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			Release Date **20120125**	Modification Count **17**

SYSTEM REQUIREMENT DESCRIPTION

5.9GHz DSRC Vehicle Awareness Device Specification

Approved by (dept, name, phone)	Issued by (dept, name, phone)
USDOT RITA, Walton Fehr, (202) 366-0278 walton.fehr@dot.gov	USDOT RITA, Walton Fehr, (202) 366-0278 walton.fehr@dot.gov

Table of Contents

1 INTRODUCTION

1.1 What is the purpose of this document?

This document will set the requirements for an automotive grade electronic module capable of sending a the SAE J2735-200911 defined "Basic Safety Message" over a Dedicated Short Range Communication (DSRC) wireless communications link.

1.2 Who should read this document?

Suppliers interested in building devices based on the requirements provided in this document.

1.3 How is this document organized?

The Structure of this document is as follows:

Section 1 – Introduction: Document's scope, revision history and requisite specifications.
Section 2 – Terminology: describes the definitions, concepts, and abbreviations used throughout the document.
Section 3 – System Description: Describes the system layout and the allocation of responsibilities and communication for the system components.
Section 4 – System Requirements: Describes the System level requirements.
Section 5 – Functional Requirements: Describes the subsystem and\or component level requirements.
Section 6 – Test Requirements: Describes the system testing requirements.

1.4 How do you receive more information?

Additional information is available in the documents listed in section 1.6. Questions are answered by the person responsible for this document (see section 1.5).

1.5 Revision History

Rev.	Vers.	Date	Description	Approved by	Responsible
001	001	07/01/10	First Issue	Walton Fehr	Frank Perry
002	001.1	07/01/10	Word "suppler" changed to "supplier" in numerous places	Walton Fehr	Walton Fehr
003	001.3	11/12/10	Changed the "HIM" acronym to "HIA" to better represent the phrase "Here I Am" Updated the "Requisite Documents" Section based on updates to cited documents\standards	Walton Fehr	Maureen Marshall

			Updated numerous Requirements based on Supplier feedback and questions Added Requirements 98-101 based on Supplier feedback and questions (Note: These requirements were added to the appropriate Sections of the Document, NOT at the end of the Document) Deprecated Requirements 55, 78, and 79 as these Requirements are no longer relevant		
004	001.4	12/27/10	Comments inserted by WLF	Walton Fehr	Walton Fehr
005	001.5	12/28/10	Updated SRD template and responded to WLF comments	Walton Fehr	Maureen Marshall
006	001.6	12/29/10	Status change from Preliminary to Initial Sample Delivery,	Walton Fehr	Walton Fehr
007	002.0	4/22/11	Restructured and revised to include initial comments from device builders and to reflect corollary work on the ASD Requirements Specification.	Walton Fehr	Jim Marousek
008	002.1	5/3/2011	Incorporated feedback from vendor feedback sessions. Added requirements for system timing (both source and standard). Added clarification to device power requirements. Revised configuration file format to CSV text file.	Walton Fehr	Jim Marousek
009	002.2	5/5/2011	Included a list of mandatory requirements that will be considered optional for a lot of material being acquired for Test Bed use ONLY. These requirements will be mandatory in future devices.	Walton Fehr	Walton Fehr
010	002.3	7/7/2011	Revised to reference the latest version (Draft 9) the IEEE 1609.2 Standard.	Walton Fehr	Jim Marousek
011	003.0	10/3/2011	1. Replaced references to “Here I Am” with the term “vehicle awareness”. 2. Replaced USDOTHIA with the term “USDOTOBE”. 3. Renumbered (sequenced) requirements 4. Removed the list of mandatory requirements. 5. Added Section 5.4 covering Secure “Non-DSRC” IP communications. 6. Added Appendix C – Security Profile 7. Added Appendix D – Firewall Rules	Walton Fehr	Jim Marousek
012	003.1	10/4/2011	1. Final comment resolution	Walton Fehr	Walton Fehr

			2. Reference to FACRA connectors added		
013	003.2	10/15/2011	1. Updated Minimum Performance Reference 2. Resolved comments from the Certification team 3. Operating state names changed, clarified	Walton Fehr	Walton Fehr
014	003.3	11/1/2011	1. Included new connector diagrams 2. Addressed comments from vendor review meeting 3. Added yaw rate requirements 4. Changed “System Message Log” to “Transmitted Message Log”	Walton Fehr	Jim Marousek
015	003.4	11/25/2011	1. Updated 1609.2 draft version reference 2. SRD-USDOTOBE-003-SYS015v001 Conducted Power Lead Transients requirement added 3. SRD-USDOTOBE-003-SYS016v001 Reversed Battery Leads requirement added 4. SRD-USDOTOBE-003-ReqINT003v001 Local Systems Interface (LSI) updated to indicate that a removable memory device is mandatory 5. SRD-USDOTOBE-003-ReqBSM034v001 EventFlag DF Persistence changed from Optional to Mandatory 6. SRD-USDOTOBE-003-ReqBSM035v001 EventFlag DF HardBraking Event Flag changed from Optional to Mandatory 7. Reference to PSID list in RSE requirements speciation added 8. SRD-USDOTVAD-003-ReqDRS002v001 changed from 20,000 to 200,000 certificate for storage purposes	Walton Fehr	Walton Fehr
016	003.5	12/02/2011	1. Added missing “Req” clause to SYS requirements. 2. Included 3 additional BSM Part II requirements in Section5.5.2. Two of which are refinements to the Path Prediction DF and the third involves the DE_VehicleType field. 3. Added HDOP to Acronym List	Walton Fehr	Patrick Chuang Jim Marousek
17	003.6	01/24/2012	1. Numerous changes indicated by change bars in the margin	Walton Fehr	Walton Fehr

1.6 Requisite Documents

This section contains reference documents, and their appropriate versions, required to meet the requirements described in this document. The Standard\Documents listed in the "Reference" portion of the requirements relate to the Standards\Documents listed here:

- CAMP VSC3 – Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements, Revision ~~9~~11.0, 10/10/2011 (available upon request)
- ~~CAMP VSC3 – Interoperability Issues of Vehicle-to-Vehicle Based Safety System Project (V2V-Interoperability) – Task 5: Security Management - Subtask 2: Security System Design Specification, September 14, 2011.~~USDOT Security Credential Management System Design, January 24, 2012
- CAMP VSC3 – Congestion Control Document (to be made available upon request)
- IEEE P1609.2, Draft 9.3, Posted as 1609.2-v2-d9_3-2011-09
- IEEE 1609.3-2010, August 2010
- IEEE 1609.4-2010, August 2010
- IEEE P1609.12, Draft 20
- IEEE 802.11-2007
- IEEE 802.11p- 2010
- Federal Communications Commission (FCC) 47 Code of Federal Regulations (CFR) Parts 0, 1, 2, & 95 Amendments for Dedicated Short Range Communications Services and Mobile Service for Dedicated Short Range Communications of Intelligent Transportation Service in the 5.850-5.925 GHz Band (5.9 GHz Band).
- SAE J551: Vehicle Electromagnetic Immunity – Electrostatic Discharge
- SAE J1113-11 2007-06: Immunity to Conducted Transients on Power Leads
- SAE J1211: Handbook for Robustness Validation of Automotive Electrical/Electronic Modules
- SAE J2735 2009-11: Dedicated Short Range Communication (DSRC) Message Set Dictionary
- Vehicle Power Connector Description (see Appendix A)
- USCAR18-2 FAKRA SMB RF Connector Supplement
- USDOT "5.9GHz DSRC Roadside Equipment" Device Specification, version 2.3

2 TERMINOLOGY

2.1 Definitions

Definition	Description
Alternating mode	The radio switches between the Control Channel and the Service Channel
Authorized Entity	An approved entity (person or software application) with security credentials that authorize attempted operations or activities.
Automotive Grade	End-application solutions, devices, and development tools supporting the automotive industry
Certificate	An electronic document which uses a digital signature, typically from a Certificate Authority to bind a public key with an identity of the person or organization holding the certificate.
Continuous mode	The radio does not switch channels. It only uses 1 channel

Digital Signature	A digital signature (created using a mathematical algorithm) gives a recipient of an electronic message assurance that the message was created by the sender, and that it is unaltered.
Latency	The latency of a J2735 BSM data element/frame is defined as the maximum age of the data in the outgoing BSM
Meaningful Value	A Valid Value for a data element within a Basic Safety Message which is not Unavailable" value.
Non-DSRC	Communications protocol outside of the 5.9GHz DSRC band
Public Key	Part of a mathematically related public/private key pair, and used to digitally sign and / or encrypt electronic messages or documents.
Sign	Digitally signing a electronic message or document using a signature.
Valid Value	A value for a data element within a Basic Safety Message that has the correct data type and is within the limits of the value as defined in SAE J2735. A value of "Unavailable" is defined as valid.
WAVE Short Message Protocol	Networking protocol specifically designed for V2X communications.
Wi-Fi	Generic term for communications technologies including wireless local area network (WLAN) which are based on the IEEE 802.11 standards.

2.2 Concepts

2.2.1 Identification of Requirements

This is the nomenclature used for requirements identification.

[Document type]-[system]-[issue number]-**Req**[requirement section][requirement number]**v**[requirement version number]

The following table explains how the requirements nomenclature is constructed and numbered:

Field	Content Description
document type	This is a constant text string set to "SRD", which is an acronym for "System Requirements Description"
System	This is a constant text string set to the system(s) to which the requirement applies.

USDOTASD	Unique to the Aftermarket Safety Device
USDOTISD	Unique to the Integrated System Device
USDOTOBE	Common to the ASD, ISD, RSD and Vehicle Awareness Device
USDOTRSE	Roadside Equipment Device
USDOTRSD	Unique to the Retrofit Safety Device
USDOTVAD	Unique to the Vehicle Awareness Device

Field	Content Description
issue number	This is set to the current issue number of this Systems Requirements Description.
requirement section	This is set to the functional category of the requirement and will be one of the following: BSM – Basic Safety Messaging COM – Other "Non-DSRC" Communications DRS – DSRC Radio Subsystem INT – Interface Requirements MPS – Message Processing System OMC – Operations, Management & Control POS – Positioning SEC – Security SYS – System TML – Transmitted Message Log TST – Testing
requirement number	This is a numeric identifier for each requirement ranging from 001 up to 999 and each filed value will be unique within a defined *requirement section* (see above).
requirement version number	This is set to the current version number of the individual requirement.

The following example illustrated how the requirements within this SRD are numbered:

SRD-USDOTOBE-003-Req 004v001

This requirement was introduced in the first issue of the SRD for the collective systems defined as USDOTOBE. It is the forth requirement in the document and it is the first version of the requirement.

SRD-USDOTVAD-003-Req 001v001

This requirement was updated in the third issue of the SRD for system USDOTVAD. It is the first requirement in the document and it has been updated to a second version.

SRD-USDOTVAD-003-Req 009v001

This requirement was introduced in the third version of the SRD for system USDOTVAD. It is the ninth requirement in the document and it is the first version of the requirement.

