
# SAE J2735 DSRC Message Dictionary Overview

# SAE J2735 DSRC Message Dictionary Overview

- 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_la_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 | 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 | |

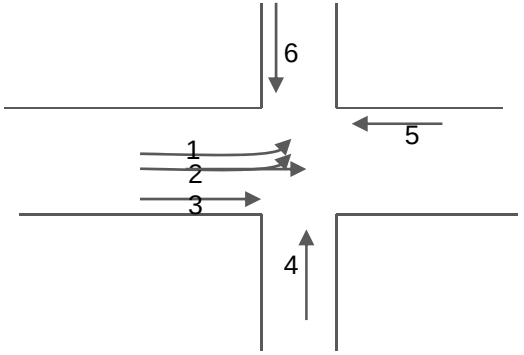
| Data item | Detail | Remarks |
|---|---|---|
| DF_VehicleStatus | ExteriorLight | |
| | WipperStatus | |
| | ThrottlePosition | |
| | VehicleData (VehicleHeight,BumperHeights,VehicleMass, VehicleType…) | |

# 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/pedestrain 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.

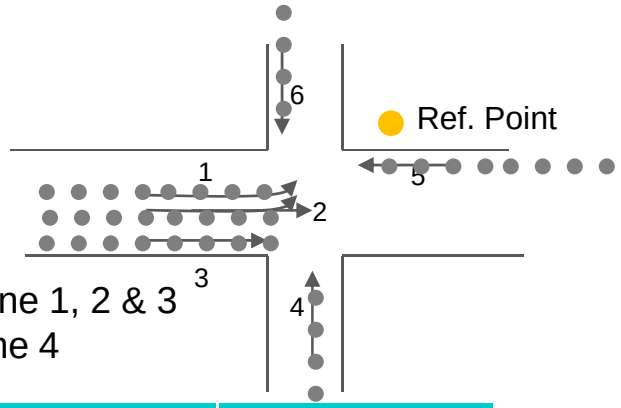
Examples: Solid Green Ball = 0x00000001, transmitted as 0x01

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




Example:
Approach1= Lane 1, 2 & 3
Approach2=Lane 4
…

| 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 maneuvors : 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 snap shots | |
| Count | # of thresholds that will be changed | |
| Sequence (1-32) of vehicleStatusRequest | Lights/wiper/brakes/TC/ABS/ESC/ rain/temp/steering/accel/yaw/obst acle/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 |