



# SAE J2735 DSRC Message Dictionary Overview

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- SAE J2735 (Rev002)
  - Message set & data elements/frames dictionary
  - Focus on 5.9GHz DSRC communication use however does not exclude other communication channel/technology use
  - Follow ASN1 and DER-BER encoding scheme

\* Message usage and performance requirements are addressed in SAE J2945 draft. Currently working on J2945.1 Basic Safety Message for V2V safety application use.

# J2735 Defined Messages

ID	Messages	Typical Use	Status
0	Reserved	N/A	
1	MSG_A_Ia_Carte	V2X	
2	MSG_BasicSafetyMessage (BSM)	V2V	Used by USDOT program & other ITS industry research
3	MSG_CommonSafetyRequest	V2?	
4	MSG_EmergencyVehicleAlert		
5	MSG_IntersectionCollisionAvoidance	V2X	
6	MSG_MapData	I2V	Based on USDOT/CAMP CICAS-V project. Used by various demo/research program
7	MSG_NMEA_Corrections	I2V	
8	MSG_ProbeDataManagement	I2V	Used by VII Proof of Concept (PoC) project
9	MSG_ProbeVehicleData	V2I	Used by VII PoC project
10	MSG_RoadSideAlert		
11	MSG_RTCM_Corrections <small>Radio Technical Commission for Maritime services 无线电技术委员会海事服务</small>	I2V	Based on USDOT/CAMP CICAS-V project. Used by various demo/research program
12	MSG_SignalPhaseAndTiming	I2V	Based on USDOT/CAMP CICAS-V project. Used by various demo/research program
13	MSG_SignalRequestMessage	V2I	
14	MSG_SignalStatusMessage	I2V	
15	MSG_TravelerInformation Message	I2V	Used by VII PoC & will be used in Model Deployment (Curve Speed Warning)

# MSG\_BasicSafetyMessage (BSM)

- Frequently broadcasted among vehicles. Meet V2V safety application needs

Data elements/frames		Description	Remarks
Part I	DSRCmsgID		
Part I: BSM Blob (Octet string)	MsgCnt		
	TemporatyID		
	DSecond		
	Latitude		
	Longitude		
	Elevation		
	PositionalAccuracy		
	TransmissionAndSpeed		
	AccelerationSet4Way		
	BrakeSystemStatus		
	VehicleSize		
Part II	SafetyExtension		Optional
	VehicleStatus		Optional

# DF\_SafetyExtension & DF\_VehicleStatus

- Designed to send additional vehicle data as needed, at equal or reduced transmission interval

Data item	Detail	Remarks
DF_SafetyExtension	EventFlag	
	PathHistory	
	PathPrediction	
	RTCMPackage	

Data item	Detail	Remarks
DF_VehicleStatus	ExteriorLight	
	WipperStatus	
	ThrottlePosition	
	VehicleData (VehicleHeight,BumperHeights,VehicleMass, VehicleType...)	

# MSG\_SignalPhaseTiming (SPaT)

## SPAT

- DSRCmsgID,
- Intersection ID
- Intersection Status
- List of movement states with lanes assoicated

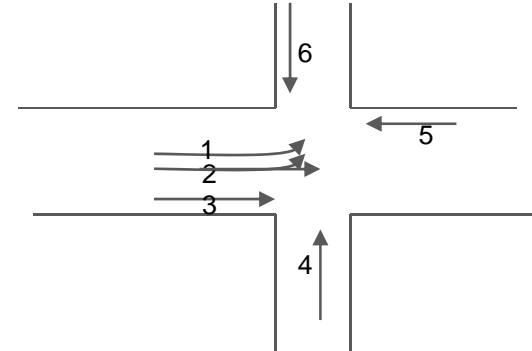
Example:

Movement1=left turn

Lane 1,2

Movement 2=straight

Lane 2,3



## Movement state

- Movement name
- List of lane numbers in this movement
- Signal/pedestrian state
- Time to change
- Yellow state
- Yellow time to change
- Pedestrian detected/ped cnt...