2.3 Abbreviations

Abbr.	Description	Definition
AC	Access Category	See IEEE 802.11-2007

Abbr.	Description	Definition
ACL	Access Control List	
AIFS	Arbitration Interframe Space	See IEEE 802.11-2007
ASN.1	Abstract Syntax Notation One	Standard and flexible notation that describes structures for representing, encoding and decoding data.
ASD	Aftermarket Safety Device	
BSM	Basic Safety Message	
C	Celsius	Unit of temperature
CA	Certificate Authority	
CAMP	Crash Avoidance Metrics Partnership	
CCH	Control Channel	
CFR	Code of Federal Regulations	
CONUS	Continental United States	
COTS	Commercial Off the Shelf	
CRL	Certificate Revocation List	
CWmin	Contention Window Minimum	See IEEE 802.11-2007
dB	Decibel	
DC	Direct Current	
DSRC	Dedicated Short Range Communications	
EDCA	Enhanced Distributed Channel Access	
EEBL	Electronic Emergency Brake Light	
EMI	Electromagnetic Interference	
ESD	Electrostatic Discharge	
FCC	Federal Communications Commission	
GB	Gigabytes	Units of storage consisting of approximately 10^9 8-bit characters
GHz	Gigahertz	
GPS	Global Positioning System	
HDOP	Horizontal Dilution of Precision	
HMI	Human Machine Interface	
IEEE	Institute of Electrical and Electronic Engineers	
IP	Internet Protocol	
ISD	Integrated System Device	
km	Kilometer	
LSI	Local Systems Interface	
mA	Milliamp	Unit of electrical current
MAC	Media Access Control	
MB	Megabyte	Units of storage, consisting of approximately 10^6 8-bit characters
Mbps	Megabytes per second	
MHz	Megahertz	
MIB	Management Information Base	
MPDUs	MAC Protocol Units	

Abbr.	Description	Definition
ms	Millisecond	
MTBF	Mean Time Between Failure	
OBE	On Board Equipment	
OFDM	Orthogonal Frequency-Division Multiplexing	
OSI	Open Systems Interconnection	
OTA	Over-the-Air	
PHY	Physical layer	Refers to a specific layer in the Open Systems Interconnection (OSI) reference model
PSID	Provider Service Identifier	
QOS	Quality of Service	
RF	Radio Frequency	
RSD	Retrofit Safety Device	
RSE	Roadside Equipment	
RSU	Roadside Unit	
SAE	Society of Automotive Engineers	
SCH	Service Channel	
SD	Secure Digital	
SRD	System Requirements Description	Describes requirements for a given system
SVC	Service Channel	
TXOP	Transmission Opportunity	See IEEE 802.11-2007
USB	Universal Serial Bus	
UTC	Universal Time, Coordinated	
VAD	Vehicle Awareness Device	
V2I	Vehicle-to-Infrastructure	
V2V	Vehicle-to-Vehicle	
V2X	Vehicle-to-(Infrastructure and/or Vehicle)	
VSC3	Vehicle Safety Communications 3 (Consortium)	
WAAS	Wide Area Augmentation System	
WAVE	Wireless Access in Vehicular Environments	
WiMAX	Worldwide Interoperability for Microwave Access	
WSM	WAVE Short Message	
WSMP	WAVE Short Message Protocol	
WSMP-S	WSMP safety supplement	

3 SYSTEM DESCRIPTION

3.1 Functional Description

The device discussed in this document is an automotive grade electronic module capable of sending a “Vehicle Awareness” message based on the Basic Safety Message defined in SAE J2735-200911. The message is to be transmitted over a DSRC Link as defined in the IEEE 1609 suite and IEEE 802.11p 2010 standards.

3.2 System Design

The automotive grade electronic module is intended for installation in various vehicles types ranging from light duty vehicles, whose weight is less than 10,000 pounds; to heavy duty class 8 trucks. This device will be installed in a vehicle without requiring connection to proprietary in-vehicle systems. It must be capable of sending and receiving the Basic Safety Message as defined in SAE J2735-200911, over a DSRC 5.9 GHz wireless communications link, as defined in the IEEE 1609 suite and IEEE 802.11p 2010 standards. The device should be capable of data storage, message processing, transmitting and receiving, as defined throughout this specification.

The Vehicle Awareness Device will have a set of operational states as illustrated in the following diagram.

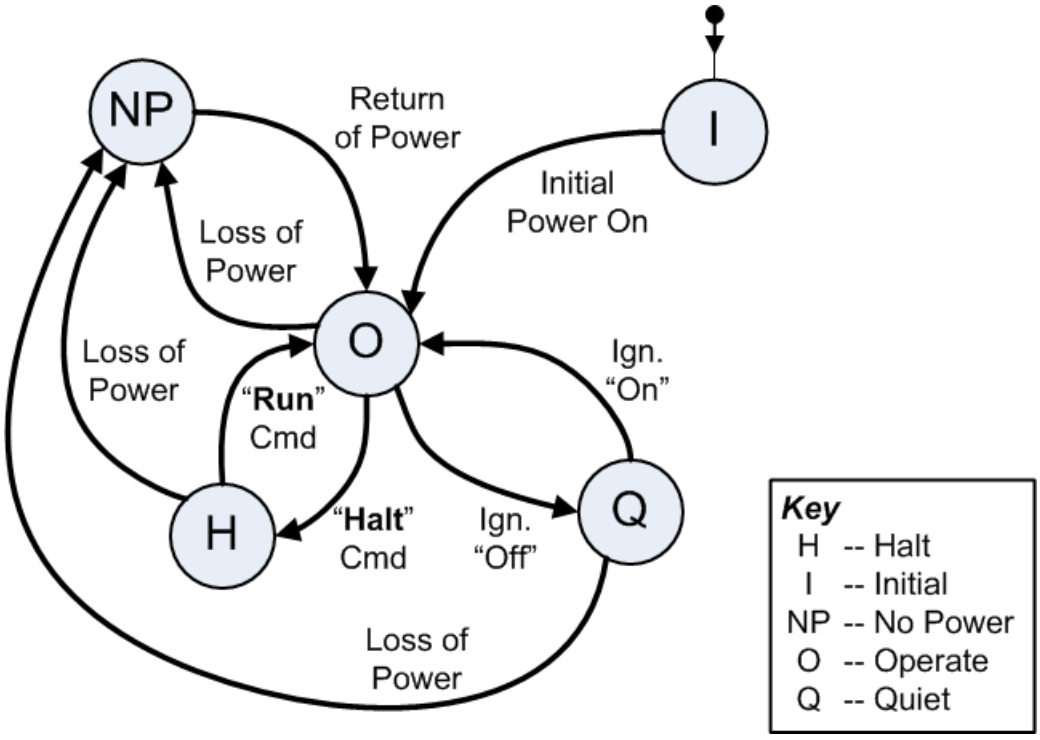


Figure 1.0 – Vehicle Awareness Device State Diagram

3.3 System Layout

The diagram below is for reference only. Only shaded blocks are discussed in this document.

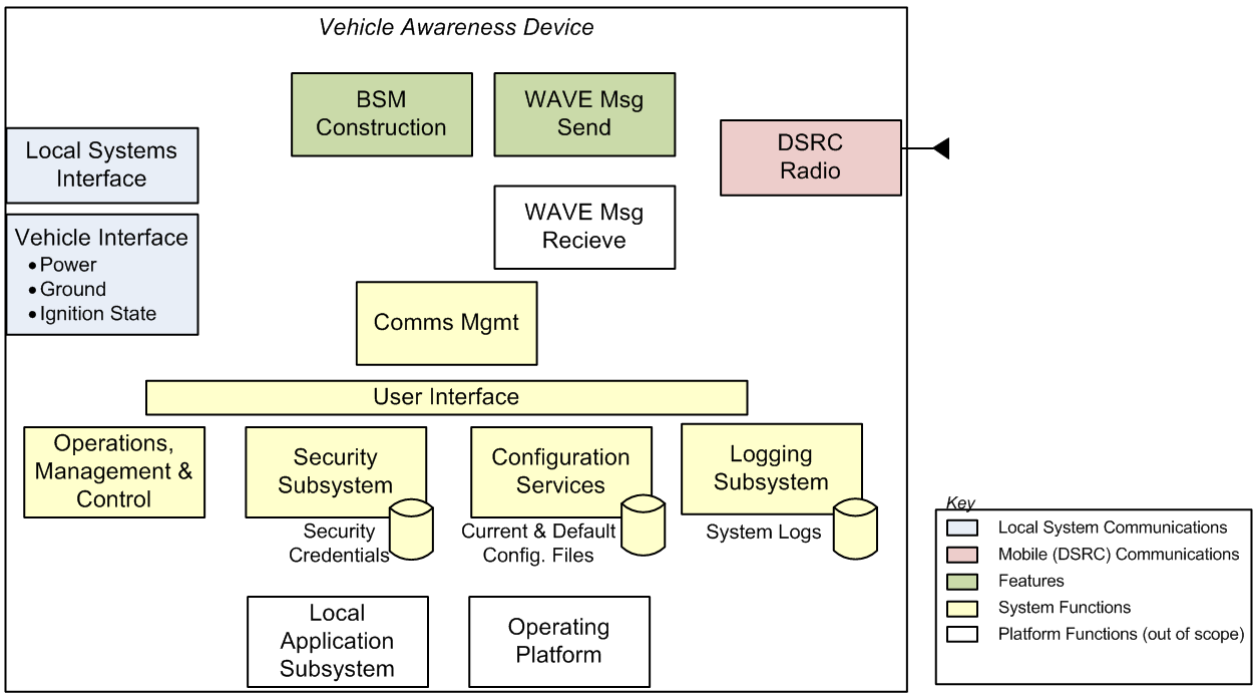


Figure 2.0 Vehicle Awareness Device Diagram

4 SYSTEM REQUIREMENTS

4.1 Mechanical Requirements

The vehicle awareness device shall meet all of the indicated requirements listed within this section.

4.1.1 Device Installation

SRD-USDOTOBE-003-ReqSYS001v001 Device Installation

Description: The installation and removal of the onboard equipment device shall not damage the vehicle external body panels or interior trim, instrument panel, or any other Original Equipment Manufacturer provide or installed portion of the vehicle.

Reference: None

Purpose: Enables vehicle to be used during test activities without permanent modification or change; other than the expected "wear and tear" resulting from normal vehicle operations.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Device Test

SRD-USDOTOBE-003-ReqSYS002v001 Device Mounting

Description: The onboard equipment device shall be mountable as an "aftermarket" device complying with state and local regulations and/or guidance related to "aftermarket" device mountings.

Reference: None

Purpose: Enables vehicle independent mounting in the vehicle

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Analysis

4.1.2 Device Size

SRD-USDOTOBE-003-ReqSYS003v001 Windshield Mounted Device Form Factor

Description: The mounted onboard equipment device shall be limited in form factor such that, if mounted on either the windshield or the dashboard, the onboard equipment device does not obstruct the driver's field of view more than a windshield mounted transponder toll tag or a dashboard mounted commercial-off-the-shelf (COTS) navigation device.

Reference: None

Purpose: Ensures unobstructed driver's field of view.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Inspection

SRD-USDOTVAD-003-ReqSYS001v001 Vehicle Interior Mounted Device Form Factor

Description: The mounted vehicle awareness device shall be limited in form factor such that, if it is to be mounted in the vehicle interior, it shall have maximum physical dimensions of 200mm by 120mm by 30mm.

Reference: None

Purpose: Allows for more installation locations with simpler attachment mechanisms.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Inspection

4.2 Performance Requirements

SRD-USDOTOBE-003-ReqSYS004v001 Device Transmitter Failure

Description: If the onboard equipment device stops transmitting, for any reason, it shall signal 'device needs servicing', the manner of signaling being specified in the onboard equipment device's operating manual.

Reference: None

Purpose: Inform the vehicle operator or maintenance technician that the device is malfunctioning

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqSYS005v001 Mean Time Between Failure (MTBF)

Description: The onboard equipment device shall have a MTBF of 10,000 hours or greater.

Reference: None

Purpose: Maximizes vehicle\device availability time during the Test.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqSYS002v001 Vehicle Types

Description: The vehicle awareness device shall meet requirements when installed in the following Vehicle Types:

- Light Duty Passenger Vehicles (i.e. 2010 Toyota Corolla LE 4-door sedan)
- Light Duty (1/2 Ton) Trucks (i.e. 2010 Ford F-150 XL with regular cab and Styleside 8ft box)
- Class 8 Tractor with Trailer (i.e. 2010Kenworth T660 tractor with extended day cab and a 53' Dorsey dry van.)

Note: Test conductor will make final vehicle choices with concurrence of the vehicle awareness device makers

Reference: None

Purpose: Provides for a large, diverse, field of Test Vehicles

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Device Test

4.3 Environmental Requirements

The all components of the device such as the main unit and antennae, and all equipment such as cabling shall be designed to operate without failure under all weather conditions experienced in the United States and its territories. The device must also meet all the defined requirements in this section.

4.3.1 Operating Voltage

SRD-USDOTOBE-003-ReqSYS006v001 Device Power Source

Description: An onboard equipment device, powered from a vehicle power source, shall operate at a range of +9 volts to +16 volts direct current (DC) nominal.

Reference: None

Purpose: Enables the device to be powered from a vehicle power source

Disposition: Mandatory, if the device is powered from a vehicle power source; otherwise, Optional

Performance Criteria: Pass\Fail

Verification Method: Test

4.3.2 Operating Current

SRD-USDOTOBE-003-ReqSYS007v001 Maximum Operating Current

Description: When the onboard equipment device is powered from a vehicle power source, the vehicle awareness device shall not exceed a maximum of 1 amp in the Halt, Operate, and Initial modes.

Note: The vehicle power source can be either a steady "hot at all time" battery feed, a switched battery feed, or a combination of the two. It is up to the device vendor to determine how their device will be powered.

Reference: None

Purpose: Prevents device from overloading existing vehicle electrical systems.

Disposition: Mandatory, if the device is powered from a vehicle power source; otherwise, Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqSYS008v001 Maximum Standby Current

Description: When the onboard equipment device is powered from a vehicle power source, the vehicle awareness device shall not exceed in Quiet (Ignition off) mode at a maximum of 1.0mA.

Note: The vehicle power source can be either a steady "hot at all time" battery feed, a switched battery feed, or a combination of the two. It is up to the device vendor to determine how their device will be powered.

