

SAE INTERNATIONAL

SAE CONNECTED VEHICLE STANDARDS

Jim Misener

Director, Technical Standards, Qualcomm

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Agenda

1. Background

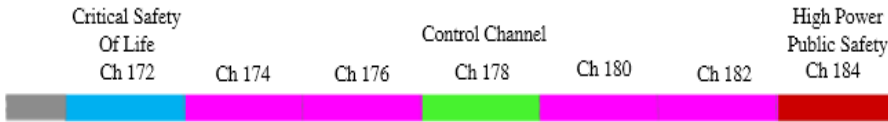
Dedicated Short Range Communications (DSRC) – For V2V safety, standards that can be used for rulemaking, prognosis for V2I

2. SAE J2945/1 – On-board System Requirements for V2V Safety Communications

3. SAE J2735 – Dedicated Short Range Communications (DSRC) Message Set Dictionary

4. Other (Current and Future) SAE DSRC Technical Committee Activities

Dedicated Short Range Communications (DSRC) for V2V Safety Applications



DSRC was designed for the 5.9GHz ITS band

Licensed under FCC Part 90 and 95

Uses “communication outside the context of a BSS” defined in 802.11p

FCC designates certain channels, e.g. V2V safety, control, public safety

V2V Standards

- IEEE 802.11 (PHY/MAC) →
- IEEE 1609.2-4 (message protocol and security services) →
- [SAE J2735 \(data dictionary / message sets: Vehicle Safety Extension\)](#) →
- [SAE J2945/1 \(on-board performance requirements\)](#)

DSRC V2V Use Cases (USDOT, OEMs) – These were tested at the Ann Arbor Safety Pilot

Emergency Electronic Brake Lights (EEBL)

- Brake “on” from several cars ahead sent to subject vehicle

Forward Collision Warning (FCW)

- Alert to elicit hard braking to prevent rear-end crash

Blind Spot Warning/Lane Change Warning (BSW/LCW)

- Alerts of fast-approaching cars from behind (and in adjoining lanes)

Do Not Pass Warning (DNPW)

- Alerts for head-on crashes during passing maneuver

Intersection Movement Assist (IMA)

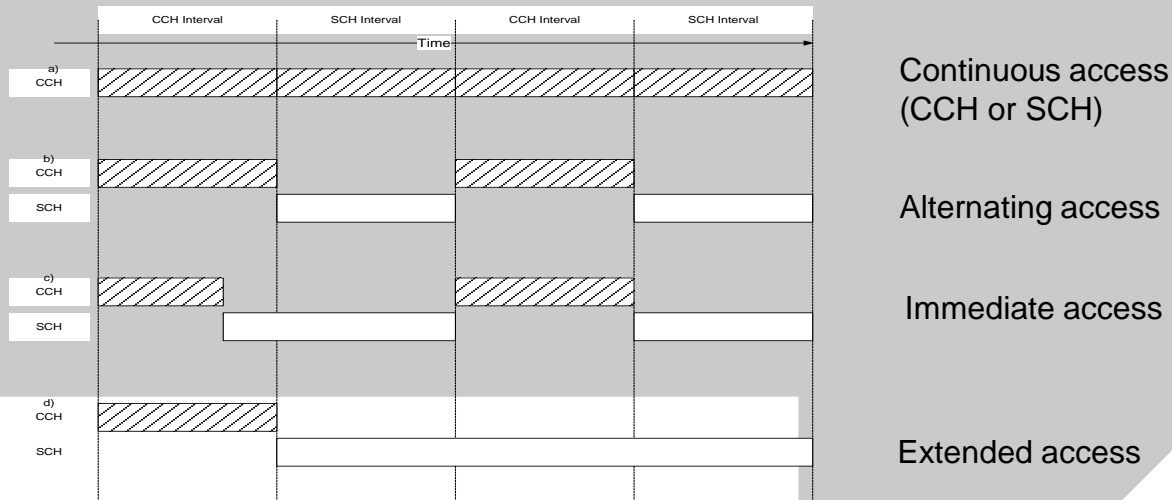
Left Turn Assist (LTA)

Standardization: Essential for Interoperable DSRC Deployment



North America: Impending Notice of Proposed Rulemaking (NPRM) is the gate

- Direct path to V2V...
 - NPRM in 2016, potential mandate announced 2017- 2017, mandatory deployment 2020 – 2021?
 - Potential: > 80% of two vehicle non-impaired vehicle crashes addressed
 - Institute of Electrical and Electronic Engineering (IEEE) and Society of Automotive Engineers (SAE) have just completed “NHTSA critical” standards:
 - IEEE 1609.2 (security), 1609.3 (networking)
 - **SAE J2735 (message sets), SAE 2945.1 (on-board V2V performance, including congestion control)**
- ...enabling an indirect path to V2I
 - Key point: SAE J2945/1 enables ‘always on’ (Ch172) V2V safety messages and potential DSRC mandate → DSRC on-board opens gate for other applications
 - Second DSRC radio needed multi-channel operation (time division concept)
 - Multiple V2I concepts, given rendezvous at control channel (IEEE 1609.4)



What is in J2945/1?

