Vehicle CAN simulator Gear and Turn Signal outputs remain unchanged • Traffic signal simulator = Stop Sign • A pedestrian enters the near-side crosswalk Phase C: • Traffic signal simulator = Stop Sign • Simulated Transit Vehicle stops at the intersection • Vehicle CAN simulator Gear and Turn Signal outputs remain unchanged • After some time elapses, the pedestrian clears the near-side crosswalk Phase D: • Pedestrian(s) remain clear of the near-side crosswalk (and far-side crosswalk). • Traffic signal simulator = Stop sign • Simulated Transit Vehicle proceeds through the intersection and exits the PCW area
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Test Case No. and Title	2.1.1.5 Transit vehicle is traveling straight, non-signalized intersection, stop sign, and pedestrian within near side crosswalk		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Prior to display of E-PCW Warn Alert, confirm that an **E-PCW Ready Alert** is displayed/ annunciated when the transit vehicle is within the enabled E-PCW area and other alerts do not yet apply. [3]			
Confirm that an **E-PCW Warn Alert** is displayed/annunciated when the transit vehicle is within the enabled E-PCW area of a non-signalized intersection, and a pedestrian is detected in the near-side crosswalk. [7] [26]			
Confirm that no E-PCW alerts are displayed/annunciated (i.e., **Alert End**) as the pedestrian clears the near-side crosswalk, and that no alerts are displayed/annunciated as the transit vehicle departs the E-PCW area. [142]			

Test Case No. and Title	**2.1.1.18 Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Objectives	**Primary Objectives:** • Confirm that an **E-PCW Inform Alert** is displayed/annunciated, replaced with a displayed/annunciated **E-PCW Warn Alert,** and finally replaced with a displayed/annunciated **E-PCW Inform Alert** (**E-PCW Alert Priority**) for ConOps Scenario #56, featuring crosswalk pushbutton detection for the near-side crosswalk and pedestrian detection in the near-side crosswalk. • Confirm that logging requirements are met and that details match manually captured/simulated scenario details, including by GNSS timestamp. **Secondary Objectives:** • Confirm that an **E-PCW Ready** Alert is displayed/annunciated prior to the Inform Alert with the transit vehicle in the E-PCW area. • Confirm that no E-PCW alerts are displayed/annunciated (i.e., **Alert End**) as the transit vehicle departs the E-PCW area.
Requirements Verified	**8,** 3, **7, 18**, 142, 26, 29, 28, 131, [logging: 149, **192, 191**, 40, 51, 43, 152, 158, 206, 207, 185, 187, 189, 190, **108**, 188, 204, **156, 44, 139, 107, 174, 175, 154**]
Brief Description	The transit vehicle approaches a signalized intersection with a green signal and with the intention of travelling straight through the intersection (no turn signal). It enters the equipped E-PCW area with no pedestrians in or with intent to enter any crosswalk. As the transit vehicle continues to approach, the signal remains green and a pedestrian (pedestrian #1) shows intent to cross the near-side crosswalk by pressing an associated crosswalk pushbutton (but does not enter the crosswalk). After a moment, a second pedestrian (pedestrian #2) enters the near-side crosswalk. The transit vehicle continues approach to the intersection, slows by braking and – for the sake of evaluating logging requirements, momentarily stops and cycles the gear position to Park and back to Forward – to yield right-of-way as necessary while pedestrian #2 traverses the near-side crosswalk. With the intersection clear, the transit vehicle proceeds forward through the intersection and departs the E-PCW area. **Note:** pedestrian #1 remains within the near-side crosswalk Inform Zone throughout the scenario.
Test Setup and Configuration	**Phase II** • Power on the E-TRP RSE and IVS, including the HIS. • Load the MAP message on the SPaT/Traffic Signal Controller Simulator. • Start the SPaT/Traffic Controller Simulator.

Test Case No. and Title	**2.1.1.18 Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
	• Ensure GPS feed is connected and operating (**note:** GPS position will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests). • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating normally and the IVS Display is receiving information from the DSRC Radio. • Enable SPaT messaging from SPaT/Traffic Signal Controller Simulator. • Open SQL Server Management Studio and run the script EpcwResultsFromLatestInteraction.sql
Test Procedure/Script	**Phase II** Simulate transit vehicle position relative to the equipped intersection in the following phased sequence, while simultaneously controlling variables as specified (all pedestrian and transit vehicle zones physically marked): Phase A: • Simulated Transit Vehicle is physically approaching the intersection and enters the PCW area • Vehicle CAN simulator outputs are Gear = Forward and Turn Signal = None • Traffic signal simulator = Green • No pedestrians enter or show intent to enter (no pushbutton or movement near) any crosswalk Phase B: • Simulated Transit Vehicle continues approach to the intersection within the PCW • Vehicle CAN simulator Gear and Turn Signal outputs remain unchanged • Traffic signal simulator = Green • Pedestrian #1 shows intent to enter the near-side crosswalk by pressing an associated pushbutton Phase C: • Simulated Transit Vehicle continues approach to the intersection within the PCW • Vehicle CAN simulator Gear and Turn Signal outputs remain unchanged • Traffic signal simulator = Green • Pedestrian #1 remains in the Inform Zone of the near-side crosswalk (and continues to remain there throughout Phase D) and Pedestrian #2 enters the near-side crosswalk. Phase D: • Simulated Transit Vehicle slows to a stop by braking to allow Pedestrian #2 to traverse the near-side crosswalk. • Vehicle CAN simulator Gear outputs are cycled from Forward to Park and back to Forward (for sake of evaluating logging) • Traffic signal simulator = Green

Test Case No. and Title	**2.1.1.18 Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
	• Pedestrian #2 clears the near-side crosswalk. Phase E: • Vehicle CAN simulator outputs are Gear remain unchanged • Traffic signal simulator = Green • The transit vehicle proceeds through the intersection and exits the PCW area • Retrieve logged collected by the logging service for this test case from the remotely hosted cloud management subsystem • Compare logged details against manually captured/simulated scenario details, including by GNSS timestamp.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	Met? Y	Met? N	Notes
Prior to display of E-PCW Inform Alert, confirm that an **E-PCW Ready Alert** is displayed/annunciated when the transit vehicle is within the enabled E-PCW area and other alerts do not yet apply. [3]			**Note:** This expected result may not be applicable to the Phase III live environment verification depending on the position of pedestrians when the transit vehicle arrives, but if applicable should be met. This requirement may be applicable to numerous Phase III test cases, as will be noted.
Confirm that an **E-PCW Inform Alert** is displayed/annunciated in Phase B when the transit vehicle is within the enabled E-PCW area, the signal is green/yellow, and Pedestrian #1 presses the pushbutton associated with the near-side crosswalk. [8] [29] [131]			
Confirm that the **E-PCW Inform Alert** is replaced by a displayed/annunciated **E-PCW Warn Alert** when Pedestrian #2 enters the near-side crosswalk in Phase C. [7] [26] [18]			

Test Case No. and Title	2.1.1.18 Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Confirm that an **E-PCW Warn Alert** is followed by a displayed/annunciated **E-PCW Inform Alert** in Phase D when the transit vehicle is within the enabled E-PCW area, the signal is green/yellow, and Pedestrian #2 clears the near-side crosswalk (with persistent Pedestrian #1 intent to cross the near-side crosswalk via pushbutton and/or presence in the Inform Zone). [8] [29/28] [131]			
Confirm that no E-PCW alerts are displayed/annunciated (i.e., **Alert End**) as the transit vehicle departs the E-PCW area. [142]			
Confirm that logged details in the TMX Event Log match manually captured/simulated scenario details and meet requirements as follows:			
• All triggered event data is logged by Roadside Subsystem logs, including E-PCW alerts each of which includes a unique identifier. [185] [204]			
• A unique roadside identification ID for each E-PCW detection and pedestrian presence zone detection is found in the TMX event log. [188]			
• Confirm that the E-PCW roadside subsystem captured all E-PCW system generated DSRC messages transmitted by and received by the E-PCW roadside subsystem. [189] [190]			**Note:** DSRC messages are not sent or received in the simulated environment (garage) and will be confirmed in controlled parking lot iteration of this test case.

Test Case No. and Title	2.1.1.18 Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
• An image is captured from the pedestrian detection cameras for every triggered E-PCW detection event in the Roadside Subsystem. [191]			
• E-PCW detection images captured correspond to the correct roadside identification ID. [188]			
• Logged details in the TMX Event Log were collected by the Roadside Subsystem and uploaded to the cloud database. [192] [108] [187]			**Note:** A design decision was made to not log data in standby mode, as the subsystem is effectively "off". As such, the portion of requirement number 187 corresponding to standby mode is not tested. Req. 187: "The E-PCW roadside subsystem shall transfer data files to a remotely hosted cloud management subsystem, when connected in both Operational and Standby modes such that no data files are lost, deleted or corrupted."
• All alert activations including alert type, alert ID and associated roadside location ID are logged by the E-PCW In-Vehicle Application. [207]			
• All alert deactivations including alert type, alert ID and associated roadside location ID are logged by the E-PCW In-Vehicle Application. [206]			
• All transit vehicle operator HIS state transitions including pre-state, Triggering Alert ID, and post state transitions are logged by the E-TRP In-Vehicle Subsystem. [158]			
• All service brake state transitions including pre-state and post state are logged by the E-TRP In-Vehicle Subsystem. [40]			

Test Case No. and Title	2.1.1.18 Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
• All Gear Position state transitions including pre and post state transitions are logged by the E-TRP In-Vehicle Subsystem. [149]			
• Vehicle speed at 1 second intervals are recorded and stored by the E-TRP In-Vehicle Subsystem. [43]			
• Vehicle heading at 1 second intervals are recorded and stored by the E-TRP In-Vehicle Subsystem. [152]			
• Vehicle latitude and longitude at 1 second intervals are recorded and stored by the E-TRP In-Vehicle Subsystem. [51]			
• All triggered event data is logged by the In-Vehicle Subsystem. [156]			
• A complete record of operational changes including the trigger causing the mode to change is logged by the E-TRP In-Vehicle Subsystem. [154]			
• Data logged by the In-Vehicle Subsystem has the correct associated date and time, synchronized to GNSS time of the logged event. [44]			
• A unique in-vehicle subsystem ID is verified and corresponds to the data collected. [139]			

Test Case No. and Title	2.1.1.18 Transit vehicle is traveling straight, signalized intersection, green/yellow light, pedestrian 1 with intent to cross near side crosswalk AND pedestrian 2 within near side crosswalk		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
• Data was collected by the In-Vehicle Subsystem. [107]			**Note:** A design decision was made to not log data in standby mode, as the subsystem is effectively "off". As such, the portion of requirement number 107 corresponding to standby mode is not tested. Req. 107: "The E-TRP in-vehicle subsystem shall transfer data files to a remotely hosted cloud management subsystem, when connected in both Operational and Standby modes such that no data files are lost, deleted or corrupted."
• All data was transferred to the cloud management system. [107]			
• The E-TRP In-Vehicle Subsystem logs captured all DSRC messages transmitted and received by the E-PTRP In-Vehicle Subsystem. [174][175]			**Note:** DSRC messages are not sent or received in the simulated environment (garage) and will be confirmed in controlled parking lot iteration of this test case.