	Green	Yellow	Red	Flashing
Ball	0x00000001	0x00000002	0x00000004	0x00000008
Left Arrow	0x00000010	0x00000020	0x00000040	0x00000080
Right Arrow	0x00000100	0x00000200	0x00000400	0x00000800
Straight Arrow	0x00001000	0x00002000	0x00004000	0x00008000
Soft Left Arrow	0x00010000	0x00020000	0x00040000	0x00080000
Soft Right Arrow	0x00100000	0x00200000	0x00400000	0x00800000
U-Turn Arrow	0x01000000	0x02000000	0x04000000	0x08000000

# MSG\_SignalPhaseAndTiming Detail

- Convey the current status of 1 or more signalized intersections
- Along with MSG\_MapData message, the receiving device can determine the state of the signal phasing and when the expected next phase will occur

Data elements/frames		Description	Remarks
DSRCmsgID			
DescriptiveName		Human readable name (for debug use)	Optional
Sequence of intersections		Up to 32 sets of intersection SPaT data	
Intersection 1 state			
	DescriptiveName	Human readable name (for debug use)	Optional
	IntersectionID		
	IntersectionStatusObject	General status (1 byte string): manual control enabled; stop time activated; intersection in conflict flash; preempt active; transit signal priority active; reserved; reserved; reserved	Optional
	TimeMark		Optional
	StateCnt	Number of movement states to follow	Optional
	States	Sequence of movement state. See next page for detail	
	Priority	Active priority status, if present	Optional
	Preempt	Active preemption state data, if present	Optional
Intersection 2 state			
...			
Intersection n state			

# Data Frame Detail: DF\_MovementState

- Convey the current signal state of a designated collection of one or more lanes of a common type.

Data elements/frames	Description	Remarks
DF_MovementState		
MovementName		Optional
LaneCnt		Optional
LaneSet	Sequence of one or more lanes	
CurrentSignalLightState	See next page for detail	
PedLightState		
SpecialSignalState		
TimeToChange		
StateConfidence		Optional
YellowState	Yellow phase time intervals.	Optional
YellowPedState	Ped. yellow phase intervals	
YellowTimeToChange		Optional
YellowStateConfidence		Optional
VehicleCount		Optional
PedDetect		Optional
PedCount		Optional



# DE\_SignalState Detail

- Current general state of the signal system
  - The state is currently active or not
  - The preempt or priority value
- Acknowledge preemption and priority
- May have multiple states to relate for a single signal/intersection

# DE\_SignalLightState Detail

## *Signal Phase Indications Encoding*

	Green	Yellow	Red	Flashing
Ball	0x00000001	0x00000002	0x00000004	0x00000008
Left Arrow	0x00000010	0x00000020	0x00000040	0x00000080
Right Arrow	0x00000100	0x00000200	0x00000400	0x00000800
Straight Arrow	0x00001000	0x00002000	0x00004000	0x00008000
Soft Left Arrow	0x00010000	0x00020000	0x00040000	0x00080000
Soft Right Arrow	0x00100000	0x00200000	0x00400000	0x00800000
U-Turn Arrow	0x01000000	0x02000000	0x04000000	0x08000000

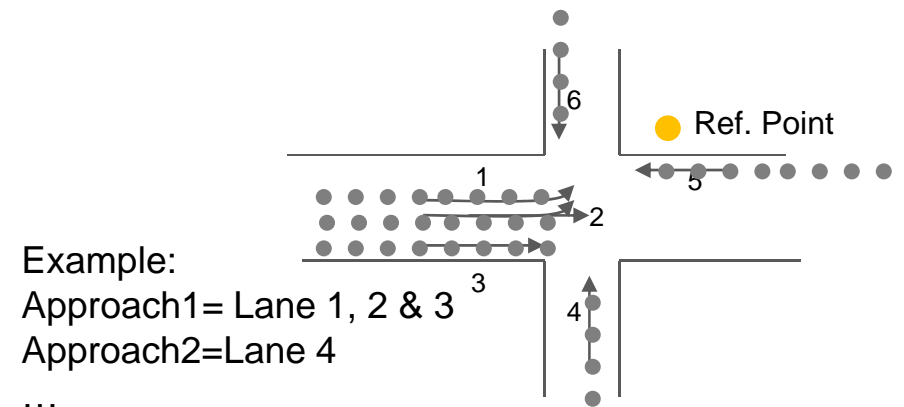
\* Note: DARK = 0x00000000

The Signal Light State value is built by ORing the various bitmasks together for that approach.

