DRIVE Sweden Innovation Cloud interpretation of utilization of the SAEJ2735 ISO 19091

Revision History

Version	Date	Author(s)	Revision Notes
0.1	2018-04-05	Anders Brolien, Volvo Cars Magnus Johansson, Scania Vijay Nagaraja Lyengar, Ericsson	Created in KRABAT Arbetsmöte #2 at Scania in Södertälje 2017-04-05
0.2	2018-04-30	Anders Brolien, Volvo Cars Magnus Johansson, Scania Vijay Nagaraja Lyengar, Ericsson Johan Östling, RISE	Re-formatting the rev 0.1 into WORD format. Small change of facts and content. Added subscription format.
0.3	2018-05-24	Magnus Johansson, Scania Vijay Nagaraja Lyengar, Ericsson Johan Östling, RISE	Small adjustment regarding "State-time-Speed" and the "id" of "region"
0.4	2018-09-05	Henrik Segesten Rickard Arvidsson Anette Westerlund Niklas Åkerblom, Volvo Cars	Added moy Added maxEndTime Added LaneWidth
0.5	2018-10-02	Vijay Nagaraja Lyengar, Ericsson	Added comment to be commented
0.6	2018-11-06	Vijay Nagaraja Lyengar, Ericsson Johan Östling, RISE Viktoria	Added comment about *Lanewidth and dWidth*
0.7	2019-08-27	Representation from: Swarco, Volvo Cars, Zenuity, Scania, Ericsson, city of Gothenburg, City of Uppsala, RISE	Corrected in MAP at maneuvers Corrected comment in MAP at SignalGroup

Content

Abbreviations and Acronyms

Abbreviation	Description
AMQP	Advanced Message Queuing Protocol
DSRC/WAVE	Dedicated Short Range Communications for Wireless Access
OEM	Original Equipment Manufacturer
SPaT	Signal Phase and Timing
MAP	MAP data (location)
DS IC	Drive Sweden Innovation Cloud
C-ITS	Cooperative Intelligent transport systems ITS ISO/TS 19091
ASN.1	ISO standard https://www.iso.org/standard/68350.html
UPER	Unsigned Packed Encoding Rules
RSMP	Road Side Message Protocol http://rsmp-nordic.org/
NTP	Network Time Protocol

Background

Today there is a mix of different data format that are available from different sources regarding "Traffic Light data" from the different road authorities in the project.

This document appointing the goal of the Drive Sweden project KRABAT WP7 connected Traffic signals data format. Due to high requirements on "open data", quality, timing etc. we need to use available certified standards from the source to the service in the car or elsewhere.

This document describes what standardized messages in specific, that should be used and be communicated over different wireless communications technology, namely a standard internet connection between two or more systems, in the DRIVE SWEDEN program www.drivesweden.net.

The current scope is limited to the two message types used for transport traffic lights data, namely the MAP and SPAT messages. The document is also in detail focusing in what parameters/fields that **MUST** be used, beside if the parameter is MANDATORY or OPTIONAL from a SAE J2735 perspective, in order to support TTG, GLOSA and other C-ITS services.

The SAE J2735 standard describes the communication pattern and messages for several infrastructural and traffic measurements applications. The communication mechanism used in the standard is the 5.9 GHz Dedicated Short Range Communications for Wireless Access in Vehicular Environments (DSRC/WAVE), referenced in this document simply as DSRC. Although the scope of the standard is DSRC it is clearly stated that the message structures are designed to be used with other wireless communications technologies as well like 5G etc.

References

[1]   Society Automobile Engineer, SAE J2735 DSRC 201603

[2]   ISO/IEC 19464:2014 Advanced Message Queuing Protocol (AMQP) v1.0 specification

[3]   Drive Sweden Innovation Cloud IT-architecture.

Traffic Lights Service specification

The high level integration combines two services: the MAP service where the OEM retrieves information on traffic intersections geographical position and the SPAT service where signal and timings for each traffic intersection traffic signal is published. The sequence diagram on next page illustrates the overall flow of messages. The communication follows a publish-subscribe pattern and is realized with the AMQP 1.0 protocol. The Traffic Light Service are initially created to handle the Drive Sweden Innovation Cloud projects and development and the purpose is to provide C-ITS services e.g TTG and GLOSA.

Time requirements for different function gives that the updated information must reach the TrafficSignalsConsumer in less than one second after the change occurs.

In order to meet this tough latency requirement, we shall use ASN.1 UPER and AMQP 1.0.

The services shall be available through the DRIVE Sweden Innovation Cloud. The Innovation Cloud, IC, through a number of API:s.