Test Case No. and Title	**2.2.1.7 Vehicle behind transit vehicle, passes on the left, and veers right in front of transit vehicle, transit vehicle brake is released**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Objectives	**Primary Objectives:** • Confirm that an **E-VTRW Inform Alert** followed by an **E-VTRW Warn Alert** is displayed/annunciated for ConOps Scenario #60, featuring the target vehicle passing the transit vehicle in such a way that it shows possible intent to make a right turn followed by an actual right turn in path of transit vehicle. • Confirm that the **E-VTRW Ready, Inform, and Warn Alerts** are started and ended within the logs based on **E-VTRW Alert** and **Alert End** conditions. Logs collected during the two test case iterations will be inspected against separately collected time points of entry/exit from the E-VTRW alert area. **Secondary Objectives:** • Confirm that an **E-VTRW Ready Alert** is displayed/annunciated prior to target vehicle presence with transit vehicle near the stop. • Confirm that the E-VTRW screen is removed (i.e., **Alert End**) as the target vehicle departs the ahead of transit vehicle area and does not reappear as transit vehicles moves beyond the configured distance from the stop.
Requirements Verified	**20, 23**, 19, 21, 30, 31, 32, 33, 34, 35, [logging: 158, **40, 149,** 203, 208, 209, 156, 44, 139, 107, **108**, 174, 175, 176, 154, 51, **43,** 152]
Brief Description	The transit vehicle is stopped with front door open and in forward gear to pick up or offload passengers. The transit releases the brake in preparation for departure, during which time a target vehicle passes the transit vehicle from behind to behind left (possible right turning vehicle) and then turns right into the path of the transit vehicle after moving into the ahead left position (right turning vehicle).
Test Setup and Configuration	**Phase II** • Power on the IVS, including the HIS. • Ensure the alternate vehicle BSM simulator is connected and operating • Ensure GPS feed is connected and operating, or position simulation is prepared. • Ensure the Vehicle CAN simulator is connected and operating. • Verify that all systems are operating normally and the IVS Display is receiving information from the DSRC Radio. • Open SQL Server Management Studio and run the script EvtrwResultsFromLatestInteraction.sql

Test Case No. and Title	**2.2.1.7 Vehicle behind transit vehicle, passes on the left, and veers right in front of transit vehicle, transit vehicle brake is released**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Procedure/Script	**Phase II** Prior to and following the sequence of phases described below (during which the vehicle ignition is to be switched on), the vehicle ignition should be switched to the off position to permit assessment of logging functions in both operational modes. Simulate transit vehicle and target vehicle positions by physically moving Simulated target vehicle relative to a transit vehicle near a virtual stop (located just upstream of an intersection) in the following phased sequence, while simultaneously controlling variables as specified (all necessary distances marked): Phase A: • Simulated Transit Vehicle is physically stopped at the virtual stop • Vehicle CAN simulator outputs are Gear = Forward, Brake = On, and Front Door = Open • No Simulated target vehicles behind or left of the transit vehicle Phase B: • Simulated Transit Vehicle releases brake in preparation to move forward away from the virtual stop • Vehicle CAN simulator outputs are Gear = Forward, Brake = Off, and Front Door = Closed* • Target vehicle passes the transit vehicle on its left, beginning at the behind position, advancing to the behind left position. Phase C: • Simulated Transit Vehicle brake remains released in preparation to move forward away from the virtual stop, but transit vehicle does not move forward or out of the configured distance • Vehicle CAN simulator outputs are Gear = Forward, Brake = Off, and Front Door = Closed* • Target vehicle continues passing the transit vehicle, turning right into the path of the transit vehicle after moving into the ahead left position. Phase D: • After right turning target vehicle clears, Simulated Transit Vehicle physically continues forward away from the stop and departs beyond the configured distance • Vehicle CAN simulator outputs are Gear = Forward, Brake = Off, and Front Door = Closed • No Simulated target vehicles behind or left of the transit vehicle * **Note:** although the front door position is set as closed in Phase B and Phase C of this test, E-VTRW logic imposes a condition that the alert will no longer be displayed (i.e., Alert End) when the transit vehicle reaches a minimum speed of 8 km/hr.

Test Case No. and Title	**2.2.1.7 Vehicle behind transit vehicle, passes on the left, and veers right in front of transit vehicle, transit vehicle brake is released**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Test Case No. and Title	2.2.1.7 Vehicle behind transit vehicle, passes on the left, and veers right in front of transit vehicle, transit vehicle brake is released		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
Confirm that an **E-VTRW Ready Alert** is displayed/annunciated when the transit vehicle is stopped in forward gear with the front door open to pick up or offload passengers within the configured E-VTRW alert area. [19]			
Confirm that **E-VTRW Inform Alert** is displayed/annunciated as the target vehicle passes the transit vehicle from behind to behind left. [20] [30] [31]			**Note:** DSRC messages are not sent or received in the simulated environment (garage). Though vehicle presence can be simulated, this can be confirmed using DSRC communications in a controlled parking lot setting. Requirements 20, 30, and 31 may not be tested in the controlled parking lot setting in every Phase 2 E-VTRW test case in which the requirement is listed.
Confirm that **E-VTRW Warn Al**ert is displayed/annunciated as the target vehicle continues to the left forward position relative to the transit vehicle and turns right into the transit vehicle path. [23] [32] [33]			**Note:** DSRC messages are not sent or received in the simulated environment (garage). Though vehicle presence can be simulated, this can be confirmed using DSRC communications in a controlled parking lot setting. Requirements 23, 32, and 33 may not be tested in the controlled parking lot setting in every Phase 2 E-VTRW test case in which the requirement is listed.
Confirm that the VTRW screen is no longer displayed (i.e., **Alert End**) as the target vehicle departs the ahead of transit vehicle area. [21] The VTRW does not re-appear as the transit vehicle departs the configured distance (15 meters default).			**Note:** DSRC messages are not sent or received in the simulated environment (garage). Though vehicle presence can be simulated, this can be confirmed using DSRC communications in a controlled parking lot setting. Requirement 21 may not be tested in the controlled parking lot setting in every Phase 2 E-VTRW test case in which the requirement is listed.
Confirm that the following details logged in the TMX Event Log match manually captured/simulated scenario details and meet requirements as follows:			
• All triggered alerts are assigned a unique identifier by the E-VTRW application. [203]			

Test Case No. and Title	2.2.1.7 Vehicle behind transit vehicle, passes on the left, and veers right in front of transit vehicle, transit vehicle brake is released		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
• All transit vehicle operator HIS state transitions including pre-state, Triggering Alert ID, and post state transitions are logged by the E-TRP In-Vehicle Subsystem. [158]			
• All data files collected by the E-TRP components were uploaded to the cloud database. [108]			
• All service brake state transitions including pre-state and post state are logged by the E-TRP In-Vehicle Subsystem. [40]			
• All Gear Position state transitions including pre and post state transitions are logged by the E-TRP In-Vehicle Subsystem. [149]			
• Vehicle speed at 1 second intervals are recorded and stored by the E-TRP In-Vehicle Subsystem. [43]			
• Vehicle heading at 1 second intervals are recorded and stored by the E-TRP In-Vehicle Subsystem. [152]			
• Vehicle latitude and longitude at 1 second intervals are recorded and stored by the E-TRP In-Vehicle Subsystem. [51]			
• All BSM DSRC messages were received when the E-VTRW application is active. [176]			**Note:** DSRC messages are not sent or received in the simulated environment (garage) and will be confirmed in controlled parking lot iteration of this test case.

Test Case No. and Title	2.2.1.7 Vehicle behind transit vehicle, passes on the left, and veers right in front of transit vehicle, transit vehicle brake is released		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
• All alert activations including alert type and alert ID are logged by the E-VTRW In-Vehicle Application. [208]			
• All alert deactivations including alert type and alert ID are logged by the E-VTRW In-Vehicle Application. [209]			
• All triggered event data is logged by the In-Vehicle Subsystem. [156]			
• Data logged by the In-Vehicle Subsystem has the correct associated date and time, synchronized to GNSS time of the logged event. [44]			
• A unique in-vehicle subsystem ID is verified and corresponds to TMX Event Log data. [139]			
• Data was collected by the In-Vehicle Subsystem. [107]			**Note:** A design decision was made to not log data in standby mode, as the subsystem is effectively "off". As such, the portion of requirement number 107 corresponding to standby mode is not tested. Req. 107: "The E-TRP in-vehicle subsystem shall transfer data files to a remotely hosted cloud management subsystem, when connected in both Operational and Standby modes such that no data files are lost, deleted or corrupted."
• All TMX Event Log data was transferred to the cloud management system. [107]			
• The E-TRP In-Vehicle Subsystem logs captured all DSRC messages transmitted and received by the E-PTRP In-Vehicle Subsystem. [174][175]			**Note:** DSRC messages are not sent or received in the simulated environment (garage) and will be confirmed in controlled parking lot iteration of this test case.