Reference: None

Purpose: Prevents device from draining vehicle battery during prolonged vehicle standby durations

Disposition: Mandatory, if the device is powered from a vehicle power source; otherwise, Optional

Performance Criteria: Pass\Fail

Verification Method: Test

4.3.3 Temperature and Humidity

The onboard equipment device shall be designed to withstand long exposure to nearly constant high relative humidity and high temperature defined in this document.

SRD-USDOTOBE-003-ReqSYS009v001 Temperature Operating Range

Description: The onboard equipment device shall operate at a temperature range of -40°C to +85°C.

Reference: None

Purpose: Ensures device will operate in extreme temperature conditions

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

~~4.3.3~~4.3.4 Shock and Vibration

SRD-USDOTOBE-003-ReqSYS010v001 Shock and Vibration in a Moving Vehicle

Description: The onboard equipment device shall withstand typical shock and vibration from usage on moving vehicles.

Reference: SAE J1211

Purpose: Ensures device can operate in a moving vehicle

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqSYS011v001 Shock and Vibration Due to Shipping

Description: The onboard equipment device shall withstand typical shock and vibration from normal shipping and handling.

Reference: SAE J1211

Purpose: Ensures device can survive shipping from the manufacturer to the designated shipping location.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

~~4.3.4~~4.3.5 Electrostatic Discharge

SRD-USDOTOBE-003-ReqSYS012v001 Device Electrostatic Discharge

Description: The onboard equipment device shall be protected from typical electrostatic discharges.

Reference: SAE J551

Purpose: Ensures device can withstand ESD

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqSYS013v001 Removable Storage Electrostatic Discharge

Description: Any removable storage equipped in an onboard equipment device shall be protected from typical electrostatic discharges.

Reference: SAE J551

Purpose: Ensures removable storage can withstand ESD

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

~~4.3.5~~4.3.6 Conducted Electrical Transients

SRD-USDOTOBE-003-ReqSYS014v001 Conducted Power Lead Transients

Description: Any device input connected to a vehicle's electrical power sources will be subjected to transient conditions including low voltage conditions during engine cranking, and various higher-voltages transients that occur.

Reference: SAE J1113 Immunity to Conducted Transients on Power Leads

Purpose: Ensures device can withstand expected power lead transients.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqSYS015v001 Reversed Battery Leads

Description: Any device input connected to a vehicle's electrical power sources will be subjected to a reversed battery lead condition.

Reference: None

Purpose: Ensures device can withstand expected reversed battery leads.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5 FUNCTIONAL REQUIREMENTS

5.1 Interface Requirements

The vehicle awareness device shall meet all of the indicated requirements listed within this section.

SRD-USDOTOBE-003-ReqINT001v001 Vehicle Interface

Description: The onboard equipment device shall connect to the Vehicle's power source using a Delphi Micro HVT connector (see Appendix A, Figures 3.0, and 3.1).

Reference: Appendix A and SAE J2922

Purpose: Enables device to be powered from the vehicles power source including a Hot-at-all-Time battery feed, a switched battery feed, and a Ground. Note: The vehicle-side of the connector pair will be provided; the vehicle awareness device manufacturer need only provide the device-side of the connector pair.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Inspection

SRD-USDOTOBE-003-ReqINT002v001 Vehicle Interface – Vehicle Data Bus

Description: The onboard equipment device shall populate the Basic Safety Message with data from a vehicle data bus using the Vehicle Interface.

Reference: None

Purpose: Enables device to populate the Basic Safety Message with "live" vehicle data

Disposition: Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqINT003v001 Local Systems Interface (LSI)

Description: The onboard equipment device shall provide at least two of the following (non-DSRC) communications interfaces/mechanisms, one from Category A and one from Category B. (Only two interfaces are needed. More interfaces can be implemented at the device maker's discretion)

Category A

- USB Port
- Ethernet Port
- Wi-Fi Port
- WiMAX (non-mobile) Port

Category B

- Removable storage (e.g. SD Card)

Reference: None

Purpose: Supports non-DSRC access for configuration and maintenance; and exchange of management data to and from the device

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqINT001v001 DSRC Radio Interface

Description: The onboard equipment device shall implement one (1) 5.9GHz DSRC radio as called out in IEEE 802.11p and IEEE 1609.

Reference: None

Purpose: Support for V2V and V2I communications.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Inspection

SRD-USDOTOBE-003-ReqINT004v001 DSRC Radio Interface

Description: If external antennae are used, the onboard equipment device shall connect to the antennae using a USCAR18 FAKRA SMB connector male type Z for 5.9GHz DSRC and male type C for GPS (see Appendix A, Figures 3.2, and 3.3).

Reference: Appendix A and USCAR18-2

Purpose: Enables device be connected to external antennae reliably.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Inspection

5.2 Operations, Monitoring and Control

The vehicle awareness device shall meet all of the indicated requirements listed within this section.

5.2.1 Operational States

For an overview of the following requirements, please refer to the operational state diagram (Figure 1.0) in Section 3.2

SRD-USDOTOBE-003-ReqOMC001v001 State Transition - Initial to Operate

Description: The onboard equipment device shall perform a state transition from the Initial State to Operate State when first activated at time of manufacture.

Reference: None

Purpose: State transition handling the first time the device is activated.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC002v001 State Transition - Operate to Quiet

Description: The onboard equipment device shall perform a state transition from Operate State to Quiet State when the ignition state determined from the switched battery feed or a bus message transitions to "Off".

Reference: None

Purpose: State transition handling when the vehicle operator intends to shut down the vehicle.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC003v001 State Transition - Operate to Halt

Description: The onboard equipment device shall perform a state transition from Operate State to Halt State in response to an Authorized Entity's "Halt" command.

Reference: None

Purpose: State transition handling. Note: Devices that use a removable storage device as the Local System Interface must provide instructions on when the device can be safely removed from the device.

Disposition: Mandatory for Category A LSI, Optional for Category B LSI

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC004v001 State Transition - Operate to No Power

Description: The onboard equipment device shall perform a state transition from Operate State to No Power State upon loss of power.

Reference: None

Purpose: State transition handling when an unintended power loss is experienced.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC005v001 State Transition - Quiet to No Power

Description: The onboard equipment device shall perform a state transition from Quiet State to No Power State upon loss of power.

Reference: None

Purpose: State transition handling when an unintended power loss is experienced.
Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC006v001 State Transition - Quiet to Operate

Description: The onboard equipment device shall perform a state transition from Quiet State to Operate State when the ignition state determined from the switched battery feed or a bus message transitions to "On".

Reference: None

Purpose: State transition handling when the vehicle operator intends to operate the vehicle.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC007v001 State Transition - No Power to Operate

Description: The onboard equipment device shall perform a state transition from No Power State to Operate State upon return of power.

Reference: None

Purpose: State transition handling when power is restored after an unintended loss.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC008v001 State Transition - Halt to Operate

Description: The onboard equipment device shall perform a state transition from Halt State to Operate State in response to an Authorized Entity's "Run" command.

Reference: None

Purpose: State transition handling

Disposition: Mandatory for Category A LSI, Optional for Category B LSI

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC009v001 State Transition - Halt to No Power

Description: The onboard equipment device shall perform a state transition from Halt State to No Power State upon loss of power.

Reference: None

Purpose: State transition handling when an unintended power loss is experienced.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC010v001 Device Shutdown Time

Description: The onboard equipment device shall enter the Quiet State no more than 15 ~~minutes~~ seconds after ignition state transitions to "Off".

Reference: None

Purpose: Enables ~~device to continue transmitting when\if vehicle is disabled~~removable memory to be safely removed for log file retrieval and other maintenance.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC011v001 Device Startup Time

Description: The onboard equipment device shall enter the Operate State no more than 10 seconds after ignition state transitions to "On".

Reference: None

Purpose: Enables device to operate rapidly upon vehicle start-up.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.2.2 Operational Configuration

SRD-USDOTOBE-003-ReqOMC012v001 Device Software/Firmware

Description: The onboard equipment device shall execute its currently installed, uniquely identified (number, name) software/firmware.

Reference: None

Purpose: Enables device operation.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC013v001 Device Configuration

Description: The onboard equipment device shall operate using the currently stored configuration parameters.

Reference: None

Purpose: Enables flexible and adaptable device operation.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC014v001 Configuration Storage

Description: The onboard equipment device shall store all configuration parameters identified in other requirements in a uniquely identified (number, name) configuration file (hereinafter referred to as the Configuration File, described in Appendix B).

Reference: None

Purpose: Provides mechanism to change device setup. Configurable parameters will be discussed in the appropriate requirements throughout the document.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC015v001 Configuration Default

Description: The onboard equipment device shall have a default value defined for each configuration parameter in the Configuration File.

Reference: None

Purpose: Support operations by providing default operational configuration values.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC016v001 Configuration Review

Description: The onboard equipment device shall enable, when the device is in Halt State, an authorized entity to view (via the LSI) the value of any configuration parameter in the Configuration File.

Reference: None

Purpose: Enables (local) review of the contents of the currently loaded Configuration File.

Disposition: Mandatory for Category A LSI, Optional for Category B LSI.

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC017v001 Configuration Modification

Description: The onboard equipment device shall enable, when the device is in Halt State or Quiet, an authorized entity to update (via the LSI) the value of any configuration parameter in the Configuration File.

Reference: None

Purpose: Enables (local) modification of the contents of the currently loaded Configuration File via a serial interface or by changes to the contents of the removable memory.

Disposition: Mandatory for Category A LSI, ~~Optional~~ Mandatory for Category B LSI.

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC018v001 Configuration Modification Validation

Description: The onboard equipment device shall validate each attempted change to the value of any configuration parameter in the Configuration File to make sure that the proposed value is appropriate.

Reference: None

Purpose: Prevents setting an invalid value for a configuration parameter in the Configuration File.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC019v001 Configuration Upload

Description: The onboard equipment device shall enable, when the device is in Halt State, an authorized entity to upload (via the LSI) the device's Configuration File.

Reference: None

Purpose: Enables uploading of the Configuration File from the device for archiving, maintenance or troubleshooting.

Disposition: Mandatory for Category A LSI, Optional for Category B LSI.

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC020v001 Configuration Download

Description: The onboard equipment device shall enable, when the device is in Halt State, an authorized entity to download (via the LSI) a Configuration File for the device.

Reference: None

Purpose: Enables downloading of Configuration File onto the device for initial configuration, maintenance or troubleshooting.

Disposition: Mandatory for Category A LSI, Optional for Category B LSI.

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC021v001 Configuration Download Validation

Description: The onboard equipment device shall not accept any (downloaded) configuration file with an invalid value of any configuration parameter in the Configuration File.

Reference: None

Purpose: Prevents downloading of an incomplete, faulty or corrupt Configuration File onto the device.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqOMC022v001 Configured Operations

Description: The onboard equipment device shall, when in Operate mode, operate using the currently stored operational configuration values.

Reference: None

Purpose: Enables flexible and adaptable device operation.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.2.3 Transmitted Message Log

SRD-USDOTVAD-003-ReqTML001v001 ~~System~~ Transmitted Message Storage

Description: The vehicle awareness device shall accept and store messages generated by internal components in formatted files generically called Transmitted Message Log (TML).

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTVAD-003-ReqTML002v001 ~~System~~ Transmitted Message Timestamp

Description: The Vehicle Awareness Device shall ensure that each logged message contains a UTC date and timestamp for each logged message. (i.e. transmitted 802.11p frames).

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTVAD-003-ReqTML003v001 Transmitted Message Log Time Threshold

Description: The Vehicle Awareness Device shall close the active TML file when configurable time threshold (default to no time limit) is reached.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTVAD-003-ReqTML004v001 Transmitted Message Log Size Threshold

Description: The Vehicle Awareness Device shall close the active TML file when configurable size threshold (default to no size limit) is reached.

Reference: None

Purpose: Enables efficient access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqTML005v001 Transmitted Message Log Close when Halted or Quiet

Description: The Vehicle Awareness Device shall close the active TML file when transitioning to a "Halt" or "Quiet" state.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives. Assures that files are properly closed before a removable memory might be removed.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqTML006v001 Transmitted Message Log Creation

Description: The Vehicle Awareness Device shall create and use a new active TML file upon closing the previously active TML file.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqTML007v001 Transmitted Message Log Filename

Description: The Vehicle Awareness Device shall create TML files with unique filenames consisting of a UTC date-stamp, ModelDeploymentDeviceID, and a sequence number.

Reference: ~~None~~Appendix B.