Examples:      Solid Green Ball = 0x00000001, transmitted as 0x01  
                  Flashing Green Ball = 0x00000009, transmitted as 0x09  
                  Solid Red Ball with Green Right Arrow = 0x00000104, transmitted as 0x0104

# MSG\_MapData

- Wrapper object to relate all types of maps such as intersection map, high speed curve outlines, segment of roadway



Data elements/frames	Description	Remarks
DSRCMsgID		
MsgCnt		
DescriptiveName		Optional
LayerType		Optional
LayerID		Optional
Sequence of intersection	Up to 32 intersections	Optional
DescriptiveName		Optional
IntersectionID		
Ref. Point	3D positional data of the reference point	Optional
RefInterNum	Present only if it is a computed intersection	Optional
Orientation	Present only if it is a computed intersection	Optional
LaneWidth		Optional
Type	As intersectionstatus object	Optional
Sequence of approaches	See DF_ApproachesObject for detail (next page)	
Sequence of preemptZones		Optional
Sequence of priorityZones		Optional
DataParameters		Optional
MsgCRC		

# DF\_ApproachesObject

- Associates a set of related approaches and egresses with each other in an intersection
- These approaches then define lanes with properties
- Lane number is the key assignment used to map to movement state in SPaT
- Lane number & intersection number as a set, represent a unique path of travel throughout the link

Data elements/frames	Description	Remarks
RefPoint	Ref. point from which subsequent data points in this link are offset	Optional
LaneWidth	Ref. width used by subsequent lanes until a new width is given	Optional
Approach		
DescriptiveName		Optional
ApproachID		
Sequence of drivingLanes		
Lane Number		
LaneWidth		Optional
VehicleLaneAttributes	Bitmask of allowed maneuvers : straight/left/right/yield/NoUTurn/NoTurnOnRed/NoStop/HOV/BusOnly/Bus&TaxiOnly/SharedLane/2WayLeftTurnLane/BikeLane	
NodeList		
KeepOutNodeList		Optional
A list of lanes connected to		Optional
Sequence of computedLanes		Optional
Sequence of TransAndBusLanes		Optional
Sequence of BarrierLanes		Optional
Sequence of CrosswalkLane		Optional
Egress		Optional

# MSG\_RTCM\_Corrections

- Encapsulate RTCM differential correction for GPS and other radio navigation signals as defined by RTCM special committee number 104 in tis various standards

Data elements/frames		Description	Remarks
DSRCMsgID			
MsgCnt			
RTCM Revision			
anchorPoint		Precise observer position, if needed	Optional
RTCMHeader		Octets of GPSStatus+antennaOffsets(XYZ)	
Sequence of RTCM messages		1-5	
	RTCM-Revision		Optional
	RTCM-ID		Optional
	RTCM-Payload		

# MSG\_ProbeDataManagement

Sent from RSU to OBU to change the snapshot generation characteristics of the OBU.

- Direct the management message to vehicles moving in specified directions
- Control how often snapshots are transmitted
- Be applied to only a random sample of vehicles
- Modify the thresholds of when event snapshots are triggered
- Modify the thresholds of start/stop snapshots

Data elements/frames	Description	Remarks
DSRCmsgID		
Sample	Vehicle population affected	
HeadingSlice	Applicable directions	
TermTime	Time to live	
TermDistance	Distance to live	
SnapShortTime		
SnapShotDistance		
TimeInterval	Interval at which to send snapshots	
Count	# of thresholds that will be changed	
Sequence (1-32) of vehicleStatusRequest	Lights/wiper/brakes/TC/ABS/ESC/rain/temp/steering/accel/yaw/obstacle/position/speed/heading...	

# MSG\_ProbeVehicleData

- Exchange status about a vehicle to typically an RSE to allow collection of vehicle traveling behavior along a segment of road
- Typically the vehicle collects one or more snapshots and send to a RSU about the point in time and space when the snapshots were taken
- Snapshots can be triggered by event/period of time/start&stop or some other occasions

Data elements/frames		Description	Remarks
DSRCmsgID			
ProbeSegmentNumber			Optional
Probe or Vehicle ID			Optional
StartVector		Space and time of transmission to the RSU	
VehicleType			
Count		# of snapshots to follow	
A sequence (1-32) of snapshots		A sequence of name-value pairs, space and time	
	Position & speed		
	VehicleSafetyExtension	EventFlags, PathHistory, PathPrediction, RTCM Pkg	Optional
	Seq. of VehicleStatus	Light, wiper, steering, throttle...	Optional