Test Case No. and Title	2.2.1.7 Vehicle behind transit vehicle, passes on the left, and veers right in front of transit vehicle, transit vehicle brake is released			
Verification Phase	**II – Garage / Controlled Parking Lot Verification**			
• A complete record of operational changes including the trigger causing the mode to change is logged by the E-TRP In-Vehicle Subsystem. [154]				

Test Case No. and Title	2.4.1.1 Operational Mode		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Test Objectives	Validate in-vehicle subsystem implementation of an operational mode. [63]		
Requirements Verified	63		
Brief Description	Demonstrate the in-vehicle subsystem running without degradation, while the transit vehicle is operating.		
Test Setup and Configuration	• Simulate in-vehicle subsystem by connecting the CCP to a 12VDC power supply. • Connect the CCP to the iBoot. • Connect the ignition switch to the power supply. • Mount the TrafiSense cameras in accordance with the TrafiSense Installation Plan. • Connect the end of the BPL cable extending from the cameras to the screw terminals on the TI X-stream rack. • Power on the TI X-stream rack. • Configure the TrafiSense settings in accordance with the TrafiSense Installation Plan.		
Test Procedure/Script	• Confirm the CCP is powered on by checking to see if the lights are illuminated on the housing of the CCP. • Trigger an E-PCW warning with a pedestrian standing in a presence zone beneath a configured and active TrafiSense camera. • Verify data was sent to the cloud management system after the alert was triggered.		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results	**Met?**		**Notes**
	Y	**N**	
In-vehicle subsystem is fully operational while being powered by the 12VDC power supply. [63]			

Test Case No. and Title	2.4.1.2 Non-Operational Mode – Standby
Verification Phase	II – Garage / Controlled Parking Lot Verification
Test Objectives	Validate in-vehicle subsystem non-operational standby mode, while the transit vehicle is not operating. [64] The transit vehicle should not be operating and the in-vehicle subsystem should be in power saving mode.
Requirements Verified	64, 63
Brief Description	Demonstrate in-vehicle subsystem implementation of a non-operational standby mode.
Test Setup and Configuration	• Simulate in-vehicle subsystem by connecting the CCP to a 12VDC power supply. • Connect the CCP to the iBoot. • Connect the ignition switch to the power supply.
Test Procedure/Script	• Verify the iBoot is powered on by checking to see if the lights are illuminated on the housing of the CCP. • Turn off the ignition switch. • Verify the CCP is running in power saving mode by confirming CCP LEDs, CVIS Management Portal, and/or TMX Event Logs.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met?		Notes
	Y	N	
In-vehicle subsystem is operational while the transit vehicle is operating [63]			
In-vehicle subsystem is fully functional in operational mode while the transit vehicle is operating [63]			
In-vehicle subsystem exhibits a power saving mode [64]			

Test Case No. and Title	**2.4.1.3 Operation Mode – Degraded**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Objectives	Validate in-vehicle subsystem implementation of an operational mode. [63] Validate in-vehicle subsystem implementation of an operational degraded mode. [67]
Requirements Verified	67, 63
Brief Description	Demonstrate the in-vehicle subsystem running without degradation, while the transit vehicle is operating. Prove the in-vehicle subsystem runs with some functionality degraded in operational degraded mode, while the transit vehicle is operating.
Test Setup and Configuration	• Simulate in-vehicle subsystem by connecting the CCP to a 12VDC power supply. • Connect the CCP to the iBoot. • Connect the ignition switch to the power supply. • Mount the TrafiSense cameras in accordance with the TrafiSense Installation Plan. • Connect the end of the BPL cable extending from the cameras to the screw terminals on the TI X-stream rack. • Power on the TI X-stream rack. • Configure the TrafiSense settings in accordance with the TrafiSense Installation Plan.
Test Procedure/Script	• Confirm the CCP is powered on by checking to see if the lights are illuminated on the housing of the CCP. • Trigger an E-PCW warning with a pedestrian standing in a presence zone beneath a configured and active TrafiSense camera. • Verify data was sent to the cloud management system after the alert was triggered. • Verify the iBoot is powered on by checking to see if the green light is illuminated. • Visit the iBoot remote control website (192.168.1.2, SUBJECT TO CHANGE). • On the iBoot remote control website, click the “ON” button to turn on the CCP that is connected. • Verify the CCP is in operating mode by making sure the lights on the housing are illuminated. • Verify the operational degraded mode by having the CCP run without the cellular chip.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Test Case No. and Title	2.4.1.3 Operation Mode – Degraded		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Expected Results	**Met?**		**Notes**
	Y	**N**	
In-vehicle subsystem is operational while the transit vehicle is operating [63]			
In-vehicle subsystem is fully functional in operational mode while the transit vehicle is operating [63]			
In-vehicle subsystem can operate in operational degraded mode, while the transit vehicle is operating [67]			
In-vehicle subsystem operates in operational degraded mode with some functionality of the system degraded, while transit vehicle is operating [67]			

Test Case No. and Title	2.4.1.6 Mode Transition: Off to Operational
Verification Phase	II – Garage / Controlled Parking Lot Verification
Test Objectives	• Demonstrate that is power is lost while in an Operational mode, the E-TRP in-vehicle subsystem shall automatically transition from Off to Operational once power is restored. [126]
Requirements Verified	126
Brief Description	Verify the mode transition of the in-vehicle system when power is lost and restored.
Test Setup and Configuration	• Connect the CCP to a 12VDC power supply • Connect the ignition switch to the power supply. • Confirm the CCP is powered on by checking to see if the lights are illuminated on the housing of the CCP. • Connect the CCP to the iBoot.
Test Procedure/Script	• Verify the iBoot is powered on by checking to see if the red light is illuminated. • Turn off the power supply. • Verify the iBoot and the CCP no longer have power by confirming neither of the lights are illuminated. • Turn on the power supply. • Verify the iBoot and CCP are now powered by confirming the lights on both pieces of hardware are illuminated. • Trigger an E-PCW warning with a pedestrians standing in a presence zone beneath a configured and active TrafiSense camera. • Verify the data was sent to the cloud management system after the alert was triggered.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met?		Notes
	Y	N	
Once power is lost, the in-vehicle subsystem automatically transitions from Off to Operational once the power was restored. [126]			

Test Case No. and Title	**2.4.2.2 Data Log Storage**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Objectives	Cloud management subsystem hosts a database to store all data files generated by E-TRP components
Requirements Verified	108
Brief Description	Prove the cloud management subsystem stores all data generated by E-TRP components.
Test Setup and Configuration	Run a series of scripts simulating different vehicle conditions (gear, brake, speed) and position relative to states that should trigger alerts and warnings (ready, inform, warn, suppress, end, etc.).
Test Procedure/Script	This may be mostly or completely accomplished by checking the TMX event log files at the conclusion of several other test cases described in section 2.X.X.X, and confirming anticipated logged file details were recorded. Ad hoc tests can be created as needed to confirm any details not captured by existing scripts/test cases result in the CDMS storage of all E-TRP component-generated data.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
All pedestrian detection log files were sent to and stored in the cloud management system.			
All pedestrian detection captured images were sent to and stored in the cloud management system.			
All GPS data from the transit vehicle was sent to and stored in the cloud management system			
All E-VTRW alert and warn conditions are recorded in CDMS			
Zone ID where the pedestrian triggered event occurred matches the zone ID in the image captured.			
All data generated by E-TRP components was sent to and stored in the cloud management system. [108]			

Test Case No. and Title	2.4.3.1 Location Accuracy
Verification Phase	II – Garage / Controlled Parking Lot Verification
Test Objectives	Confirm the in-vehicle subsystem implementation of a positioning service capable of 2.5 meter accuracy circular error probability. Confirm the in-vehicle subsystem implementation of a positioning service capable of 1 meter accuracy circular error probability.
Requirements Verified	124, 123
Brief Description	Check the accuracy of the position service capabilities.

Test Setup and Configuration	• Simulate the transit vehicle in operational mode. Follow the instructions for E-TRP Test Case No. 2.1.1.1 for how to configure hardware for setup:
	  • Power on the E-TRP RSE and IVS, including the HIS.
	  • Load the MAP message on the SPaT/Traffic Signal Controller Simulator.
	  • Start the SPaT/Traffic Controller Simulator.
	  • Ensure GPS feed is connected and operating (**note:** GPS position will be simulated in Garage-based tests, but captured using configured equipment in Controlled Parking Lot-based tests).
	  • Ensure the Vehicle CAN simulator is connected and operating.
	  • Verify that all systems are operating normally and the IVS Display is receiving information from the DSRC Radio.
	  • Enable SPaT messaging from SPaT/Traffic Signal Controller Simulator.
	• Install and connect antennas on transit vehicle.
	• Install and connect antennas roadside antennas near intersection.

Test Procedure/Script	• Power on transit vehicle. • Have the transit vehicle drive past the intersection. • Review the data sent via DSRC message to verify the accuracy of the circular error probability.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	Met?		Notes
	Y	N	
In-vehicle subsystem's positioning service has a 2.5 meter accuracy circular error probability [124]			

Test Case No. and Title	2.4.3.1 Location Accuracy		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
In-vehicle subsystem's positioning service has a capability of 1 meter accuracy circular error probability [123]			

Test Case No. and Title	**2.4.3.2 Calculate Location**		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Test Objectives	Demonstrate the in-vehicle subsystem calculating the position of the transit vehicle.		
Requirements Verified	146		
Brief Description	Verify the in-vehicle subsystem calculating the transit vehicle's position.		
Test Setup and Configuration	• Instrument test vehicle with CCP. • Setup mobile device inside test vehicle to record GPS location.		
Test Procedure/Script	• Record GPS position on mobile device. • Record position on CCP inside test vehicle. • Compare GPS position in test vehicle with that of the GPS position recorded on the CCP.		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results	**Met?**		**Notes**
	Y	**N**	
In-vehicle subsystem calculates the position of the transit vehicle. [146]			

Test Case No. and Title	2.4.3.3 Location Services (Includes Communication) Test Case (II)		
Verification Phase	II – Garage / Controlled Parking Lot Verification		
Test Objectives	Demonstrate the in-vehicle subsystem calculating the speed of the transit vehicle.		
Requirements Verified	147		
Brief Description	Verify the in-vehicle subsystem calculating the transit vehicle's speed.		
Test Setup and Configuration	• Instrument test vehicle with CCP.		
Test Procedure/Script	• Record speed from test vehicle's speedometer. • Record speed on CCP inside test vehicle. • Compare speed recorded on speedometer with that of the speed recorded on the CCP.		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results	**Met?**		**Notes**
	Y	**N**	
In-vehicle subsystem calculated the heading of the transit vehicle. [147]			