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqTML008v001 Transmitted Message Log Retention

Description: The Vehicle Awareness Device shall retain TML files indefinitely provided that sufficient storage is available.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTVAD-003-ReqTML009v001 Transmitted Message Log Purge

Description: The Vehicle Awareness Device shall, if there is insufficient storage available for additional TML files or records, purge the oldest of the currently stored TML files or records until sufficient storage is made available.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTVAD-003-ReqTML010v001 Transmitted Message Log Access

Description: The Vehicle Awareness Device shall enable authorized entities to access and review TML files stored (locally) on the device.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTVAD-003-ReqTML011v001 Transmitted Message Log Upload

Description: The Vehicle Awareness Device shall enable authorized entities to transfer TML files from the device to a (remote) back end system.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqTML012v001 Transmitted Message Log Deletion

Description: The Vehicle Awareness Device shall enable authorized entities to delete TML files stored on the device.

Reference: None

Purpose: Enables access to information required to support system operations, such as diagnosis, troubleshooting and support of wider Safety Pilot objectives.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqTML013v001 Logging Transmitted 802.11p Frames

Description: The Vehicle Awareness Device shall store all transmitted 802.11p frames in dedicated TML files.

Reference: None

Purpose: Enables comparison of messages transmitted by the device and messages received by other devices during post test analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqTML014v001 Message Log Format

Description: All logged 802.11p frames shall be stored in pcap format file (using libpcap, v1.1.1 or later for UNIX based systems; or WinPcap v4.1.2 or later for Microsoft Windows based systems, or equivalent for other operating systems).

Reference: None

Purpose: Determines the format of the message in the TML.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification+++ Method: Test

SRD-USDOTVAD-003-ReqTML015v001 Transmitted Packet Log Size

Description: The vehicle awareness device shall provide at least 4GB of storage space for the logging of transmitted 802.11 frames in TML files.

Reference: None

Purpose: Provides estimated file storage space for storing log data for 60 days.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.2.4 Device Positioning and Timing

SRD-USDOTOBE-003-ReqPOS001v001 Positioning Determination Occurrence

Description: The onboard equipment device shall establish position of the vehicle (and qualifiers) on the surface of the earth every 100ms or at the configured transmit rate, and the time at which it was at that position.

Note: The position of the vehicle reported in a Basic Safety Message is defined as the theoretical point on the surface of the roadway below the center of a rectangle oriented about the vehicle's axis of symmetry front-to-back that encompasses the farthest forward and rearward points and side-to-side points on the vehicle including original equipment such as outside rear view mirrors and aftermarket equipment such as trailer hitches on the surface of the WSG-84 ellipsoid. ~~None~~

Purpose: To determine the current vehicle position.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqPOS002v001 Vehicle Speed

Description: The onboard equipment device shall derive its current vehicle speed and heading within values (currently 0.35 m/sec speed and 3 degrees heading when speed >12.5 m/sec) specified in the Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012.

Purpose: To determine the current vehicle speed and heading.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTOBE-003-ReqPOS003v001 Vehicle Position

Description: The onboard equipment device shall derive its current vehicle position and time at that position within values (currently 1.5m longitude, 1.5m latitude, and 3.0m elevation) specified in the Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012.

Purpose: To make vehicle speed and position data available for device applications.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTOBE-003-ReqPOS004v001 Positioning Failure Handling

Description: The onboard equipment device shall use a proper null value in transmitted messages should it not be able to determine its current position.

Reference: SAE J2735 2009-11

Purpose: To facilitate diagnostics and troubleshooting.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTOBE-003-ReqPOS005v001 Positioning Corrections

Description: The onboard equipment device shall, for any device using a GPS receiver as part of its positioning service, be configurable (default to ON) to use WAAS corrections.

Reference: None

Purpose: To increase the accuracy of positioning information.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Inspection

SRD-USDOTOBE-003-ReqPOS006v001 System Timing Source

Description: The onboard equipment device shall maintain a system clock based on timing information from the GPS receiver.

Reference: None

Purpose: To increase the accuracy of timing information.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqPOS007v001 System Time Standard

Description: The onboard equipment device shall conform to the Universal Time, Coordinated (UTC) standard.

Reference: ITU-R Recommendation TF.460-4: Standard-frequency and time-signal emissions. International Telecommunication Union, Annex I.

Purpose: Standards conformance.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

5.2.5 Device Security

This section of the specification contains the requirements securing the device and controlling access to the device. Please note that the requirements relating to security of DSRC communications are located in a separate section (5.3.5) of the document.

SRD-USDOTOBE-003-ReqSEC001v001 Communications Interface Access Control

Description: The onboard equipment device shall maintain access control (e.g. configurable firewalls and ACLs) for each non-DSRC communications interface configured for IP.

Reference: None

Purpose: Enables device security while providing access for authorized entities in support of operations and maintenance.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTOBE-003-ReqSEC002v001 Secure non-DSRC Communications

Description: The onboard equipment device shall support at least one of the following secure access mechanisms for each non-DSRC communications interface configured for IP.

- Transport Layer Security (TLS) v1.2
- Internet Protocol Security (IPSec) for IPv4
- Internet Protocol Security (IPSec) for IPv6
- Secure Shell, v2 (SSH-2)
- SSH File Transfer Protocol v6.

Reference: None

Purpose: Enables secure communications over IP enabled (non-DSRC) links in support of operations and maintenance.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3 DSRC Radio Subsystem

5.3.1 FCC Compliance

SRD-USDOTOBE-003-ReqDRS001v001 FCC Regulation 47 CFR Compliance for DSRC

Description: The onboard equipment device shall comply with Federal Communications Commission (FCC) 47 Code of Federal Regulations (CFR) Parts 0, 1, 2, and 95 amendments for Dedicated Short Range Communications (DSRC), mask/class type C.

Reference: Federal Communications Commission (FCC) 47 Code of Federal Regulations (CFR) Parts 0, 1, 2, and 95 amendments for Dedicated Short Range Communications Services and Mobile Service for Dedicated Short Range Communications of Intelligent Transportation Service in the 5.850-5.925 GHz Band (5.9 GHz Band).

Purpose: FCC Compliance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.2 Radio Count

SRD-USDOTVAD-001-ReqDRS001v001 Number of DSRC Radios

Description: The vehicle awareness device shall support a radio configured to operate on a single channel in the 5.9GHz (DSRC) band.

Reference: None

Purpose: DSRC radio coverage and performance.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.3 IEEE 802.11

SRD-USDOTOBE-003-ReqDRS002v001 IEEE 802.11 Conformance

Description: The onboard equipment device shall conform to IEEE Std. 802.11-2007

Reference: IEEE 802.11-2007

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS003v001 IEEE 802.11 Physical Layer

Description: The onboard equipment device shall implement options defined in Clause 17 of IEEE 802.11-2007, unless otherwise indicated (including all data rates in 17.2.3.3).

Reference: IEEE 802.11-2007, Clause 17

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS004v001 IEEE 802.11 Modulation Scheme

Description: The onboard equipment device shall implement the Orthogonal Frequency-Division Multiplexing (OFDM) physical layer of the Open Systems Interconnection (OSI) model.

Reference: IEEE 802.11-2007, Clause 17

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Device Test

SRD-USDOTOBE-003-ReqDRS005v001 IEEE 802.11 Default Values

Description: The onboard equipment device shall use the default values defined in IEEE 802.11-2007 unless otherwise indicated (including the coverage class in 17.3.8.6).

Reference: IEEE 802.11-2007

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS006v001 IEEE 802.11 Quality of Service

Description: The onboard equipment device shall send 802.11 data frames using the Quality of Service (QoS) Data subtype.

Reference: IEEE 802.11-2007

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS007v001 Arbitration Interframe Spacing Value

Description: The onboard equipment device shall configure an AIFS of a given access category with an integer value from 2 to X, where the value of X is based on the chip set used – as defined by the vendor.

Reference: IEEE 802.11-2007

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS008v001 Transmission Opportunity Value

Description: The onboard equipment's IEEE 802.11 TXOP Limit of a given AC shall be capable of being set to 0.

Reference: IEEE 802.11-2007

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS009v001 Contention Window Minimum Value

Description: The onboard equipment‘s IEEE 802.11 CWmin of a given AC shall take any value of the form (2^k)-1, for k = 1 through Y, where the value of Y is based on the chip set used – as defined by the vendor.

Reference: IEEE 802.11-2007

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.4 IEEE 802.11p

SRD-USDOTOBE-003-ReqDRS010v001 IEEE 802.11p Conformance

Description: The onboard equipment device shall conform to IEEE 802.11p-2010.

Reference: IEEE 802.11p-Standard for Information Technology-Telecommunications and Information Exchange between systems-Local and Metropolitan Networks-Specific Requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Wireless Access in Vehicle Environments, Amendment 6, Published in 2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Device Test

SRD-USDOTOBE-003-ReqDRS011v001 IEEE 802.11p Basic Service Set

Description: The onboard equipment device shall send MAC Protocol data units (MPDUs) outside the context of a basic service set (BSS), i.e. with the Management Information Base (MIB) variable dot11OCBEnabled set to "true".

Reference: IEEE 802.11p-Standard for Information Technology-Telecommunications and Information Exchange between systems-Local and Metropolitan Networks-Specific Requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Wireless Access in Vehicle Environments, Amendment 6, Published in 2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS012v001 IEEE 802.11p Regulatory Class 17

Description: The onboard equipment device shall support Regulatory class 17 (even 10 MHz channels in the range 172 to 184).

Reference: IEEE 802.11p-Standard for Information Technology-Telecommunications and Information Exchange between systems-Local and Metropolitan Networks-Specific Requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Wireless Access in Vehicle Environments, Amendment 6, Published in 2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS013v001 IEEE 802.11p Regulatory Class 18

Description: The onboard equipment device shall support Regulatory class 18 (odd 20 MHz channels 173 and 181).

Reference: IEEE 802.11p-Standard for Information Technology-Telecommunications and Information Exchange between systems-Local and Metropolitan Networks-Specific Requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Wireless Access in Vehicle Environments, Amendment 6, Published in 2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS014v001 IEEE 802.11p Enhanced Distributed Channel Access

Description: The onboard equipment device shall have a configurable EDCA parameter set. By default, the EDCA parameter set is the default set defined in IEEE 802.11p-2010, Table 7-37a.

Reference: IEEE 802.11p -Standard for Information Technology-Telecommunications and Information Exchange between systems-Local and Metropolitan Networks-Specific Requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Wireless Access in Vehicle Environments, Amendment 6, Published in 2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS015v001 IEEE 802.11p Option Enhanced Receiver Performance

Description: For each implemented modulation and coding combination, the onboard equipment device supplier shall indicate if the vehicle awareness device supports the Optional Enhanced receiver performance requirements (both for adjacent and non-adjacent rejection) defined in IEEE 802.11p-2010, Table 17-13a.

Reference: IEEE 802.11p-Standard for Information Technology-Telecommunications and Information Exchange between systems-Local and Metropolitan Networks-Specific Requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Wireless Access in Vehicle Environments, Amendment 6, Published in 2010

Purpose: Standards Conformance

Disposition: Optional

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.5 IEEE 1609.2

SRD-USDOTOBE-003-ReqDRS016v001 IEEE 1609.2 Conformance

Description: The onboard equipment device shall conform to IEEE P1609.2, Draft 9, posted as 1609.2-v2-d9-2011-05.

Reference: IEEE P1609.2, Draft 9.3, posted to IEEE website as 1609.2-v2-d9_3-2011-09.

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS017v001 IEEE 1609.2 Security Profile

Description: The onboard equipment device shall comply with the 1609.2 Security Profile as defined in Appendix C of this specification.

Reference: Appendix C

Purpose: Streamline secure communications processing.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-~~USDOTVAD~~USDOTOBE-003-~~ReqDRS002v001~~ ReqDRS002v001 IEEE 1609.2 Certificates

Description: The ~~vehicle awareness~~onboard equipment device shall be able to simultaneous store at least ~~twenty~~ two hundred eleven thousand (211,000) 1609.2 certificates.

Reference: IEEE P1609.2, Draft 9.3, Posted as 1609.2-v2-d9_3-2011-09.

Purpose: Store sufficient security credentials to support 5 minute life span (with 30 second overlap) for at approximately two (2) years (12/hr x 24 hr/day x 2 years).

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS018v001 IEEE 1609.2 Time-Limited Certificates

Description: The onboard equipment device shall make use of time-limited 1609.2 certificates, with a start and end time.

Reference: IEEE P1609.2, Draft 9.3, Posted as 1609.2-v2-d9_3-2011-09, Security Profile Appendix C.

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS019v001 IEEE 1609.2 Certificate Deletion upon Expiration

Description: The onboard equipment device shall delete expired 1609.2 certificates.

Reference: None

Purpose: Efficient use of device storage.