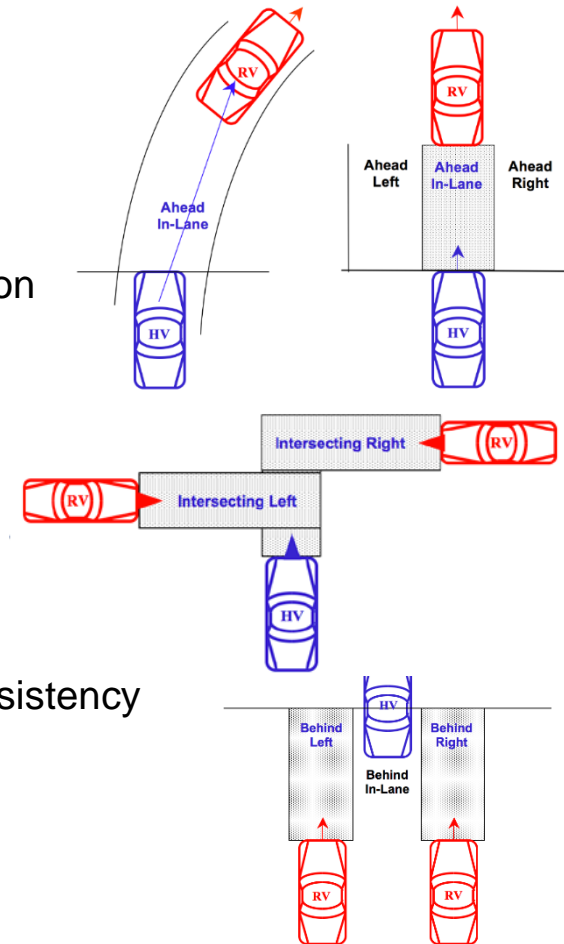
Primary Goal: Target Classification (location, time-to-collision)

Scope: on-board performance requirements

- Transmission (with some exception, e.g., security)
- Does not specify safety applications
...but is based on V2V safety applications

Content:

- V2V Safety Systems Concept of Operations and System Description
 - Mapping of application requirements to requirements
- Interface Description
- Minimum Requirements
 - Compliance: Lower layer (IEEE standards) + SAE J2735 + FCC 47 CFR, Parts 0, 1, 2, 95
 - Positioning and Timing Requirements
 - Basic Safety Message (contents, timing, priorities, accuracy, persistency congestion control)
 - RF Performance
 - Security and Privacy + Security Management
 - Parameter Settings
 - Appendices (informative)



- Time (UTC time)
- Message Count (random starting time)
- Temporary ID (randomized every 5 min)
- Position Data Elements (Latitude, Longitude, Elevation)
- Positional Accuracy (Semi Major Axis, Semi Minor Axis, Semi Major Axis Orientation)
- Transmission State
- Speed
- Heading
- Steering Wheel Angle
- Acceleration (Longitudinal, Lateral, Vertical, Yaw Rate)
- Brake System Status (for each wheel [traction, abs, scs, brakeBoost, and auxBrakes])
- Vehicle Size (Width, Length)

Vehicle Safety Extension

- Vehicle Event Flags

The system shall set the Hard Braking event flag when the corresponding event condition is met (see SAE J2735). If the information is available, the system sets the ABS, Traction Control, and Stability Control event flags when the corresponding event conditions occur, and the system may support additional event flags.

- Path History (200 – 21- m, 15 points max)
- Path Prediction (radius and confidence)
- Exterior Lights

In the J2735 data dictionary today, there are:

- 16 Messages (plus 16 test messages)
- 156 Data Frames
- 231 Data Elements
- ~58 External Elements
- ~65 Places where regional content can be inserted without coordination with others
- ~526 Reusable data concepts

16 Messages

1.	BasicSafetyMessage	(BSM)	Mature
2.	CommonSafetyRequest	(CSR)	Remove
3.	EmergencyVehicleAlert	(EVA)	Fix in J2945/2
4.	IntersectionCollisionAvoidance	(ICA)	Mature/??
5.	MapData	(MAP)	Mature/++
6.	NMEACorrections	(NMEA)	Remove/??
7.	PersonalSafetyMessage	(PSM)	Fix in J2945/9+
8.	ProbeDataManagement	(PDM)	Needs Work
9.	ProbeVehicleData	(PVD)	Needs Work
10.	RoadSideAlert	(RSA)	Needs Work
11.	RTCMcorrections	(RTCM)	Mature
12.	SignalPhaseAndTiming Message	(SPAT)	Mature
13.	SignalRequestMessage	(SRM)	Mature
14.	SignalStatusMessage	(SSM)	Mature
15.	TravelerInformation Message	(TIM)	Needs Work
16.	TestMessages		

Other (Current and Future) SAE DSRC Technical Committee Activities

SAE J2945 / Documents

J2945 / 0 Dedicated Short Range Communication (DSRC) Minimum Performance Requirements (also called “base” or “slash zero”)

J2945 / 1 On-board Minimum Performance Requirements for V2V Safety Systems

J2945 / 2 DSRC Requirements for V2V Safety Awareness

J2945 / 3

J2945 / 4

J2945 / 5

J2945 / 6 Performance Requirements for Cooperative Adaptive Cruise Control and Platooning (TBD: probably recommended practice)

J2945 / 7

J2945 / 8

J2945 / 9 Performance Requirements for Safety Communications to Vulnerable Road Users (recommended practice)

Committee prioritizing 2016 standardization plan. Candidates:

- V2I (Traveler Information Message, Probe Data Management, Probe Vehicle Data, Roadside Alert)?
- Security Management?
- Map Management?
- Data Distribution?
- System Monitoring?

Additional Resources: USDOT funds SAE contract team to help Committee, considering:

- Public good
- Foundational
- Requirements clear
- Champions and experts available
- Sufficiently Mature
- Consistent w/ USDOT Policy

Committee Discussion and Consensus