Test Case No. and Title	**2.4.3.4 Calculate Heading**		
Verification Phase	**II – Garage / Controlled Parking Lot Verification**		
Test Objectives	Demonstrate the in-vehicle subsystem calculating the heading of the transit vehicle.		
Requirements Verified	148		
Brief Description	Verify the in-vehicle subsystem calculating the transit vehicle's heading.		
Test Setup and Configuration	• Instrument test vehicle with CCP. • Setup mobile device inside test vehicle to record heading using Compass app.		
Test Procedure/Script	• Record heading using Compass app on mobile device. • Record heading on CCP inside test vehicle. • Compare heading in Compass app with that of the heading recorded on the CCP.		
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)		
Expected Results	**Met?**		**Notes**
	Y	**N**	
In-vehicle subsystem calculates the heading of the transit vehicle. [148]			

Test Case No. and Title	**2.4.3.5 DSRC Range**
Verification Phase	**II – Garage / Controlled Parking Lot Verification**
Test Objectives	Verify the DSRC radio range has a 100 meters line of sight from vehicle to roadside equipment. [133]
Requirements Verified	133
Brief Description	Prove the DSRC radio range by sending a message from the transit vehicle to the roadside equipment.
Test Setup and Configuration	• Install the transit vehicle equipment • Install the roadside equipment • Broadcast a DSRC radio message from the transit vehicle to the roadside equipment
Test Procedure/Script	• Install the antennas on the transit vehicle. • Install the roadside antennas 100 meters away from the transit vehicle. • Broadcast a DSRC message from the transit vehicle to the roadside equipment.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results	**Met?**		**Notes**
	Y	**N**	
DSRC message was sent from the transit vehicle's antennas			
DSRC message was received from the roadside antennas			
DSRC radio has a range of at least 100 meters line of sight from the vehicle to the roadside equipment [133]			**Note:** DSRC messages are not sent or received in the simulated environment (garage) and will be confirmed in controlled parking lot iteration of this test case.

3.0 Phase III (Live Environment Verification)

Live Environment Verification of E-TRP requirements will be demonstrated during the fully-integrated deployment phase in Cleveland, Ohio, prior to revenue service deployment. No TSPW requirements will be demonstrated at this time. However, TSPW functionality will be demonstrated to the USDOT and GCRTA during scheduled service on equipped transit vehicles and/or ad hoc scenarios in a closed-loop environment.

4.0 Phase IV Post-Fielding

Post-Fielding E-TRP/TSPW requirements will be verified using data collected during the revenue service period in Cleveland, Ohio.

Test Case No. and Title	**4.1.1.0 Supportability**
Verification Phase	**IV – Post-Fielding Verification**
Test Objectives	**Primary Objectives:** • Confirm that the E-TRP system performs with adequate reliability. This means the E-TRP system exhibits a Mean Time to Repair (MTTR), on average, within 2 hours (i.e., MTTR ≤ 2 hours). MTTR will be determined by averaging the duration of all periods where the E-TRP system (IVS and/or RSE) enters Maintenance mode and successfully regains Normal mode. • Confirm that the E-TRP system has an Inherent Availability (Ai), or an operational "up time" of 98% or greater (i.e., Ai ≥ 98%). Ai is based on Mean Time between Failures (MTBF) and will be calculated as MTBF / (MTBF + MTTR). Ai excludes preventative and scheduled maintenance, and any associated logistic time. Ai will be evaluated for the same evaluation period as MTTR, with the MTBF resulting from the average duration of all periods where the E-TRP system is collectively (IVS and RSE) in Normal/Standby mode (i.e., no component is in Degraded or Maintenance mode).
Requirements Verified	**150, 151**
Brief Description	Collected field test data will be used to determine MTTR, MTBF, and Ai for the E-TRP system.
Test Setup and Configuration	Ensure the CDMS and all logging and upload plugins are performing as anticipated following installation and preceding the Live Environment Verification phase.
Test Procedure/Script	• Periodically monitor data storage of the SQL Azure database via the Management Portal and the health of the system via the CDMS user interface. This includes ensuring that the anticipated number of vehicle statuses are reported at the expected rate/timeframes, and that activity state changes of the RSE are taking place. • Following the field study period, calculate the MTTR, MTBF, and Ai at the E-TRP system level.
Pass / Fail	☐ Pass (met all expected results) ☐ Fail (did not meet one or more expected results)

Expected Results [requirement]	**Met?**		**Notes**
	Y	**N**	
MTTR ≤ 2 hours. [151]			
Ai ≥ 98%. [150]			

APPENDIX A. TSPW Requirements Traceability Matrix

Table A-1 below identifies the Test Case(s) in which each requirement from the TSPW System Requirements Document [2] is verified.

Table A-1. TSPW Requirements Traceability Matrix

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
71	**71**	In-Vehicle Subsystem Power Interface	The E-TRP in-vehicle subsystem shall operate on 12 Volts Direct Current (VDC).			1.4.1.0;			
70	**70**	In-Vehicle Subsystem Power Interface	The E-TRP in-vehicle subsystem should consume no more than 10 Milliamps when powered via 12 VDC in Standby mode.			1.4.1.0;			
295	**(132)**	TSPW (E-PCW) Roadside Subsystem Power Interface	The TSPW (E-PCW) roadside subsystem shall operate on 120 Volts Alternating Current (VAC), 60 Hz.			1.4.1.0;			
56	**56**	Wireless Communications Interface Protocols	RW-PM Tool Adverse Weather Event Criteria shall be defined in objective terms that may be measured performance parameters, derived from the parameters, or forecast from the parameters.			1.5.1.0;			
57	**57**	Wireless Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a Bluetooth Classic interface.			1.5.1.0;			
58	**58**	Wireless Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement Bluetooth Low Energy (BLE) interface.			1.5.1.0;			
60	**60**	Wireless Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a 4G cellular interface.			1.5.1.0;			
61	**61**	Wireless Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a DSRC 5.9 GHz interface.			1.5.1.0;			
144	**144**	Wireless Communications Interface Protocols	E-TRP in-vehicle subsystem messages transmitted over the DSRC 5.9 GHz interface shall be compliant with SAE J2735.			1.7.1.0;			
83	**83**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement an ISO 15765-4 (CAN) interface.			1.5.1.0;			
84	**84**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement an ISO 14230-4 (Keyword Protocol 2000) interface.			1.5.1.0;			
85	**85**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement an ISO 9141-2 (Asian, European, Chrysler vehicles) interface.			1.5.1.0;			
86	**86**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a SAE J1850 VPW (GM Vehicles) interface.			1.5.1.0;			
87	**87**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a SAE J1850 PWM (Ford Vehicles) interface.			1.5.1.0;			
88	**88**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement an ISO 15765 interface.			1.5.1.0;			
89	**89**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement an ISO 11898 (raw CAN) interface.			1.5.1.0;			
90	**90**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a GMLAN Single Wire CAN (GMW3089) interface.			1.5.1.0;			
91	**91**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a Ford Medium Speed CAN (MS CAN) interface.			1.5.1.0;			
92	**92**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall implement a SAE J1939 bus interface.			1.5.1.0;			
93	**93**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem should implement a SAE J1708 interface. Note: The SAE J1708 interface may be implemented via external conversion equipment.			1.5.1.0;			
94	**94**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall be able to simultaneously receive and process data from an ISO 15765 bus AND any of the other protocols listed as required in this document.			1.5.1.0;			
155	**155**	Vehicle Communications Interface Protocols	The E-TRP in-vehicle subsystem shall be able to simultaneously receive and process data from two J1939 databus channels.			1.5.1.0;			
296	**(140)**	TSPW (E-PCW) Roadside Subsystem Interfaces	The TSPW (E-PCW) DSRC Roadside Unit shall implement interfaces compliant with the RSU Specification v4.0.			1.5.1.0;			

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
297	**(145)**	TSPW (E-PCW) Roadside Subsystem Interfaces	TSPW (E-PCW) Roadside Subsystem messages transmitted over the DSRC 5.9 GHz interface shall be compliant with SAE J2735.			1.7.1.0;			
113	**113**	Physical Interface	The E-TRP in-vehicle subsystem shall implement a method for secure physical attachment to the host vehicle.			1.6.1.0;			
1	**1**	User Interface	The E-TRP in-vehicle subsystem shall not obstruct the Transit Vehicle driver's field of view.				**Note:** E-TRP Test Cases 2.1.2.1 to 2.1.2.37 list shared E-TRP/TSPW requirement #1. However, it is recognized in the expected results that this requirement "…will be evaluated throughout the Phase III demonstration through driver survey. This may be conducted at the end of shift rather than directly following each test case." Because of this, and because the focus of those test cases covers numerous E-TRP only requirements, these test cases are not presented in the TSPW Acceptance Test Plan.	**Note:** E-TRP Test Cases 3.1.1.1 to 3.1.1.37 list shared E-TRP/TSPW requirement #1. However, it is recognized in the expected results that this requirement "…will be evaluated throughout the Phase III demonstration through driver survey. This may be conducted at the end of shift rather than directly following each test case." Because of this, and because the focus of those test cases covers numerous E-TRP only requirements, these test cases are not presented in the TSPW Acceptance Test Plan.	
276		User Interface - TSPW Enabled Alert Area	The location where the TSPW application begins to provide alerts shall be configurable based on the distance a transit vehicle is from entering a TSPW pedestrian detection zones and the speed of the transit vehicle.		2.1.1, 2.1.4, 2.1.5				
261		User Interface - TSPW Enabled Alert Area	All TSPW application alerts shall stop once the transit vehicle has completely exited (or passed-by) the TSPW Enabled Area.		NONE - ALL ALERTS WILL DEACTIVATE PRIOR TO THIS OR ARE SUPERSEDED BY ALERTS CAUSED BY POV OR SECOND TV				
159		User Interface - TSPW TVO HIS	The E-TRP subsystem Transit Vehicle Operator HIS shall be configurable to either provide or not provide alerts, maintaining all other required functionality, including alert logging. ***Note:*** *The suppression of alerts is known as "Cloaked Mode." Cloaked mode will be used during a baselining period at the beginning of operational fielding.*		2.1.16				
215		User Interface - TVO-SRA	The TSPW application shall provide a TVO-SRA when the transit vehicle is within a TSPW Enabled Area.		2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.9, 2.1.10, 2.1.11, 2.1.14, 2.1.15				
247		User Interface - TVO-SRA	The TVO-SRA shall end once the transit vehicle has completely departed or passed by all TSPW pedestrian detection roadway zones.		2.1.1, 2.1.2, 2.1.3				
219		User Interface - TVO-IA	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching the pedestrian detection roadway zones, if a pedestrian is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a TVO-IA.		2.1.4				
224		User Interface - TVO-IA	While the TSPW enabled transit vehicle is approaching and in motion within any pedestrian detection roadway zone, if a pedestrian is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a TVO-IA.		2.1.4				