Disposition: ~~Mandatory~~Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS020v001 IEEE 1609.2 Certificate Deletion

Description: The onboard equipment device shall enable the deletion of stored 1609.2 certificates by an authorized entity via the LSI when in "Halt" or "Quiet" mode.

Reference: None

Purpose: Support for 1609.2 operations.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqDRS003v001 IEEE 1609.2 Certificate Reload

Description: The vehicle awareness device shall enable the re-load of new certificates by an authorized entity via the LSI when in "Halt" or "Quiet" mode.

Reference: None

Purpose: Support for 1609.2 operations.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS021v001 IEEE 1609.2 Static Certificate while in an Event Condition

Description: The onboard equipment device shall not change its certificate while a SAE J2735-200911 defined event condition exists unless the event lasts longer than the end of the overlap period between certificates.

Reference: None

Purpose: Maintain Device identity while in an Event Condition

Disposition: Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS022v001 Randomize MAC Addresses on Certificate Change

Description: The onboard equipment device shall randomize the DSRC radio's MAC Addresses upon a change of 1609.2 Certificate.

Reference: None

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqDRS004v001 Inbound Message Non-Authentication

Description: The vehicle awareness device shall not authenticate incoming WAVE messages.

Reference: None

Purpose: Enables data integrity and security.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS023v001 Inbound Message Acceptance

Description: The onboard equipment device shall accept all incoming WAVE messages received by the DSRC radio (whether signed or not signed).

Reference: None

Purpose: Streamline secure communications processing.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.6 IEEE 1609.3

SRD-USDOTOBE-003-ReqDRS024v001 IEEE 1609.3 Conformance

- **Description:** The onboard equipment device shall conform with IEEE 1609.3-2010, August 2010

.

Reference: IEEE 1609.3-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTVAD-003-ReqDRS005v001 IEEE 1609.3 WSMP

Description: The vehicle awareness device shall transmit WAVE Short Message Protocol (WSMP) messages.

Reference: IEEE 1609.3-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS025v001 IEEE 1609.3 Send Basic Safety Messages as WSMP

Description: The onboard equipment device shall send Basic Safety Messages within WAVE Short Messages.

Reference: IEEE 1609.3-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Device Test

SRD-USDOTOBE-003-ReqDRS026v001 IEEE 1609.3 Safety Supplement

Description: The onboard equipment device shall support the transmission of the WSMP Safety Supplement specified in Annex G of IEEE 1609.3-2010.

Reference: IEEE 1609.3-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS027v001 IEEE 1609.3 WSMP-S Control Field

Description: The onboard equipment device shall be capable of sending a configured WSMP-S Control Field (default value 0x01).

Reference: IEEE 1609.3-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS028v001 IEEE 1609.3 PSID-Specific User Priority

Description: The onboard equipment device shall assign a configurable PSID value (to the value specified for the associated application area defined in IEEE 1609.12-D2, default to "0x20") and a configurable User Priority value (default to 2) to each data frame.

Reference: IEEE 1609.3-2010, IEEE P1609.12-D2

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test\Device Test

SRD-USDOTOBE-003-ReqDRS029v001 IEEE 1609.3 WSMP Header Options

Description: The onboard equipment device shall support the following WSM header options, as part of the configuration file:

- Data Rate
- Transmit Power Used

Reference: IEEE 1609.3-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test\Device Test

SRD-USDOTOBE-003-ReqDRS030v001 WSMP Congestion Controlled Transmission Rate

Description: The onboard equipment device shall transmit WSMs as per the current congestion control algorithm.

Reference: None

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-~~USDOTOBE~~USDOTVAD-003-~~ReqDRS031v001~~ ReqDRS031v001 IP Firewall Rules

Description: The ~~onboard equipment~~vehicle awareness device shall comply with the IP Firewall Rules as defined in Appendix D of this specification for all DSRC Radios.

Reference: ~~None~~Appendix D.

Purpose: Secure IP Communications

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.7 IEEE 1609.4

SRD-USDOTOBE-003-ReqDRS032v001 IEEE 1609.4 Standard Conformance

Description: The onboard equipment device shall conform to IEEE 1609.4-2010 for all DSRC radios.

Reference: IEEE 1609.4-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS033v001 IEEE 1609.4 Radio Operating Mode Support

Description: The DSRC radio in the onboard equipment device shall be capable of operating either in "continuous" (single channel) or "alternating" (Channel Switching) modes, as shown in IEEE 1609.4-2010 Figure 10, with a default mode of “continuous”.

Reference: IEEE 1609.4-2010

Purpose: Turn Channel Switch mode on and off

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS034v001 Continuous Channel Mode

Description: If configured for “continuous” mode, a DSRC radio in the onboard equipment device shall also be configurable to operate (send and receive messages) on any of the 10 MHz (default to Channel 172) or 20 MHz channels with no message time interval restrictions.

Reference: None

Purpose: Support for low latency safety messages (possibly faster than a 10 Hz message rate).

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS035v001 Alternating Channel Mode

Description: If configured for "alternating" mode, a DSRC radio in the onboard equipment device shall be configurable to send messages either on Channel 178 during the Control Channel (CCH) interval, or on any of the 10 MHz or 20 MHz service channels (as directed by the RSU).

Reference: IEEE 1609.4-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS036v001 Service Channel Interval

Description: If configured for "alternating" mode, a DSRC radio in the onboard equipment device shall be configurable to switch on every SCH interval to the configured SCH.

Reference: IEEE 1609.4-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS037v001 Randomize MAC Addresses on Device Power Up

Description: The onboard equipment device shall randomize the DSRC radio media access control (MAC) Addresses upon Power-Up (i.e., when the device is turned on).

Reference: None

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS038v001 Service Channel MAC Address Configuration

Description: The onboard equipment device shall randomly generate different MAC addresses for the Service Channel (SCH).

Reference: None

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS039v001 Control Channel MAC Address Configuration

Description: The onboard equipment device shall randomly generate different MAC addresses for the Control Channel (CCH).

Reference: None

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS040v001 IEEE 1609.4 Avoid Synchronized Collision

Description: During the CCH interval, when in "alternating" mode, the onboard equipment device shall mitigate the synchronized collision phenomenon discussed in Annex B of IEEE 1609.4-2010.

Reference: IEEE 1609.4-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS041v001 IEEE 1609.4 Readdressing Option

Description: The onboard equipment device shall be capable of implementing the readdressing option defined in IEEE 1609.4-2010, Clause 6.7.

Reference: IEEE 1609.4-2010

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.8 Radio Performance

SRD-USDOTOBE-003-ReqDRS042v001 Transmission Range

Description: The onboard equipment device shall transmit DSRC communication signals 360 degrees around the specified vehicle types (as called out in SRD-USDOTOBE-003-SYS002v001) throughout a

range of 1m to 300m, with a maximum Packet Error Rate of 10.0%, in an open field under the following conditions:

- When transmitting in an 802.11p Regulatory class 17 (default Channels 172 or 178) channel.
- When transmitting Part 1 of the BSM
- With a BSM Transmission Rate of 10 Hz
- 6 Mbps data rate

Reference: None

Purpose: Ensure sufficient transmission range to support multiple devices and multiple test scenarios

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS043v001 Receive Range

Description: The onboard equipment device shall receive DRSC communication signals 360 degrees around the specified vehicle types (as called out in SRD-USDOTOBE-003-SYS002v001) throughout a range of 1m to 300m, with a maximum Packet Error Rate of 10.0%, in an open field under the following conditions:

- When receiving in an 802.11p Regulatory class 17 (even 10 MHz channels in the range 172 to 184) channel.
- When receiving Part 1 of the BSM
- With a BSM receive rate of 10 Hz
- 6 Mbps data rate

Reference: None

Purpose: Ensure sufficient transmission range to support multiple devices and multiple test scenarios

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.3.9 Congestion Control

SRD-USDOTOBE-003-ReqDRS044v001 Congestion Control (Under Development)

Description: The onboard equipment device shall support full congestion control logic as defined in the CAMP Task VSC3 Congestion Control Document.

Reference: CAMP Task VSC3 Congestion Control Document

Purpose: Mitigate congestion during multiple device tests

Disposition: Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS045v001 Congestion Control Algorithm Loading (Under Development)

Description: The onboard equipment device shall allow the loading of one (1) executable congestion control strategy as defined in CAMP Task VSC3 Congestion Control Document, while the device is in "Halt" mode. (Default: No congestion control; default transmission rates, power levels, etc.).

Reference: CAMP Task VSC3 Congestion Control Document

Purpose: Mitigate congestion during multiple tests

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS046v002 Congestion Control Parameters (Under Development)

Description: The onboard equipment device shall store the following default congestion control parameters upon start up:

- Operating Channel
- Default transmit power
- Default data rate
- Radio EDCA settings
- Message Rate

Reference: None

Purpose: Set\Manipulate Congestion Control parameters.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS047v001 Congestion Control Parameter Setting on Radio Startup

Description: At startup, the onboard equipment device shall execute the loaded congestion control algorithm using the configured parameter values.

Reference: None

Purpose: Set\Manipulate Congestion Control parameters.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS048v001 Congestion Control Indicators

Description: Upon request the onboard equipment device shall provide the following Congestion Control indicators to an authorized entity.

- Receive Signal Strength (dB)

- Channel Busy Ratio (% busy)
- Transmission Data Rate (Mbps)
- Packet Error Rate (PER) as defined in CAMP VSC3 – Congestion Control Document (to be made available upon request)

Reference: None

Purpose: Enables operation of the congestion control algorithm(s)

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS049v001 Congestion Control Parameter Configuration

Description: The onboard equipment device shall allow an authorized entity to configure the following congestion control parameters while the device is in halt mode:

- Transmit Rate
- Power Level
- Message Rate

Reference: None

Purpose: Set\Manipulate Congestion Control parameters

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS050v001 Congestion Control Stop

Description: The onboard equipment device shall stop execution of the loaded congestion control algorithm upon transition to Halt State.

Reference: None

Purpose: Set\Manipulate Congestion Control parameters

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqDRS051v001 Congestion Control Start

Description: The onboard equipment device shall start the execution of the congestion control algorithm upon transition to Operate State.

Reference: None

Purpose: Set\Manipulate Congestion Control parameters

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.4 Other Communications

SRD-USDOTOBE-003-ReqCOM001v001 Local Systems Interface – Protocol Support

Description: The onboard equipment device shall implement one of the following protocol suites for any Category A LSI interface type as listed in SRD-USDOTOBE-003-ReqINT003v001.

- Internet Protocol v4 (IPv4)
- Internet Protocol v6 (IPv6)

Reference: None

Purpose: Supports local or remote access for configuration and maintenance over non-DSRC communications interface.

Disposition: Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-~~USDOTRSE~~USDOTOBE-003-ReqCOM002v001 Secure Non-DSRC IP Communications

Description: The onboard equipment device shall support at least one of the following secure access mechanisms for each non-DSRC communications interface configured for IP.

- Transport Layer Security (TLS) v1.2
- Internet Protocol Security (IPSec) for IPv4
- Internet Protocol Security (IPSec) for IPv6
- Secure Shell, v2 (SSH-2)
- SSH File Transfer Protocol v6.

Reference: None

Purpose: Enables secure communications over IP enabled (non-DSRC) links in support of operations and maintenance.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqCOM003v001 Non-DSRC IP Firewall Rules

Description: The onboard equipment device shall comply with the IP Firewall Rules as defined in Appendix D of this specification for all non-DSRC IP Interfaces.

Reference: None

Purpose: Secure IP Communications

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqCOM004v001 Secure Non-DSRC IP Communications Account Password Reset

Description: All system accounts for any non-DSRC communications interfaces on the onboard equipment devices shall have resettable passwords. Unique passwords must be assigned to devices provided for a particular installation.

Note: All ~~default~~ Passwords **must** ~~be provided to USDOT or its designee~~be closely held by the device maker. Secure passwords shall be chosen with passwords implementing an entropy of 80 bits (a random password of 13 characters in length chosen from all possible characters).

Reference: None

Purpose: Enables secure communications over IP enabled (non-DSRC) links in support of operations and maintenance.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.5 WSMP Message Processing

5.5.1 SAE J2735 Message Types

SRD-USDOTOBE-003-ReqMPS001v001 DSRC Basic Safety Message

Description: The onboard equipment device shall conform to section 5.2 - Basic Safety Message (BSM) in the Society of Automotive Engineers (SAE) Standard J2735 2009-11: Dedicated Short Range Communications (DSRC) Message Set Dictionary, including relevant specifications outlined in Annex A; implementing ASN.1 format.

Reference: SAE J2735 2009-11

Purpose: Standards Conformance. Enables interoperability by using industry standard message definitions.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

5.5.2 SAE J2735 Basic Safety Message Type – Details

SRD-USDOTOBE-003-ReqBSM001v001 Basic Safety Message Generation

Description: The onboard equipment device shall generate a BSM message at its configured message rate.