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
235		User Interface - TVO-IA	While the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, if a pedestrian is located within the center roadway zones (zones 5 or 6) the TSPW application shall provide a TVO-IA.		2.1.5, 2.1.6, 2.1.12, 2.1.13, 2.1.16				
236		User Interface - TVO-IA	While the TSPW enabled transit vehicle is departing and in motion within both the forward and rear pedestrian detection roadway zones, if a pedestrian is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a TVO-IA.		2.1.4				
242		User Interface - TVO-IA	While the TSPW enabled transit vehicle is departing and in motion within the forward pedestrian detection roadway zones, if a pedestrian is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a TVO-IA.		2.1.4				
223		User Interface - TVO-WA	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching pedestrian detection zones, if a pedestrian is located within any pedestrian detection roadway zone (zones 3-6) the TSPW application shall provide a TVO-WA.		2.1.5, 2.1.6, 2.1.7, 2.1.8				
225		User Interface - TVO-WA	While the TSPW enabled transit vehicle is approaching and in motion within any pedestrian detection roadway zone, if a pedestrian is located within any pedestrian detection roadway zone (zones 3-6) the TSPW application shall provide a TVO-WA.		2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.15				
240		User Interface - TVO-WA	While the TSPW enabled transit vehicle is departing and in motion within both the forward and rear pedestrian detection roadway zones, if a pedestrian is located within any pedestrian detection roadway zone (zones 3-6) the TSPW application shall provide a TVO-WA.		2.1.5, 2.1.6, 2.1.7, 2.1.8				
246		User Interface - TVO-WA	While the TSPW enabled transit vehicle is departing and in motion within the forward pedestrian detection roadway zones, if a pedestrian is located within any forward pedestrian detection roadway zone (zone 3 or 5) the TSPW application shall provide a TVO-WA.		2.1.7, 2.1.8				
248		User Interface - TVO HIS Inform/Warn Alert End	Once detected pedestrians are clear of the zones causing a TVO-IA, the TVO-IA shall be deactivated.		2.1.4				
282		User Interface - TVO HIS Inform/Warn Alert End	Once the transit vehicle has completely passed a zone where detected pedestrians are causing a TVO-IA, the TVO-IA shall be deactivated.		2.1.4, 2.1.5, 2.1.6				
333		User Interface - TVO HIS Inform/Warn Alert End	Once detected pedestrians are clear of the zones causing a TVO-WA, the TVO-WA shall be deactivated.		2.1.7				
334		User Interface - TVO HIS Inform/Warn Alert End	Once the transit vehicle has completely passed a zone where detected pedestrians are causing a TVO-WA, the TVO-WA shall be deactivated.		2.1.7, 2.1.8				
279		User Interface - TVO HIS Non-Alert	While the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, a pedestrian located within the Danger Waiting Zone (zone 2) shall NOT cause a TVO-IA.		2.1.4, 2.1.7, 2.1.8, 2.1.9				
280		User Interface - TVO HIS Non-Alert	Once the TSPW enabled transit vehicle has departed the rear pedestrian detection roadway zones a pedestrian located within the rear pedestrian detection roadway zones (zone 4 or 6) shall NOT cause a TVO-WA.		2.1.5, 2.1.6, 2.1.15				
335		User Interface - TVO HIS Non-Alert	While the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, a pedestrian located within the curbside pedestrian detection roadway zones (zone 3 or 4) shall NOT cause a TVO-WA.		2.1.5, 2.1.6, 2.1.10, 2.1.11				
231		User Interface - TVO HIS Alert Priority	If multiple simultaneous alerts occur for the Transit Vehicle Operator HIS, the highest priority alert shall be presented.		2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.12, 2.1.13, 2.1.15, 2.1.16				
289		User Interface - TVO HIS Alert Priority	The Transit Vehicle Operator HIS alert priority (from highest to lowest priority) shall be: TVO-WA, TVO-IA, TVO-SRA.		2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.12, 2.1.13, 2.1.15, 2.1.16				
200		User Interface - TSPW OTVP HIS	The TSPW vehicle pedestrian HIS shall be configurable to either provide or not provide alerts, maintaining all other required functionality, including alert logging. ***Note:*** *The suppression of alerts is known as "Cloaked Mode." Cloaked mode will be used during a baselining period at the beginning of operational fielding.*		2.1.16				

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
232		User Interface - OTVP-WA	While the TSPW enabled transit vehicle is approaching and in motion within any pedestrian detection roadway zone, if a pedestrian is located within any pedestrian detection roadway zone (zones 3-6) the TSPW application shall provide a OTVP-WA.		2.1.5, 2.1.6, 2.1.7, 2.1.8				
241		User Interface - OTVP-WA	While the TSPW enabled transit vehicle is departing and in motion within both the forward and rear pedestrian detection roadway zones, if a pedestrian is located within any forward pedestrian detection roadway zone (zone 3 or 5) the TSPW application shall provide a OTVP-WA.		2.1.7, 2.1.8				
249		User Interface - OTVP-WA	While the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, if a pedestrian is located within the forward center pedestrian detection zone (zone 5) AND if a DSRC-Enabled Personally Owned Vehicle is detected to be approaching from behind the transit vehicle in the adjacent-left lane, the TSPW application shall provide a OTVP-WA.		2.1.12, 2.1.16				
260		User Interface - OTVP HIS Alert End	Once detected pedestrians are clear of the zones causing an OTVP-WA, the OTVP-WA shall be deactivated.		2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.12				
290		User Interface - OTVP HIS Alert End	Once the transit vehicle has completely passed a zone where detected pedestrians are causing an OTVP-WA, the OTVP-WA shall be deactivated.		2.1.7				
281		User Interface - OTVP HIS Non-Alert	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching pedestrian detection zones, a pedestrian located within the Danger Waiting Zone (zone 2) or any pedestrian detection roadway zone (zones 3-6) shall NOT cause an OTVP-WA.		2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.15				
283		User Interface - OTVP HIS Non-Alert	While the TSPW enabled transit vehicle is stopped within pedestrian detection roadway zones (zones 3-6) AND no DSRC-Enabled Personally Owned Vehicles are approaching from behind the transit vehicle, a pedestrian located within the Danger Waiting Zone (zone 2) or any pedestrian detection roadway zone (zones 3-6) shall NOT cause an OTVP-WA.		2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8				
284		User Interface - OTVP HIS Non-Alert	While the TSPW enabled transit vehicle is departing and in motion within both the forward and rear pedestrian detection roadway zones AND if the front of the transit vehicle has departed the forward pedestrian detection roadway zones (zone 3 or 5), a pedestrian located within the Danger Waiting Zone (zone 2) or any pedestrian detection roadway zone (zones 3-6) shall NOT cause an OTVP-WA.		2.1.4, 2.1.5, 2.1.6				
285		User Interface - OTVP HIS Non-Alert	While the TSPW enabled transit vehicle is departing and in motion within the forward pedestrian detection roadway zones AND the front of the transit vehicle has departed the forward roadway zones (zone 3 or 5), a pedestrian located within the Danger Waiting Zone (zone 2) or any pedestrian detection roadway zone (zones 3-6) shall NOT cause an OTVP-WA.		2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8				
201		User Interface - TSPW RP HIS	The TSPW Roadside Pedestrian HIS shall be configurable to either provide or not provide alerts, maintaining all other required functionality, including alert logging. ***Note:*** *The suppression of alerts is known as "Cloaked Mode." Cloaked mode will be used during a baselining period at the beginning of operational fielding.*		2.1.16				
216		User Interface - RP-TAM-Approach	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching a TSPW pedestrian detection roadway zones, the TSPW application shall provide a RP-TAM-Approach alert including the vehicle route number.		2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
233		User Interface - RP-TAM-Stop	Once the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, the TSPW application shall provide a RP-TAM-Stop Alert, including the vehicle route number.		2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
218		User Interface - RP-IA	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching pedestrian detection roadway zones, if a pedestrian is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a RP-IA.		2.1.4				
230		User Interface - RP-IA	While the TSPW enabled transit vehicle is approaching and in motion within any pedestrian detection roadway zone, if a pedestrian is located within the danger waiting zone (zone 2) the TSPW application shall provide a RP-IA.		2.1.4				

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
234		User Interface - RP-IA	While the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, if a pedestrian is located within the center pedestrian detection roadway zones (zone 5 or 6) the TSPW application shall provide a RP-IA.		2.1.5, 2.1.6, 2.1.12, 2.1.13, 2.1.16				
237		User Interface - RP-IA	While the TSPW enabled transit vehicle is departing and in motion within both the forward and rear pedestrian detection roadway zones, if a pedestrian is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a RP-IA.		2.1.4				
243		User Interface - RP-IA	While the TSPW enabled transit vehicle is departing and in motion within the forward pedestrian detection roadway zones, if a pedestrian is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a RP-IA.		2.1.4				
222		User Interface - RP-WA	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching pedestrian detection roadway zones, if a pedestrian is located within any pedestrian detection roadway zone (zones 3-6) the TSPW application shall provide a RP-WA.		2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.15				
227		User Interface - RP-WA	While the TSPW enabled transit vehicle is approaching and in motion within any pedestrian detection roadway zone, if a pedestrian is located within any pedestrian detection roadway zone (zones 3-6) the TSPW application shall provide a RP-WA.		2.1.5, 2.1.6, 2.1.7, 2.1.8				
239		User Interface - RP-WA	While the TSPW enabled transit vehicle is departing and in motion within both the forward and rear pedestrian detection roadway zones, if a pedestrian is located within any pedestrian detection roadway zone (zones 3-6) the TSPW application shall provide a RP-WA.		2.1.5, 2.1.6, 2.1.7, 2.1.8				
245		User Interface - RP-WA	While the TSPW enabled transit vehicle is departing and in motion within the forward pedestrian detection roadway zones, if a pedestrian is located within any forward pedestrian detection roadway zone (zone 3 or 5) the TSPW application shall provide a RP-WA.		2.1.7, 2.1.8				
226		User Interface - RP Alert End	The RP-TAM-Approach alert shall deactivate once the transit vehicle stops within the pedestrian detection roadway zone or passes the transit stop.		2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
257		User Interface - RP Alert End	The RP-TAM-Stop Alert shall deactivate once the front of the transit vehicle moves out of the forward pedestrian detection roadway zones.		2.1.4				
286		User Interface - RP Alert End	Once detected pedestrians are clear of the zones causing a RP-IA, the RP-IA shall be deactivated.		2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
336		User Interface - RP Alert End	Once the transit vehicle has completely passed a zone where detected pedestrians are causing a RP-IA, the RP-IA shall be deactivated.		2.1.4				
337		User Interface - RP Alert End	Once the transit vehicle has completely passed a zone where detected pedestrians are causing a RP-WA, the RP-WA shall be deactivated.		2.1.5, 2.1.6, 2.1.7, 2.1.8				
338		User Interface - RP Alert End	Once detected pedestrians are clear of the zones causing a RP-WA, the RP-WA shall be deactivated.		2.1.7				
255		User Interface - RP HIS Alert Priority	If multiple simultaneous alerts occur for the Roadside Pedestrian HIS, the highest priority alert shall be presented to the roadside pedestrians.		2.1.14, 2.1.15				
291		User Interface - RP HIS Alert Priority	The Roadside Pedestrian HIS alert priority (from highest to lowest priority) shall be: RP-WA, RP-IA.		2.1.15				
339		User Interface - RP HIS Alert Priority	The Roadside Pedestrian HIS Traveler Advisory alert priority (from highest to lowest priority) shall be: RP-TAM-Stop Alert, RP-TAM-Approach Alert.		2.1.14, 2.1.15				
287		User Interface - RP HIS Non-Alert	While the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, pedestrians located within the Danger Waiting Zone (zone 2) or curbside pedestrian detection roadway zones (zones 3-4) shall not cause a RP-IA or RP-WA.		2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.9, 2.1.10, 2.1.11				

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
288		User Interface - RP HIS Non-Alert	Once the TSPW enabled transit vehicle has departed the rear pedestrian detection roadway zones a pedestrian located within the rear pedestrian detection roadway zones (zone 4 or 6) shall NOT cause a RP-WA or RP-IA.		2.1.5, 2.1.6				
311		User Interface - MP-SRA	The TSPW application shall provide a MP-SRA to subscribed mobile devices within the TSPW Enabled Area when the transit vehicle is within a TSPW Enabled Area.		2.1.2, 2.1.3, 2.1.4, 2.1.7, 2.1.8, 2.1.9				
312		User Interface - MP-SRA	The MP-SRA shall end once the subscribed mobile device has departed the TSPW Enabled Area.		2.1.2, 2.1.3				
217		User Interface - MP-TAM-Approach	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching pedestrian detection roadway zones, the TSPW application shall provide MP-TAM-Approach Alerts, including the vehicle route number, to subscribed mobile devices.		2.1.2, 2.1.3, 2.1.5, 2.1.6, 2.1.7, 2.1.8				
228		User Interface - MP-TAM-Approach	While the TSPW enabled transit vehicle is approaching and in motion within any pedestrian detection roadway zone, the TSPW application shall provide MP-TAM-Approach Alerts, including the vehicle route number, to subscribed mobile devices.		2.1.2, 2.1.3, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
220		User Interface - MP-IA	While the TSPW enabled transit vehicle is within the TSPW Enabled Area, in motion and approaching pedestrian detection roadway zones, if a subscribed mobile device is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a MP-IA to the subscribed mobile device.		2.1.4				
229		User Interface - MP-IA	While the TSPW enabled transit vehicle is approaching and in motion within any pedestrian detection roadway zone, if a subscribed mobile device is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a MP-IA to the subscribed mobile device.		2.1.4				
238		User Interface - MP-IA	While the TSPW enabled transit vehicle is departing and in motion within both the forward and rear pedestrian detection roadway zones, if a subscribed mobile device is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a MP-IA to the subscribed mobile device.		2.1.4				
244		User Interface - MP-IA	While the TSPW enabled transit vehicle is departing and in motion within the forward pedestrian detection roadway zones, if a subscribed mobile device is located within the Danger Waiting Zone (zone 2) the TSPW application shall provide a MP-IA to the subscribed mobile device.		2.1.4				
258		User Interface - MP HIS Alert End	Once the subscribed mobile device has moved from a pedestrian detection zone causing a MP-IA, the MP-IA shall be deactivated.		2.1.4				
264		User Interface - MP HIS Alert End	Once the transit vehicle has completely passed a zone where detected pedestrians are causing a MP-IA, the MP-IA shall be deactivated.		2.1.4				
221		User Interface - MP HIS Non-Alert	If a pedestrian is located within any pedestrian detection roadway zone no TSPW mobile alerts shall be provided to that pedestrian.		2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.10, 2.1.11, 2.1.12, 2.1.13, 2.1.15				
292		User Interface - MP HIS Non-Alert	While the TSPW enabled transit vehicle is stopped within the pedestrian detection roadway zones, a pedestrian located within the Danger Waiting Zone (zone 2) or curbside pedestrian detection roadway zones (zone 3 or 4) shall NOT cause a MP-IA.		2.1.4, 2.1.7, 2.1.8				
254		User Interface - MP Alert Priority	If multiple simultaneous alerts occur for the Mobile Pedestrian HIS the highest priority alert shall be presented.		2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
293		User Interface - MP Alert Priority	The Mobile Pedestrian HIS alert priority (from highest to lowest priority) shall be: MP-WA, MP-IA, MP-TAM-Approach Alert, and then MP-SRA.		2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
340		User Interface - POV-HIS	The location where the TSPW application begins to provide alerts shall be configurable based on the distance a POV is from entering a TSPW pedestrian detection zones and the speed of the vehicle.		2.1.11-2.1.12				
250		User Interface - POV-IA	If a transit vehicle is stopped within the pedestrian detection roadway zones AND a DSRC-Enabled Personally Owned Vehicle is approaching from behind the transit vehicle and in the same lane AND a pedestrian is located within the forward center pedestrian detection roadway zone (zone 5), the TSPW application shall provide a POV-IA.		2.1.12				

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
251		User Interface - POV-WA	If a transit vehicle is stopped within the pedestrian detection roadway zones, AND a DSRC-Enabled Personally Owned Vehicle is approaching from behind the transit vehicle in the same lane AND a pedestrian is located within the rear pedestrian detection roadway zones (zone 4 or 6), the TSPW application shall provide a POV-WA.		2.1.11, 2.1.13				
252		User Interface - POV-WA	If a transit vehicle is stopped within the pedestrian detection roadway zones, AND a DSRC-Enabled Personally Owned Vehicle is approaching from behind the transit vehicle in the adjacent-left lane AND a pedestrian is located within pedestrian detection roadway zones (zones 4, 5, or 6), the TSPW application shall provide a POV-WA.		2.1.11, 2.1.12, 2.1.13				
259		User Interface - POV HIS Alert End	Once detected pedestrians are clear of the zones causing a POV-IA, the POV-IA shall be deactivated.		2.1.12				
341		User Interface - POV HIS Alert End	Once detected pedestrians are clear of the zones causing a POV-WA, the POV-WA shall be deactivated.		2.1.11				
342		User Interface - POV HIS Alert End	Once the POV has completely passed a zone where detected pedestrians are causing a POV-IA, the POV-IA shall be deactivated.		2.1.12				
343		User Interface - POV HIS Alert End	Once the POV has completely passed a zone where detected pedestrians are causing a POV-WA, the POV-WA shall be deactivated.		2.1.11				
256		User Interface - POV HIS Alert Priority	If multiple simultaneous alerts occur for the DSRC-Enabled Personally Owned Vehicle HIS, the highest priority alert shall be presented.		2.1.11				
294		User Interface - POV HIS Alert Priority	The Transit Vehicle Operator HIS alert priority (from highest to lowest priority) shall be: POV-WA, and then POV-IA.		2.1.11				
205		User Interface - TSPW Alert ID	The TSPW application shall assign a unique identifier to each TSPW alert.	1.1.1	2.1.5				
266		Functional Characteristics - TSPW Application	The TSPW application shall detect the presence of pedestrians within the Danger Waiting Zone which represents the area of the transit stop passenger waiting area where a part of a moving transit vehicle could traverse.	1.1.1					
267		Functional Characteristics - TSPW Application	The TSPW application shall detect the presence of pedestrians within the In Roadway Forward Curb Zone which encompasses the roadway in the lane closest to the transit stop and roughly one-half the width (curb-side) of the transit vehicle and one-half of the total length of the transit stop waiting area near the front of a stopped transit vehicle.	1.1.1					
268		Functional Characteristics - TSPW Application	The TSPW application shall detect the presence of pedestrians within the In-Roadway Rear Curb Zone which encompasses the roadway in the lane closest to the transit stop and roughly one-half of the total width (curb-side) of the transit vehicle and one-half of the total length of the transit waiting area to the rear of the stopped transit vehicle.	1.1.1					
269		Functional Characteristics - TSPW Application	The TSPW application shall detect the presence of pedestrians within the In Roadway Forward Center Zone which encompasses the roadway in the lane closest to the transit stop starting laterally at the mid-point of the lane and extending to the mid-point of the adjacent lane, or further, if possible and longitudinally encompassing roughly one-half the length of the transit stop waiting area to the front of the transit vehicle.	1.1.1					
270		Functional Characteristics - TSPW Application	The TSPW application shall detect the presence of pedestrians within the In Roadway Rear Center Zone which encompasses the roadway in the lane closest to the transit stop starting laterally at the mid-point of the lane and extending to the mid-point of the adjacent lane, or further, if possible and longitudinally encompassing roughly one-half the length of the transit stop waiting area to the rear of the transit vehicle.	1.1.1					
271		Functional Characteristics - TSPW Application	The TSPW application shall detect DSRC-enabled vehicles entering the TSPW Enabled Area.		2.1.10, 2.1.11, 2.1.12, 2.1.13, 2.1.16				
272		Functional Characteristics - TSPW Application	The TSPW application shall detect which lane approaching DSRC-Enabled Personally Owned Vehicles occupy, the Approach Lane or the Passing Lane.		2.1.10, 2.1.11, 2.1.12, 2.1.13, 2.1.16				