Reference: SAE J2735 2009-11

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003- ReqBSM002v001 Basic Safety Message Transmission

Description: The onboard equipment device shall transmit the generated BSM over the DSRC radio interface at its configured message rate.

Reference: SAE J2735-200911, IEEE P1609.2, Draft 9.3, May 2011, IEEE 1609.3, August 2010, IEEE 1609.4, August 2010, IEEE 802.11-2007, and IEEE 802.11p D11.0, March 2010

Purpose: The purpose of the device is enable the US DOT or its agents to conduct research related to vehicle-to-vehicle communications

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Device Test

SRD-USDOTOBE-003-ReqBSM003v001 Application Security Profile

Description: The onboard equipment device shall use the Application Security Profile for Basic Safety Messages.

Reference: Appendix C.

Purpose: Standards Conformance

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Device Test

SRD-USDOTOBE-003-ReqBSM004v001 Basic Safety Message Part I Transmission Rate

Description: The Basic Safety Message Part I message transmission rate shall be configurable within the range of 2 Hz to 20 Hz with a default to 10 Hz.

Reference: None

Purpose: Congestion control

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM005v001 Basic Safety Message Part II Transmission Interval

Description: The onboard equipment device shall transmit each of the required Basic Safety Message Part II data frames and data elements with every "Nth" BSM Part I message with "N" being a configurable value with a default of ~~10~~1.

Note: ~~None~~Direction from CAMP application developers.

Purpose: Enables multiple Test Configurations

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM006v001 Event Triggered Basic Safety Message

Description: The onboard equipment device shall transmit a Basic Safety Message triggered by one or more vehicle generated events as soon as possible, but within 50 ms.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Note: The Hard Braking event is considered "triggered" if the specified acceleration rate is reached.

Purpose: Multiple Test Configurations

Disposition: Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM007v001 General Data Frames and Data Elements – Part 1

Description: The Basic Safety Message Part 1 shall include, at a minimum, the data frames and data elements listed below:

- DSRCmsgID
- MsgCount
- TemporaryID
- DSecond
- Latitude
- Longitude
- Elevation
- Positional Accuracy
- TransmissionAndSpeed::Speed
- Heading
- AccelerationSet4Way::Longitudinal Acceleration, Yaw

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Provides a minimum set of data for simulating real world conditions

Disposition: Mandatory

Performance Criteria: Pass\Fail. Note: Requirements for BSM values will be specified elsewhere in this specification.

Verification Method: Device Test

SRD-USDOTOBE-003-ReqBSM008v001 General Data Frames and Data Elements - Part II

Description: The Basic Safety Message Part II shall include at a minimum, the data frames and data elements listed below, subject to limitations defined in requirements elsewhere in this specification and in the Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document.

- Event Flags
- PathHistory
- PathPrediction
- Vehicle Type

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Provides a minimum set of data for simulating real world conditions

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM009v001 Basic Safety Message Data Frame/Element Values

Description: The onboard equipment device shall provide a means for populating all required data frames and data values as listed on SRD-USDOTOBE-003-ReqBSM007v001 and SRD-USDOTOBE-003-ReqBSM008v001 above.

Reference: None

Purpose: Enables multiple Test Configurations

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM010v001 Basic Safety Message Data Frame/Element Value Population

Description: The onboard equipment device shall populate all required data frames and data values as listed on SRD-USDOTOBE-003-ReqBSM007v001 and SRD-USDOTOBE-003-ReqBSM008v001above.

Reference: None

Purpose: Enables multiple Test Configurations

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM011v001 MsgCount DE Initialization

Description: The onboard equipment device shall initialize the MsgCount field in the Basic Safety Message to any value in the range 0-127 when sending the first message with a given DSRCmsgID,

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Message Tracking and Identification

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM012v001 MsgCount DE Rotation on Temporary ID Change

Description: The onboard equipment device shall initialize the MsgCount field in the Basic Safety Message to any value in the range 0-127 if the sender has changed identity by changing its TemporaryID since sending the most recent message with that DSRCmsgID,

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM013v001 TemporaryID DE Rotation

Description: The onboard equipment device shall assign random valid values for the TemporaryID that are not predictable.

Note: A part of the TemporaryID may be held fixed as noted in Appendix B.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM014v001 TemporaryID DE Rotation on Certificate Change

Description: The onboard equipment device shall change the TemporaryID to a random valid value when any Certificate associated with the message is changed

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM015v001 TemporaryID DE Rotation on Reception of Same TemporaryID

Description: If the onboard equipment device receives\processes Basic Safety Messages, the vehicle awareness device shall change its TemporaryID to a different random valid value when it receives a Basic Safety Message with the same TemporaryID.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Device Anonymity

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM016v001 DSecond DE Value Determination

Description: The onboard equipment device shall set the value of the DSecond data element when the BSM Part I vehicle location data is determined by the sensor source.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM017v001 DSecond DE Accuracy

Description: The onboard equipment device shall maintain accuracy of DSecond data element of the BSM with values within one milliseconds of UTC when the vehicle's location is determined.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM018v001 Latitude DE Value

Description: The onboard equipment device shall set the value of the Latitude data element of the BSM with values that are within at least within 1.5 meters of the actual latitude at an HDOP smaller than 5 under open sky conditions within the 1 sigma absolute error

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM019v001 Latitude DE Value Determination

Description: The onboard equipment device shall set the value of the Latitude data element when the BSM Part I positional data is determined based on the sensor source.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM020v001 Latitude DE Value Accuracy

Description: The onboard equipment device shall maintain accuracy of Latitude data element of the BSM with values within one milliseconds of UTC when the vehicle's location is determined.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM021v001 Longitude DE Value

Description: The onboard equipment device shall set the value of the Longitude data element of the BSM with values that are within at least within 1.5 meters of the actual longitude at an HDOP smaller than 5 under open sky conditions within the 1 sigma absolute error

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM022v001 Longitude DE Value Determination

Description: The onboard equipment device shall set the value of the Longitude data element when the BSM Part I positional data is determined based on the sensor source.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory, if the device receives\processes Basic Safety Messages; otherwise, Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM023v001 Longitude DE Value Accuracy

Description: The onboard equipment device shall maintain accuracy of Longitude data element of the BSM with values within one milliseconds of UTC when the vehicle's location is determined.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory, if the device receives\processes Basic Safety Messages; otherwise, Optional

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM024v001 Elevation DE Value

Description: The onboard equipment device shall set the value of the Elevation data element of the BSM with values that are within at least within 3 meters of the actual elevation at an HDOP smaller than 5 under open sky conditions within the 1 sigma absolute error

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM025v001 PositionalAccuracy DF Value

Description: The onboard equipment device shall set the value of the PositionalAccuracy data frame of the BSM with values most recently received from the GPS receiver.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM026v001 Speed DE Value Latency

Description: The onboard equipment device shall ensure that the value of the Speed data element of the BSM has a latency of less than 220 milliseconds.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM027v001 Speed DE Value Accuracy

Description: The onboard equipment device shall generate values for the Speed data element of the BSM with accuracy better than 0.35 m/sec.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM028v001 Heading DE Value Latency

Description: The onboard equipment device shall ensure that the value of the Heading data element of the BSM has a latency of less than 220 milliseconds.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM029v001 Heading DE Value Error Tolerance

Description: The onboard equipment device shall ensure that the value of the Heading data element of the BSM has an error shall be less than 3 degrees when the vehicle speed is between 0.56 m/sec and 12.5 m/sec. The error shall be less than 2 degrees when the vehicle speed is greater than 12.5m/sec.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM030v001 Heading DE Value Latching

Description: The onboard equipment device shall, when the vehicle speed drops below 0.56 m/sec, latch the value of the Heading data element of the BSM to the last known good heading value above 0.56 m/sec.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM031v001 Heading DE Value Unlatching

Description: The onboard equipment device shall unlatch the value of the Heading data element of the BSM when the vehicle speed exceeds 0.83m/sec.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM032v001 Longitudinal Acceleration DE Value Accuracy

Description: The onboard equipment device shall ensure that the value of the LongitudinalAcceleration data element of the BSM has an accuracy that is less than 0.1 m/sec^2.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM033v001 Longitudinal Acceleration DE Value Latency

Description: The onboard equipment device shall ensure that the value of the LongitudinalAcceleration data element of the BSM has a latency of less than 220 milliseconds.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM048v001 Yaw Rate DE Value Unavailability

Description: The onboard equipment device shall use the value of 32767 when the yaw rate of the vehicle is unavailable or cannot be determined.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM049v001 Yaw Rate Noise DE Value

Description: The onboard equipment device shall ensure that yaw rate noise shall be better than one sigma of 0.5 degree per second.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM050v001 Yaw Rate Bias DE Value

Description: The onboard equipment device shall ensure that the absolute value of the yaw rate bias shall be less than 0.3 degree/second.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM051v001 Yaw Rate Latency DE Value

Description: The onboard equipment device shall ensure that the latency of the yaw rate shall be less than 220 ms.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM034v001 EventFlag DF Persistence

Description: If one or more events are active, the onboard equipment device shall include the EventFlags data frame in Basic Safety Message Part II for as long as the event(s) is active.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Multiple Test Configurations

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM035v001 EventFlag DF HardBraking Event Flag

Description: The onboard equipment device shall set the HardBraking event flags as part of the EventFlag data frame in the BSM, Part II VehicleSafetyExtension data frame when the vehicle has decelerated or is decelerating at a rate greater than 0.4 g ~~and only if the event duration is equal to or larger than 400 ms~~.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Multiple Test Configurations

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM036v001 EventFlag DF HardBraking Event Flag Latency

Description: The onboard equipment device shall ensure that the initial detection of the value triggering the HardBraking Event Flag data element of the BSM Part II has a latency of less than 220 milliseconds.~~The onboard equipment device shall ensure that the value of the HardBraking Event Flag data element of the BSM Part II has a latency of less than 220 milliseconds~~.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure that vehicle safety applications have accurate positioning and timing data.

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM037v001 PathHistory DF PathHistoryPointSets

Description: The onboard equipment device shall populate the PathHistory data frame in the VehicleSafetyExtension part of the Basic Safety Message Part II with PathHistoryPointSets-04.

Reference: SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM038v001 PathHistory Distance

Description: The onboard equipment device shall populate the PathHistory data frame in the VehicleSafetyExtension part of the Basic Safety Message Part II with an adaptable number of PathHistory points so that the represented Path History distance (i.e. the distance between the first and last Path History point) is at least 300 meters.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM039v001 PathHistory Perpendicular Distance Difference

Description: The onboard equipment device shall incorporate Path History points in the PathHistory data frame in the VehicleSafetyExtension part of the Basic Safety Message Part II such that the

perpendicular distance between any point on the vehicle path and the line connecting two consecutive Path History points is less than 1 meter

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM040v001 PathHistory Data Source

Description: The onboard equipment device shall populate the Path HistoryPoints data element in the PathHistory data frame in the VehicleSafetyExtension part of the Basic Safety Message Part II with position data elements (Latitude, Longitude, Elevation), sampled at a periodic time interval (typically, 100 ms) and interpolated in between by circular arcs, representing the recent vehicle movement over a certain distance.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM041v001 PathHistory Conciseness

Description: The onboard equipment device shall populate PathHistory data frame in the VehicleSafetyExtension part of the BSM Message Part II with a minimum number of Path History points, selected as a subset of the available vehicle path position data elements, necessary to satisfy the required error tolerance between the vehicle path and its Path History representation.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM042v001 PathHistory Point Order

Description: The onboard equipment device shall populate PathHistory data frame in the VehicleSafetyExtension part of the BSM Message Part II with a time ordered Path History points, with the first point being the closest in time to current UTC time.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM043v001 PathHistory Point Maximum Count

Description: The onboard equipment device shall populate PathHistory data frame in the VehicleSafetyExtension part of the BSM Message Part II with the 23 most recent among the computed set of points, if the number of Path History points needed to meet requirements stated elsewhere in this specification exceeds the maximum allowable (23) number of points specified in PathHistoryPointsSets-04, (effectively the distance requirement shall be relaxed).

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM044v001 PathPrediction DF Values

Description: The onboard equipment device shall include a PathPrediction data frame in the VehicleSafetyExtension data frame in each generated Basic Safety Message Part II, only if both radius and confidence values are meaningful values.

For the purposes of the Path Prediction Minimum Performance Requirements, Steady State Conditions are defined as follows: The vehicle is driving on a curve with constant radius. The average of the absolute value of the change of yaw rate over time is smaller than 0.5 deg/sec2

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM045v001 PathPrediction DF Confidence

Description: Path Prediction Confidence shall be sent with every frame. The Path Prediction Confidence shall be calculated according to the method that is specified in a separate design document. The onboard equipment device shall not include a PathPrediction data frame in the VehicleSafetyExtension data frame in a generated Basic Safety Message Part II, if the confidence value is zero (0).