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
273		Functional Characteristics - TSPW Application	The TSPW application shall detect the location of approaching TSPW-enabled Transit Vehicles with respect to the TSPW Enabled Area and pedestrian detection zones.		2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.14, 2.1.15				
274		Functional Characteristics - TSPW Application	The TSPW application shall detect whether a TSPW-enabled transit vehicle is moving or is stopped.		2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7, 2.1.8, 2.1.10, 2.1.11, 2.1.12, 2.1.13, 2.1.14, 2.1.15, 2.1.16				
156	156	E-TRP In-Vehicle Platform Logging Service	The E-TRP in-vehicle subsystem shall implement a logging service.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
44	44	E-TRP In-Vehicle Platform Logging Service	All E-TRP in-vehicle subsystem logs shall be associated with the date and time, synchronized to GNSS time, of the logged event.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
344		E-TRP In-Vehicle Platform Logging Service	All E-TRP In-Vehicle Subsystem log timestamps shall use Coordinated Universal Time (UTC) as a reference.	1.1.1					
139	139	E-TRP In-Vehicle Platform Logging Service	All E-TRP in-vehicle subsystem logs shall be associated with a unique vehicle ID.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
157	157	E-TRP In-Vehicle Platform Logging Service	The E-TRP in-vehicle subsystem shall store all logs for a minimum of 48 hours.			1.1.1.0;			
107	107	E-TRP In-Vehicle Platform Logging Service	The E-TRP in-vehicle subsystem shall transfer data files to a remotely hosted cloud management subsystem, when connected in both Operational and Standby modes such that no data files are lost, deleted or corrupted.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
174	174	E-TRP In-Vehicle Platform Logging Service	The E-TRP in-vehicle subsystem shall capture all DSRC messages utilized by the E-TRP system as transmitted by the E-TRP in-vehicle subsystem. Note: It is expected that for evaluation purposes a separate DAS system will be provided that will record all DSRC messages sent or received by the E-TRP in-vehicle subsystem.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
175	175	E-TRP In-Vehicle Platform Logging Service	The E-TRP in-vehicle subsystem shall capture all E-TRP system generated DSRC messages received by the E-TRP in-vehicle subsystem. The E-TRP in-vehicle subsystem shall capture all E-TRP system generated DSRC messages received by the E-TRP in-vehicle subsystem. The E-TRP in-vehicle subsystem shall capture all E-TRP system generated DSRC messages received by the E-TRP in-vehicle subsystem.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
158	**158**	E-TRP In-Vehicle Platform Logging Events	The E-TRP in-vehicle subsystem shall store a log of all transit vehicle operator HIS state transitions including pre-state, Triggering Alert ID and post state.			1.1.1.0;	2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
40	**40**	E-TRP In-Vehicle Platform Logging Events	The E-TRP in-vehicle subsystem shall store a log of all service brake state transitions including pre-state and post state.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
149	**149**	E-TRP In-Vehicle Platform Logging Events	The E-TRP in-vehicle subsystem shall store a log of all Gear Position state transitions including pre-state and post state.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
154	**154**	E-TRP In-Vehicle Platform Logging Events	The E-TRP in-vehicle subsystem shall log a record of all operational mode changes including the trigger causing the mode change.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
51	**51**	E-TRP In-Vehicle Platform Logging Events	The E-TRP in-vehicle subsystem shall store the vehicle latitude and longitude at 1 second intervals.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
43	**43**	E-TRP In-Vehicle Platform Logging Events	The E-TRP in-vehicle subsystem shall store the vehicle speed at 1 second intervals.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
152	**152**	E-TRP In-Vehicle Platform Logging Events	The E-TRP in-vehicle subsystem shall store the vehicle heading at 1 second intervals.				2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
41		TSPW In-Vehicle Application Logging Events	The TSPW application shall store a log of each alert activation including alert type, alert ID and associated roadside location ID.	1.1.1	2.1.5				
153		TSPW In-Vehicle Application Logging Events	The TSPW application shall store a log of each alert deactivation including alert type, alert ID and associated roadside location ID.	1.1.1	2.1.5				
196		TSPW In-Vehicle Application Logging Events	The TSPW application shall store a log of all On Transit Vehicle Pedestrian HIS state transitions including pre-state and post state.	1.1.1	2.1.5				
298		TSPW Roadside Platform Logging Service	The TSPW Roadside Subsystem shall implement a logging service.	1.1.1	2.1.5				
299		TSPW Roadside Platform Logging Service	All TSPW Roadside Subsystem logs shall be associated with the date and time, synchronized to GNSS time, of the logged event.	1.1.1					
345		TSPW Roadside Platform Logging Service	All TSPW Roadside Subsystem log timestamps shall use Coordinated Universal Time (UTC) as a reference.	1.1.1					
301		TSPW Roadside Platform Logging Service	All TSPW Roadside Subsystem logs shall be associated with a unique roadside location ID.	1.1.1	2.1.5				
300		TSPW Roadside Platform Logging Service	The TSPW Roadside Subsystem shall transfer data files to a remotely hosted cloud management subsystem, when connected in both Operational and Standby modes such that no data files are lost, deleted or corrupted.	1.1.1	2.1.5				
302		TSPW Roadside Platform Logging Service	The TSPW Roadside Subsystem shall store all TSPW system generated DSRC messages transmitted by the TSPW Roadside Subsystem. ***Note:*** *It is expected that for evaluation purposes a separate DAS system will be provided that will record all DSRC messages sent or received by the TSPW roadside subsystem.*		2.1.5				
303		TSPW Roadside Platform Logging Service	The TSPW Roadside Subsystem shall store all TSPW system generated DSRC messages received by the TSPW Roadside Subsystem. ***Note:*** *It is expected that for evaluation purposes a separate DAS system will be provided that will record all DSRC messages sent or received by the TSPW roadside subsystem.*		2.1.5				
304		TSPW Roadside Platform Log Events	The TSPW Roadside Subsystem shall log a record of all operational mode changes including the trigger causing the mode change.	1.1.1	2.1.5				
214		TSPW Roadside Application Log Events	The TSPW application shall log when a pedestrian detection zone is triggered and an enabled transit vehicle is within the TSPW area.		2.1.5				

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
180		TSPW Roadside Application Log Events	If an enabled transit vehicle is within the TSPW Enabled Area, the TSPW application shall store an image of a pedestrian detection zone when triggered.		2.1.5				
197		TSPW Roadside Application Log Events	The TSPW roadside application shall store a log of all Roadside Pedestrian HIS state transitions including pre-state, triggering Alert ID and post state.	1.1.1	2.1.5				
198		TSPW Roadside Application Log Events	The TSPW application shall store a log of all alerts provided to mobile application subscribers, including the triggering Alert ID.	1.1.1	2.1.5				
63	63	In-Vehicle Subsystem Modes of Operation	The E-TRP in-vehicle subsystem shall implement an operational mode. Note: Operational mode describes a mode when the transit vehicle is operating and the E-TRP subsystem is running without degradation.				2.4.1.1; 2.4.1.2; 2.4.1.3;		
67	67	In-Vehicle Subsystem Modes of Operation	The E-TRP in-vehicle subsystem shall implement an operational degraded mode. Note: Operational-degraded mode describes a mode when the transit vehicle is operating and the E-TRP in-vehicle subsystem is running with some functionality degraded.				2.4.1.3;		
64	64	In-Vehicle Subsystem Modes of Operation	The E-TRP in-vehicle subsystem shall implement a non-operational standby mode. Note: Standby mode describes a mode when the transit vehicle is not operating and the E-TRP in-vehicle subsystem is in power saving mode.				2.4.1.2;		
65	65	In-Vehicle Subsystem Modes of Operation	The E-TRP in-vehicle subsystem shall implement a non-operational maintenance mode. Note: Maintenance mode describes a mode when the E-TRP in-vehicle subsystem is powered enough for maintenance support, but the main applications may or may not be running.			1.9.1.1;			
66	66	In-Vehicle Subsystem Modes of Operation	The E-TRP in-vehicle subsystem shall implement a non-operational off mode. Note: Off mode describes a mode when the E-TRP in-vehicle subsystem is not powered and will not respond to triggers to transition to other modes.			1.9.1.2;			
68	68	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem shall transition from Operational and Standby mode when the transit vehicle ignition transitions from on to off.				2.1.1.4;		
69	69	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem shall transition from Standby to Operational mode when the transit vehicle ignition transitions from off to on.				2.1.1.4;		
76	76	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem shall transition into the operational mode within 2 minutes after sensing vehicle ignition.				2.1.1.5;		
75	75	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem should transition into the operational mode within 15 seconds after sensing vehicle ignition.				2.1.1.5;		
119	119	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem shall transition from Standby to Maintenance mode when triggered remotely by a maintainer.			1.9.1.3;			
121	121	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem shall transition from Maintenance to Standby mode when triggered remotely by a maintainer.			1.9.1.3;			
125	125	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem shall automatically attempt to recover from a fault, and if successful transition from degraded to an operational state.			1.9.2.2;			
126	126	In-Vehicle Subsystem Mode Transitions	If power is lost while in an Operational mode, the E-TRP in-vehicle subsystem shall automatically transition from Off to Operational once power is restored.				2.4.1.6;		
117	117	In-Vehicle Subsystem Mode Transitions	The E-TRP in-vehicle subsystem should automatically transition to non-operational mode "Off" if the transit vehicle engine is off and the transit vehicle battery drops below a configurable value.			1.9.1.4;			
305		TSPW Roadside Subsystem Modes of Operation	The TSPW Roadside Subsystem shall implement an operational mode. ***Note:*** *Operational mode describes a mode when the roadside subsystem is operating without degradation.*		2.2.1				
306		TSPW Roadside Subsystem Modes of Operation	The TSPW Roadside Subsystem shall implement an operational degraded mode. ***Note:*** *Operational-degraded mode describes a mode when the roadside subsystem is operating with some functionality degraded.*		2.2.1				
307		TSPW Roadside Subsystem Modes of Operation	The TSPW Roadside Subsystem shall implement a non-operational off mode. ***Note:*** *Off mode describes a mode when the roadside subsystem is not powered and will not respond to triggers to transition to other modes.*	1.2.3					

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
308		TSPW Roadside Subsystem Mode Transitions	The TSPW Roadside Subsystem shall automatically attempt to recover from a subsystem fault, and if successful transition from degraded to an operational state.	1.2.4					
309		TSPW Roadside Subsystem Mode Transitions	If power is lost while in an Operational mode, the TSPW Roadside Subsystem shall automatically transition from Off to Operational once power is restored.	1.2.5					
73	73	Time	The E-TRP system shall maintain time in all operational and non-operational modes.			1.9.2.6;			
77	77	Time	The E-TRP system shall synchronize its system time with GNSS time upon transition from a non-operational to an operational mode.			1.9.2.4;			
78	78	Time	The E-TRP system shall synchronize its system time with GNSS time at a configurable interval between 1 and 1440 minutes. Note: Once a minute to once a day.			1.9.2.5;			
74	74	Configuration	The E-TRP system shall maintain the system configuration in all operational and non-operational modes.			1.9.2.7;			
108	108	Data Warehousing	The E-TRP cloud management subsystem shall host a database to store all data files generated by E-TRP components.				2.4.2.2; 2.1.1.18; 2.2.1.7; 2.3.1.0 (E-TRP-specific);		
146	146	Location Services	The E-TRP in-vehicle subsystem shall calculate the position of the transit vehicle.				2.4.3.2;		
147	147	Location Services	The E-TRP in-vehicle subsystem shall calculate the speed of the transit vehicle.				2.4.3.3;		
148	148	Location Services	The E-TRP in-vehicle subsystem shall calculate the heading of the transit vehicle.				2.4.3.4;		
124	124	Location Services	The E-TRP in-vehicle subsystem shall implement a positioning service capable of 2.5 meter accuracy circular error probability.				2.4.3.1;		
123	123	Location Services	The E-TRP in-vehicle subsystem should implement a positioning service capable of 1 meter accuracy circular error probability.				2.4.3.1;		
133	133	Communications Range	The E-TRP system shall have a DSRC radio range of at least 100 meters line of sight from vehicle to roadside equipment.				2.4.3.5;		
47	47	Physical Characteristics	The E-TRP in-vehicle subsystem shall be no larger than 5.5 inches tall (with respect to the mounting surface) by 11 inches x 8.5 inches. Note: About the size of a FedEx Medium Priority Mail Flat Rate Box			1.6.1.0;			
48	48	Physical Characteristics	The E-TRP in-vehicle subsystem should be no larger than 2 inches tall (with respect to the mounting surface) by 8 inches x 4 inches. Note: About the size of a red masonry brick.			1.6.1.0;			
114	114	Electromagnetic Radiation	The E-TRP in-vehicle subsystem shall be compliant with the electromagnetic compatibility requirements of SAE J1113, including procedures -2, -4, -11, -13, -21, -22, -26, -27, 41, 42j.			1.7.2.0; 1.7.3.0 (FCC)			
50	50	Temperature	The E-TRP In-Vehicle Subsystem shall operate at automotive temperatures consistent with SAE J1211 Interior-Instrument Panel-Other (-40 C to 85 C).			1.7.5.0;			
310	(130)	Temperature	The TSPW (E-PCW) Roadside Subsystem shall operate at temperatures between -10 C to 60 C.			1.7.5.0;			
112	112	Shock and Vibration	The E-TRP in-vehicle subsystem shall be resistant to permanent damage from shock and vibrations normally associated with automotive electrical components and consistent with SAE J1211.			1.7.4.0;			
346		Water Resistance	The TSPW Roadside Subsystem components shall be at least NEMA 4 compliant.	1.2.1					
150	150	Availability	The E-TRP system Inherent Availability should be 98% Note: This requirement serves as a goal for the E-TRP system. Inherent Availability (Ai) is MTBF/MTBF+MTTR (MTBF= Mean Time Between Failure, MTTR = Mean Time to Repair) excludes preventative or scheduled maintenance and logistic time (travel time, paperwork, etc.).						4.1.1.0;
151	151	Reliability	The E-TRP system should have a Mean Time to Repair (MTTR) of less than or equal to 2 hours.						4.1.1.0;
95	95	Status Monitoring	The E-TRP in-vehicle subsystem shall implement physical indicator of the power state of the on-board computational platform. Note: Off, Standby and Operating are example states.			1.6.1.0;			

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
96	**96**	Status Monitoring	The E-TRP in-vehicle subsystem shall implement physical indicator that a system fault has occurred, and which fault group.			1.6.1.0;			
97	**97**	Status Monitoring	The E-TRP in-vehicle subsystem should implement physical indicator of the operational state of the Bluetooth connection.			1.6.1.0;			
98	**98**	Status Monitoring	The E-TRP in-vehicle subsystem should implement physical indicator of the operational state of the DSRC connection.			1.6.1.0;			
99	**99**	Status Monitoring	The E-TRP in-vehicle subsystem should implement physical indicator of the operational state of the GNSS connection.			1.6.1.0;			
100	**100**	Status Monitoring	The E-TRP in-vehicle subsystem should implement physical indicator of the operational state of the cellular connection.			1.6.1.0;			
101	**101**	Status Monitoring	The E-TRP in-vehicle subsystem should implement physical indicator of the operational state of the Wi-Fi connection.			1.6.1.0;			
102	**102**	Status Monitoring	The E-TRP in-vehicle subsystem should implement physical indicator of the operational state of the vehicle data-bus connection.			1.6.1.0;			
105	**105**	Status Monitoring	All E-TRP subsystems shall implement an interface allowing status to be remotely monitored.			1.6.1.0;			
79	**79**	Software Maintainability	The E-TRP in-vehicle subsystem computing component shall implement a Type A HDMI receptacle connector for use as a connection for a local terminal display for system maintenance.			1.6.1.0;			
80	**80**	Software Maintainability	The E-TRP in-vehicle subsystem computing component shall implement a Type A, USB receptacle for use as connection for a local keyboard for system maintenance.			1.6.1.0;			
82	**82**	Software Maintainability	All configurable software and firmware components of the E-TRP system shall be programmable via an external connector.			1.8.1.0;			
81	**81**	Software Maintainability	All configurable software and firmware components of the E-TRP system shall be programmable via an external connector.			1.8.1.0;			
118	**118**	Software Maintainability	The E-TRP in-vehicle subsystem shall implement an interface for a maintainer to remotely wake up the equipment for maintenance purposes.			1.8.1.0;			
120	**120**	Software Maintainability	The E-TRP in-vehicle subsystem shall implement an interface for a maintainer to remotely put the subsystem into standby mode from maintenance mode.			1.8.1.0;			
103	**103**	Data Maintainability	The E-TRP system components shall implement an interface to extract data files on-demand from the unit locally via wire.			1.5.1.0;			
104	**104**	Data Maintainability	The E-TRP in-vehicle subsystem shall implement an interface to extract data files on-demand from the unit locally via Wi-Fi.			1.8.2.0;			
106	**106**	Data Maintainability	The E-TRP in-vehicle subsystem shall implement an interface to extract data files on-demand from the unit remotely.			1.8.2.0;			
111	**111**	System Reset	The E-TRP in-vehicle subsystem shall implement a physical reset capability.			1.6.1.0;			
109	**109**	System Reset	The E-TRP subsystems shall implement an interface to reset/reboot the unit remotely via cellular.			1.8.3.0;			
110	**110**	System Reset	The E-TRP in-vehicle subsystem shall implement an interface to reset/reboot the unit remotely via Wi-Fi.			1.8.3.0;			
62	**62**	Cellular Provisioning	If the E-TRP in-vehicle subsystem implements a Subscriber Identification Module (SIM) card, the SIM card shall be accessible via an access panel.			1.6.1.0;			
143	**143**	Accessibility	The E-TRP in-vehicle subsystem electrical connections shall be accessible for disconnection and reconnection by maintenance personnel without equipment disassembly our dismounting.			1.6.1.0;			
116	**116**	Safety	The E-TRP in-vehicle subsystem shall prevent electrical discharge to occur such that damage to host vehicle is caused.			1.7.2.0;			

TSPW Rqmt No.	E-TRP Rqmt No.	System / SubSystem	Requirement	TSPW Test Cases		E-TRP/TSPW Test Cases			
				Phase 1	Phase 2	Phase 1	Phase 2	Phase 3	Phase 4
127	**127**	Security	The E-TRP system components shall be packaged such that they are resistant to tampering by unauthorized personnel.			1.6.1.0;			
193	**193**	Security	The E-TRP subsystem DSRC communications channels shall be protected from unauthorized modification.			1.6.1.0;			
347		Security	The TSPW system maintenance interfaces shall be protected from unauthorized access.	1.2.2					

Source: Battelle

APPENDIX B. List of Acronyms and Abbreviations

ANSI	American National Standards Institute
BSM	Basic Safety Messages
CAN	Controller Area Network
CCP	Common Computing Platform
CDMS	Cloud Data Management Subsystem
ConOps	Concept of Operations
CV	Connected Vehicle
DAS	Data Acquisition System
DSRC	Dedicated Short-Range Communication
E-TRP	Enhanced Transit Safety Retrofit Package
GCRTA	Greater Cleveland Regional Transit Authority
GNSS	Global Navigation Satellite System
HDMI	High-Definition Multimedia Interface
HIS	Human Interface Subsystem
-IA	Inform Alert
IEC	International Electrotechnical Institute
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
IVP	Integrated V2I Prototype
IVS	In-Vehicle Subsystem
MP	Mobile Pedestrian
OTVP	On Transit Vehicle Pedestrian
PDS	Pedestrian Detection Subsystem
PMDS	Pedestrian Mobile Device Subsystem
PoC	Proof-of-Concept
POV	DSRC-Enabled Personally Owned Vehicle
POVS	DSRC-Enabled Personally Owned Vehicle Subsystem
PSM	Personal Safety Message
RAAP	Remote Administration Access Point
RP	Roadside Pedestrian
RSE	Roadside Equipment
RSU	Roadside Unit

SAE	Society of Automotive Engineers
SCMS	Security Credential Management Service
-SRA	System Ready Alert
-TAM	Traveler Advisory Message
TBD	To Be Determined
TMX	Transportation Message Exchange
TSPW	Transit Bus Stop Pedestrian Warning
TVO	Transit Vehicle Operator
USB	Universal Serial Bus
U.S. DOT	United States Department of Transportation
V2I	Vehicle to Interface
-WA	Warn Alert

U.S. Department of Transportation
ITS Joint Program Office-HOIT
1200 New Jersey Avenue, SE
Washington, DC 20590

Toll-Free “Help Line” 866-367-7487
www.its.dot.gov

FHWA-JPO-17-484

U.S. Department of Transportation