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM046v001 PathPrediction DF Error Tolerance

Description: The onboard equipment device shall calculate the radiusOfCurve value with error of less than one half lane width.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM052v001 PathPrediction DF Maximum Allowable Error Bound

Description: The onboard equipment device shall populate the Path Prediction DF with a calculated radius which has less than 2% error rate from the actual radius (when the vehicle is in steady state conditions over a range from 100 m to 2500 m).

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM053v001 PathPrediction DF Recalculation Interval

Description: The onboard equipment device shall re-populate the PathPrediction data frame after a transition from the original constant radius (R1) to the target constant radius (R2) within 4 seconds under the maximum allowable error bound defined in SRD-USDOTOBE-003-ReqBSM**052**v001.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Vehicle trajectory analysis

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqBSM054v001 VehicleType DE Value Inclusion

Description: The onboard equipment device shall include the correct value in the VehicleType data element in the VehicleSafetyExtension data frame in each generated and sent Basic Safety Message Part II, only if VehicleWidth or VehicleLength in the BSM Part I is set to “unavailable”.

Reference: Model Deployment Safety Device DSRC BSM Communication Minimum Performance Requirements-VSC3 Internal Document, ~~Revision 9.0, 10/10/2011~~Revision 11.1 01/24/2012 and SAE J2735-200911

Purpose: Ensure vehicle type data element is included and set correctly in the BSM Part II data frame if vehicle width or vehicle length is not a meaningful value

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

6 TEST REQUIREMENTS

6.1 Radio Transmission

SRD-USDOTOBE-003-ReqTST001v001 Transmission Measurement

Description: The onboard equipment device shall support a DSRC radio transmission pattern 360 degrees around the specified vehicle types (as called out in SRD-USDOTOBE-003-SYS002v001) throughout a range of 1m to 300m, with a maximum Packet Error Rate of 10.0%, in an open field under the following conditions:

- When transmitting in an 802.11p Regulatory class 17 (even 10 MHz channels in the range 172 to 184) channel.
- When transmitting Part 1 of the BSM
- With a BSM Transmission Rate of 10 Hz
- 6 Mbps data rate

Reference: SAE J2735 2009-11/802.11p

Purpose: Enables common test procedures.

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTOBE-003-ReqTST002v001 Pattern Measurement Location

Description: Measurements of the radio transmission pattern shall be made in the middle of an open field with no man-made or natural structures that would reflect 5.9 GHz radiation within 2.5 kilometers (km) of the test vehicle(s).

Reference: None

Purpose: Enables common test procedures

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

6.2 Vehicle Location

SRD-USDOTOBE-003-ReqTST003v001 Data Elements Measurement - Stationary Vehicle

Description: The onboard equipment device shall provide vehicle location data elements of the basic safety message to within the required values of ground truth (defined as predetermined geographic coordinates for a fixed point or points in the test area) with the vehicle stationary.

Reference: None

Purpose: Enables common test procedures

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTOBE-003-ReqTST004v001 Data Elements Measurement – Moving Vehicle

Description: The onboard equipment device shall provide vehicle location data elements of the basic safety message to within required values of ground truth (defined as predetermined geographic coordinates for a fixed point or points in the test area) with the vehicle traveling at speeds of 20 and 45 mph, and in a Figure 8 pattern.

Reference: None

Purpose: Enables common test procedures

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqTST005v001 Data Elements Measurement Test Units

Description: Measurements of vehicle location data elements shall be made with the vehicle stationary and with the vehicle being driven, at speeds of 20 and 45 mph, over a specified point with a known geographic location plotting 10 data points per second over 10 minute duration.

Reference: None

Purpose: Enables common test procedures

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqTST006v001 Data Elements Measurement Ground Truth Test Point

Description: The location of the given ground truth points shall be established with equipment capable of measurements within 10cm of the absolute location.

Reference: None

Purpose: Enables common test procedures

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqTST007v001 Data Elements Measurement Location

Description: Measurements of vehicle location data elements shall be made at a location near the middle of the continental United States (CONUS), at a location with no overhead obstruction within 1 km of the given measurement point.

Reference: None

Purpose: Enables common test procedures

Disposition: Mandatory

Performance Criteria: Pass\Fail

Verification Method: Test

SRD-USDOTOBE-003-ReqTST008v001 Data Elements Time Measurement

Description: The time at which the reference equipment in the test vehicle(s) pass over the given ground truth point shall be measured using equipment capable of giving a time measurement with accuracy within 1msec UTC time.

Reference: None

Purpose: Enables common test procedures

Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

SRD-USDOTOBE-003-ReqTST009v001 Data Elements Vehicle Location Measurement

Description: The vehicle's reported location at the time at which it passes the ground truth point shall be calculated using a linear extrapolation assuming a constant vehicle velocity.

Reference: None

Purpose: Enables common test procedures

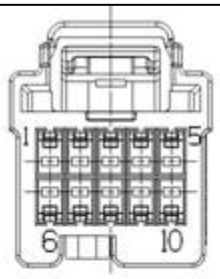
Disposition: Mandatory

Performance
Criteria: Pass\Fail

Verification
Method: Test

Appendix A: Vehicle Power Connector

The below image is for reference only. This is an image of the Delphi Micro HVT male connector looking into the cable side of the harness connector. The pin side of the header or in-line mate will have the same orientation. Pin assignments for the main power and ground are determined by the right angle header so that power and ground are on the outside corners of the in-board row of pins.



a. Pin 1 – Hot at All Times battery feed
b. Pin 2 – not assigned
c. Pin 3 – Hot in Run battery feed
d. Pin 4 – not assigned
e. Pin 5 – Ground
f. Pin 6 – not assigned
g. Pin 7 – Brake signal
h. Pin 8 – CAN High
i. Pin 9 – CAN Low
j. Pin 10 – not assigned

Figure 3.0 Connector Pin Diagram

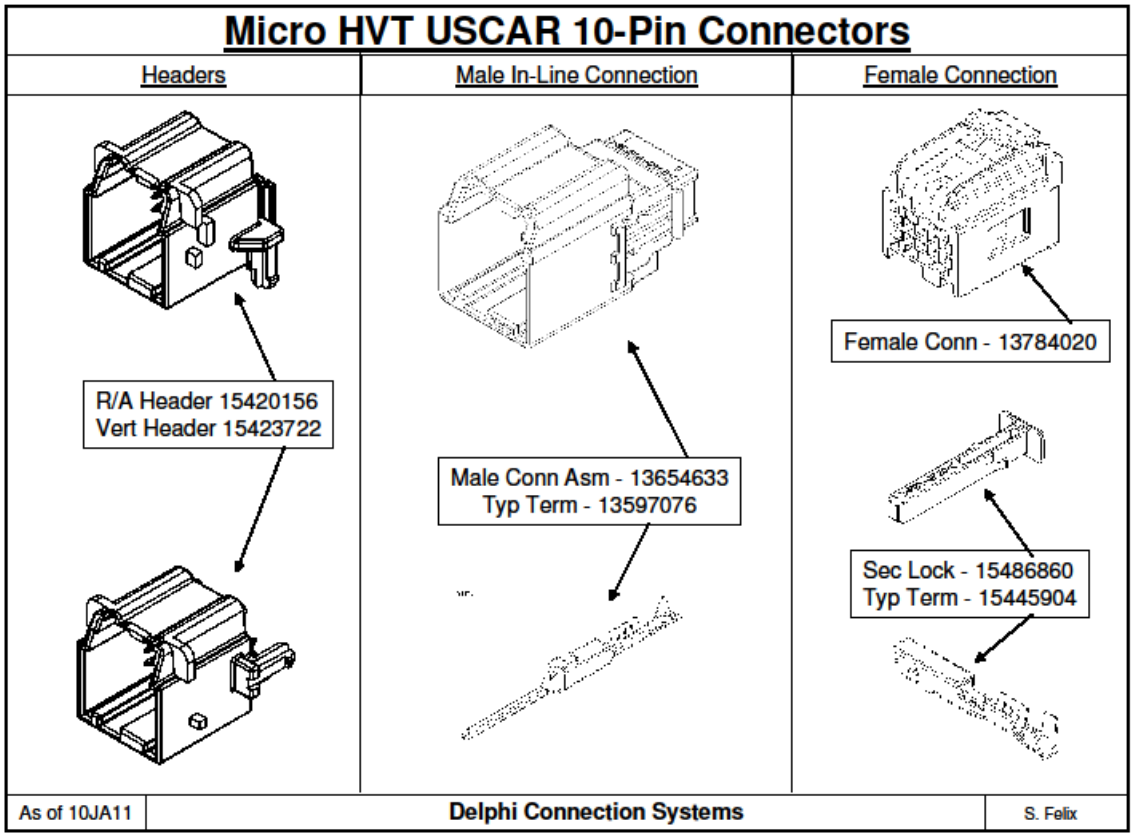


Figure 3.1 Connector Family

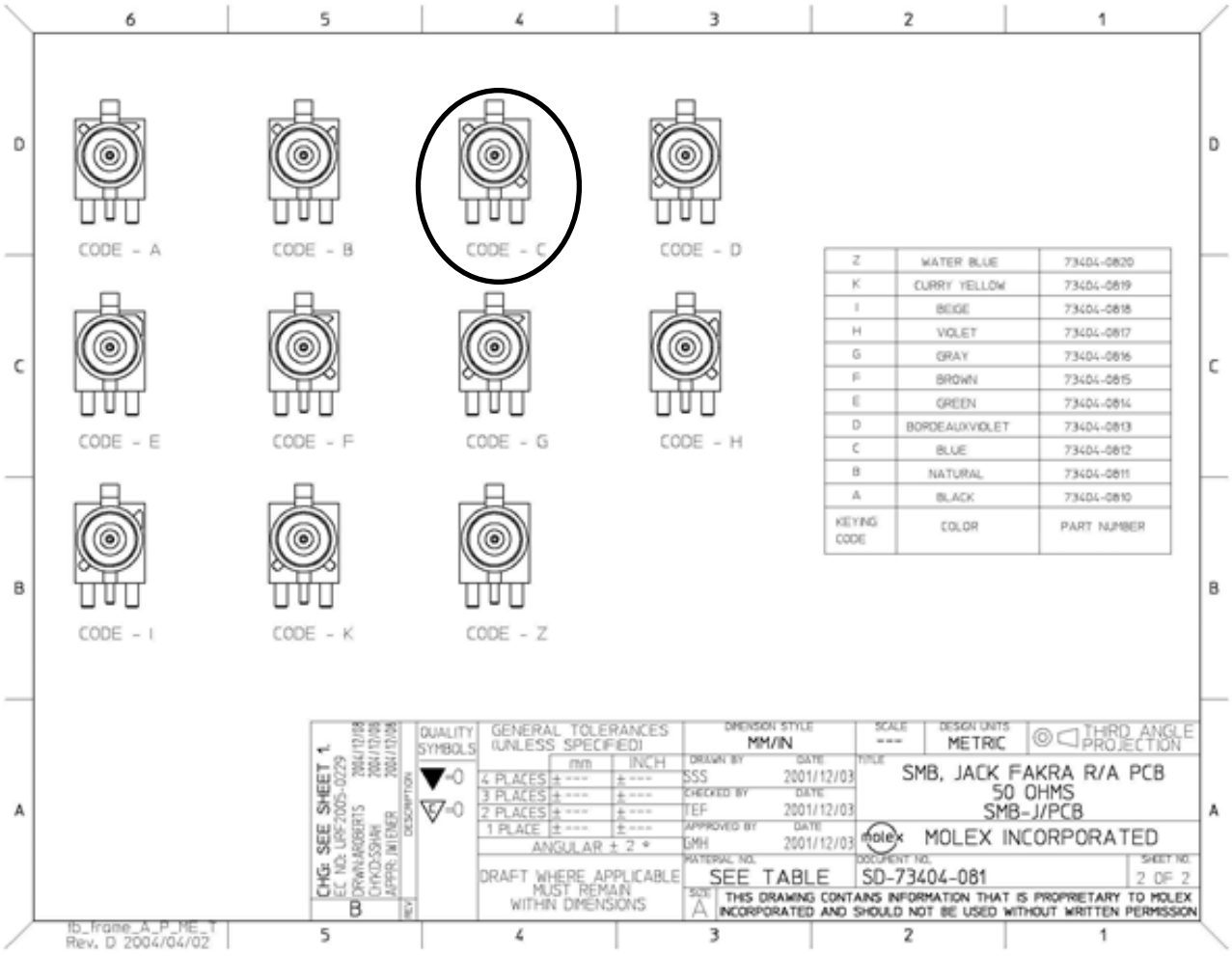


Figure 3.2 FACRA SMB Male Type C for GPS

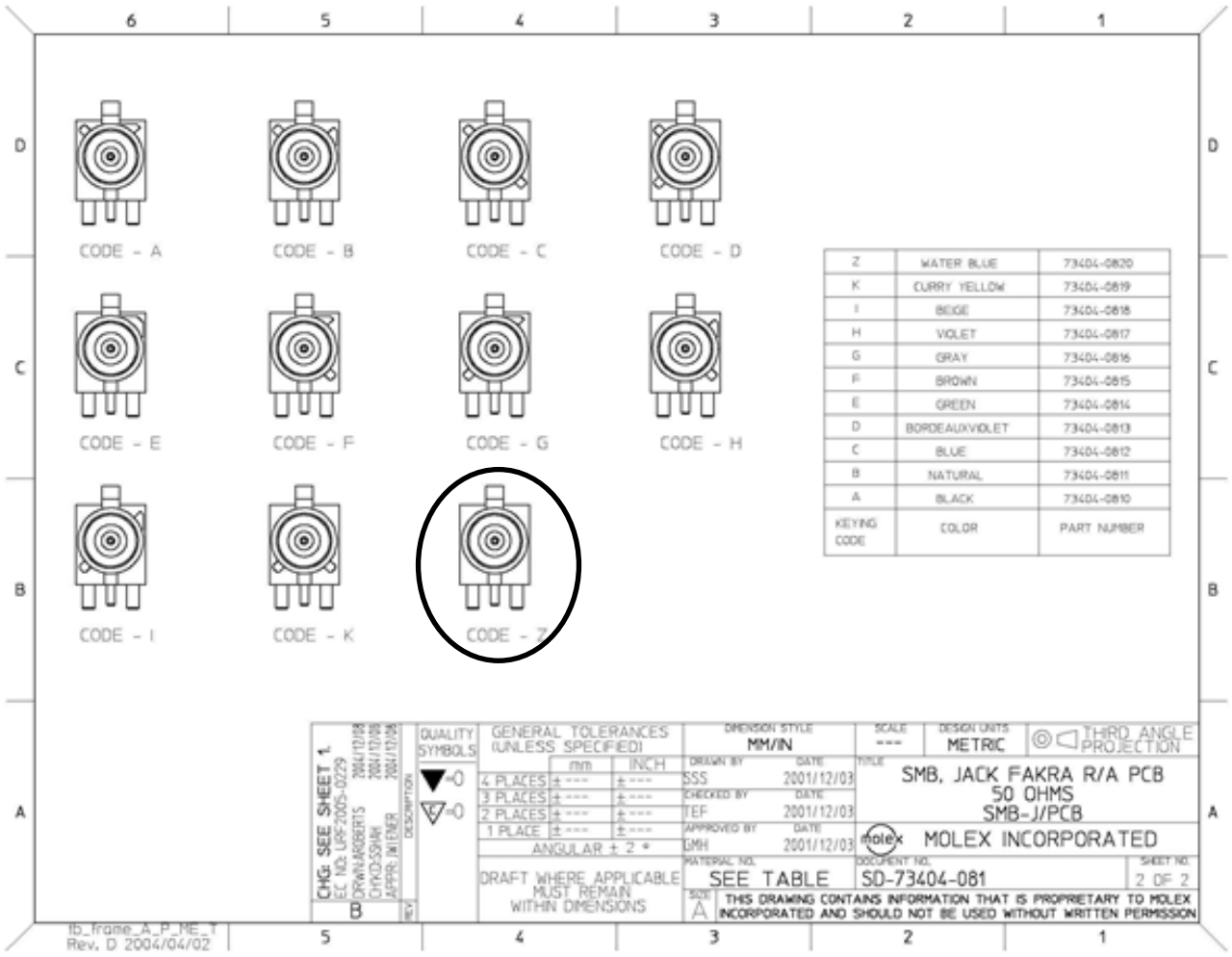


Figure 3.3 FACRA SMB Male Type Z for 5.9GHz DSRC

Appendix B: Configuration and Certificate File Format

DIRECTORY STRUCTURE

The removable media will include a sub-directory of the root directory named "ModelDeploymentConfigurationItems" that will contain a configuration file, and a sub-directory named "1609Certificates" that will contain files for the 1609 certificates. These directories will contain no sub-directories.

CONFIGURATION FILE

The following is an example of a text-based configuration file that will be placed on the removable memory while removed from the device.

```
# Vehicle Awareness Device
# Configuration File Format
# Modified Date: 01/23/2012
# Version: 0.1
#
# Format Convention:
# Comments are followed by either '#' or ';' and should not be
# considered as part of the configuration items.
# Empty lines should be ignored.
#

# Device Configuration Items

# Model Deployment Device ID
# Set by the Test Conductor at time of device installation
# Fixed two bytes with random two bytes TemporaryID, Full random TemporaryID
#   control flag
# Fixed upper two bytes = 0, Random = 1
TemporaryIDControl=0
# Unprogrammed ID value = 0
# Programmed ID value range: 0x0001 to 0xffff (1 to 65,535)
ModelDeploymentDeviceID=0

# Memory Device Mount Time
# Set by the device when the memory is first mounted
# Units are UTC date and time
# Unprogrammed value = 0
MemoryDeviceMountTimeDate=0

# GPS Antenna Offset Values
# Units follow J2375 definition.
# The offset value should be added to the value derived from the GPS
#   receiver to give the desired position value.
# Longitude, Latitude units: 1/10th integer microdegrees
# Elevation units 0.1 meters (decimeters)
LongitudeOffset=0
LatitudeOffset=0
ElevationOffset=0

# Vehicle Type Value
# Allowed values defined in J2735
# Not Equipped, Not known or unavailable = 0
VehicleType=0
```

```
# Vehicle Size Values
# Vehicle length and width units: 0.01 meters (centimeters)
# Not known or unavailable = 0
VehicleLength=0
VehicleWidth=0
```

SHORT-LIVED CERTIFICATE FILES

In order to use a short-lived certificate, a Vehicle Awareness Device needs access to (a) the short-lived certificate (which includes a public signing key for messages signed using that certificate) and (b) the private signing key associated with the public signing key in the short-lived certificate, and 288 short-lived certificates (with associated private keys) are required to cover each day of operation. The LCDS LCDS will produce a single file that contains the 288 short-lived certificates and associate private signing and encryption keys for that day and copy as many of these files as necessary to each SD card to cover the period when that SD card would be in use until it is replaced with a different SD card that contains certificates for an additional period.

The file names used to hold the certificates will follow the pattern "ShortLivedYYYYMMDD.crt" where YYYY is the 4-digit year, MM is the 2-digit month (e.g., "01" for January, "12" for December), and DD is the 2-digit day of the month (e.g., "01" for the first day of the month) for the day on which the certificates contained in the file are valid. (This date and all other times referred to in this document are UTC times. So, the file "ShortLived20110701.crt" would contain certificates valid from 7/1/2011 12:00:00 AM UTC until 7/2/2011 12:00:30 AM UTC.)

Within each file, the 288 certificates will be arranged in chronological order by the start date of the period during which each certificate is valid. So, the first certificate in the file ShortLived20110701.crt will be valid from 7/1/2011 12:00:00 AM until 7/1/2011 12:05:30 AM, the second certificate in this file will be valid from 7/1/2011 12:05:00 AM until 7/1/2011 12:10:30 AM, etc.

Each certificate and signing private key combination will be stored in as a fixed-length binary structure in that file, in encrypted format. , The plaintext information is stored according to the CertificateAndPrivateKey structure defined below:

```
Struct {
    Certificate cert;
    uint8       s[32];
    uint8       nullvalue<var>;
}  CertificateAndPrivateKey
```

The notation used in this definition is the same as that described in the IEEE 1609.2 standard, with the Certificate data structure as defined in IEEE 1609.2 following the constraints identified in the ~~CAMP~~ USDOT Security Design Document.

- The cert field is the 1609 Certificate provided by the SCMS that includes public signing key for the Vehicle Awareness Device valid for a specific period.
- The s field is the private signing key associated with the public signing key in this certificate.
- The null field is a variable length field that is used to pad the structure to ensure that each entry is of fixed length of 1,024 bytes.

Each certificate and signing key combination is encrypted and authenticated using AES-CCM, as defined in IEEE 1609.2, resulting in a fixed-length entry each of 1,024 (plaintext block) + 16 (authentication tag) + 12 (nonce) = 1,052 bytes. A single key will be used for all devices and all device suppliers.

Because the certificate/primary key data are arranged chronologically with a fixed number of bytes reserved for each item, the nth entry in the file is always associated with the nth time of the day. For example, the 7th entry is for the 7th time period of the day, so would be valid from 12:30:00 AM until 12:35:30 AM. (If a certificate is not available for a specific time period, the portion of the file reserved for that certificate will be filled with null values, thus ensuring that the nth entry is always associated with the nth time period of each day.)

Other Data Required by the LCDS

The 1609Certificates directory may contain other files that the LCDS uses to help manage certificates across the multitude of SD cards and Vehicle Awareness Devices that will be in use. These names of these files will NOT begin with “ShortLived”, so they can be easily distinguished from files that contain 1609 certificates.

An Example

On 7/13/2012 at 1:47:03 PM (UTC), a Vehicle Awareness Device is preparing to send a BSM. The following process could be used by a Vehicle Awareness Device to broadcast a BSM.

- The device computes the file name ShortLived20110713.crt for the file that will hold the appropriate certificate.
- The device computes the offset within that file where the certificate is located. The time 1:47:03 PM is within the 166th 5-minute interval in the day, so the certificate data structure begins at file offset 168,960 (i.e., 165 times the fixed length of 1,024 per certificate).
- The device opens the file and reads 1,024 bytes from the file starting at byte offset 168,960.
- The device decodes the 1,024 bytes read as a CertificateAndPrivateKey structure.
- The device prepares the BSM and copies the cert field from the CertificateAndPrivateKey into the appropriate location within the BSM data packet.
- The device computes the digital signature of the BSM data packet and attaches it to the packet.
- The device transmits the signed BSM data packet.

Note that this process is conceptual – in practice, many of these steps will be managed by the 1609.2 stack that is part of the Vehicle Awareness Device software architecture.

Appendix C: Security Profile

C.1 Overall

These are the security profiles for use in Safety Pilot Model Deployment only. This document does not constitute a commitment or indication as to the security profiles for use in any other project or deployment.

Needs

- All messages need to be signed so recipients can authenticate the source of the message. Recipients have the responsibility to determine if they trust the source.
- Signatures will be checked on messages were action results. Messages collected in log files should be included regardless of authenticity.
- The same cryptographic signature (and if needed encryption) process needs to be applied to all messages – BSM's, TIM's, SPaT's, GID's, WSA's, IP datagrams.

Refer to "5.9GHz DSRC Roadside Equipment" Device Specification, version 2.3 for complete security profiles.

Appendix D: Firewall Rules

This section defines the Firewall Rules for the Vehicle Awareness Device.

Table D.1: — Protected IP Interfaces

Interface	Purpose
DSRC Radio	Wireless communications with other DSRC enabled mobile devices and with DSRC enabled infrastructure devices.
Local System Interface	Configuration and management interface

Table D.2: — Protected IP Interface Addressing

Interface	Address Scope
DSRC Radio	IPv6 link-local, non-routable
Local System Interface	IPv6 link-local, non-routable
	IPv4 non-routable

Table D.3 — Protected IP Interface Security Configuration

Interface	Rule	Firewall Policies
DSRC Radio	**Allow**	• None
	Deny	• All IPv4 ingress and egress traffic • All IPv6 ingress and egress traffic
Local System Interface	**Allow**	**IPv6 Rules** • IPv6 Traffic on Linked-Local address subnet • Ingress IPv6 TELNET over TLS v1.2 traffic from LMD , TCP port 992 • Ingress IPSEC (for IPv6) traffic from LMD • Ingress IPv6 Secure-Shell (SSH-2, SFTP) traffic from LMD, TCP, port 22 • Egress IPv6 traffic from Vehicle Awareness Device to LMD **IPv4 Rules** • Ingress IPv4 TELNET over TLS v1.2 traffic from LMD, TCP/IP port 992 • Ingress IPSEC (for IPv4) traffic from LMD • Ingress IPv4 Secure-Shell (SSH-2, SFTP) traffic from LMD, TCP port 22 • Egress IPv4 traffic from Vehicle Awareness Device to LMD
	Deny	• All IPv4 ingress traffic except those defined in the “Allow” section • All IPv6 ingress traffic except those defined in the “Allow” section