The service will be as described above be available through an API service. On next page there is a picture and description how it works more in detail.
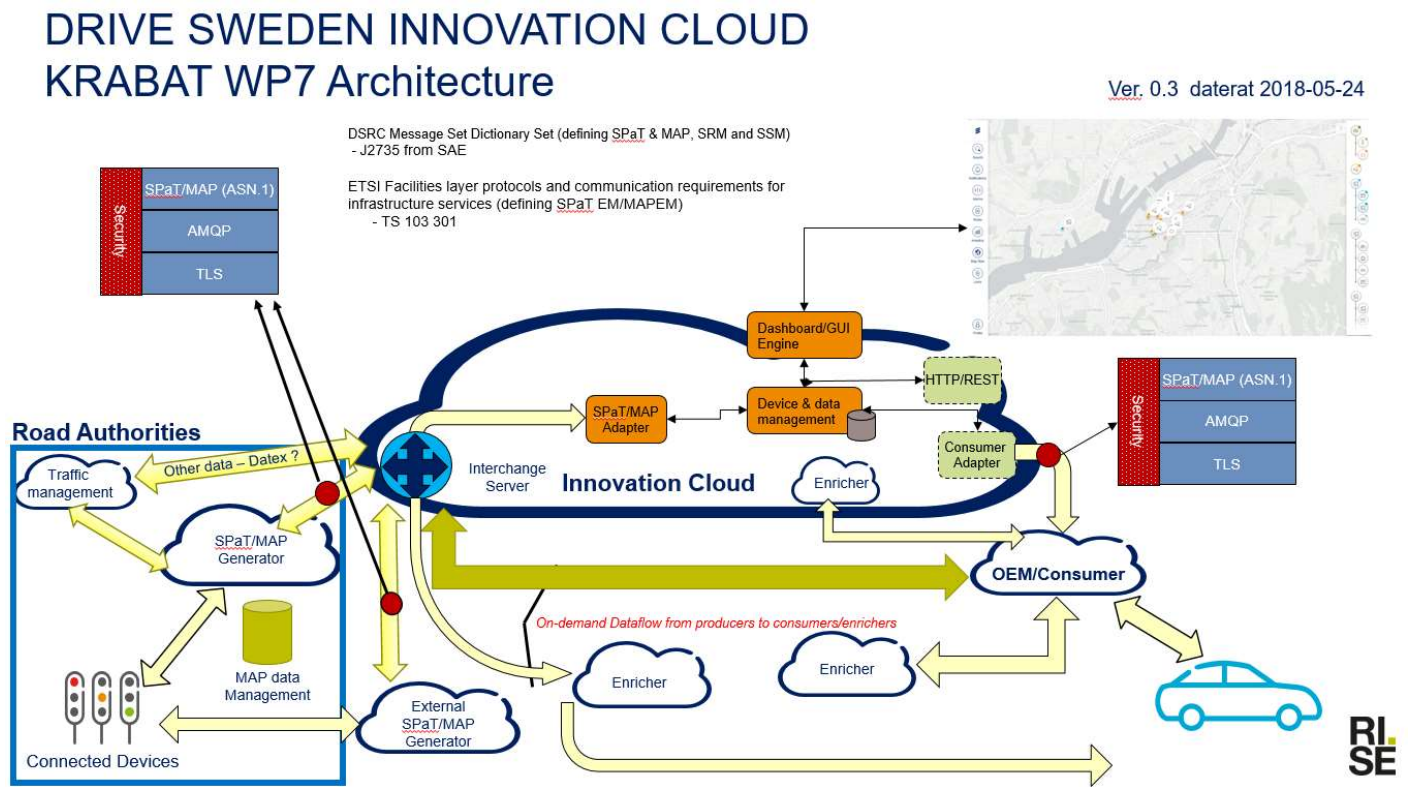
Picture 1. Drive Sweden Innovation Cloud

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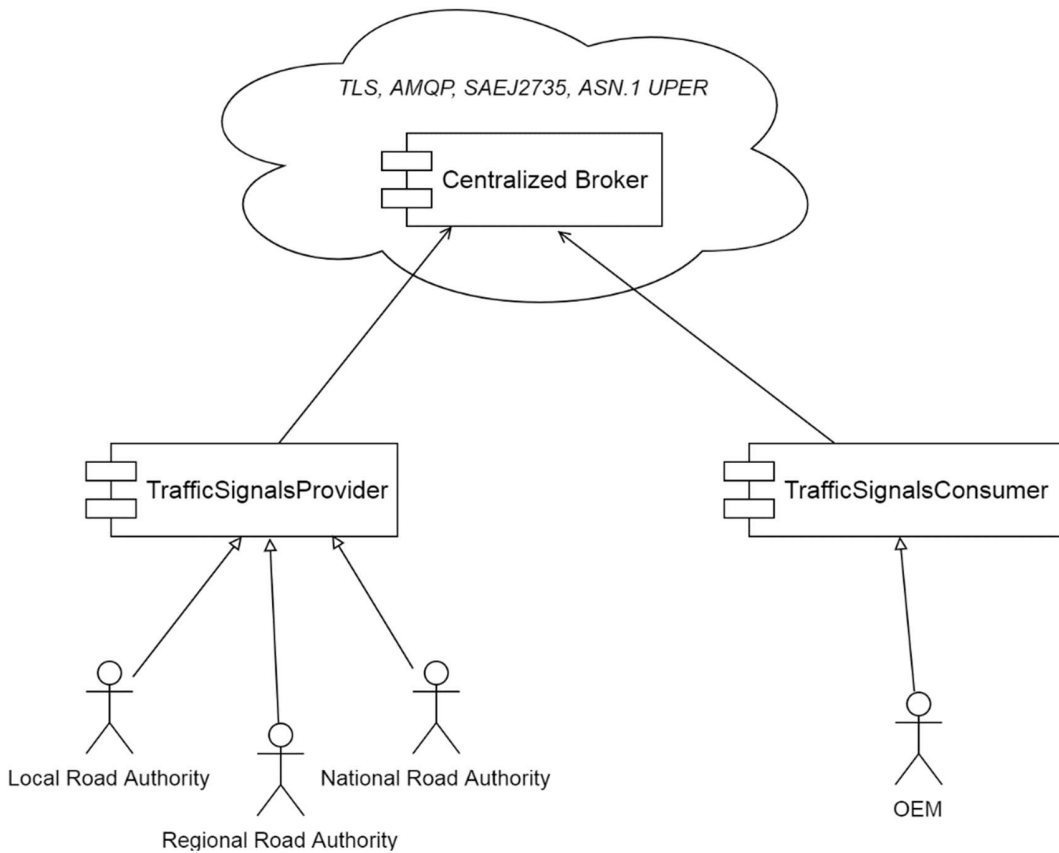
Picture 2. Centralized Broker

The Centralized Broker provides the following functionality:

- storage of MAP messages
- geographic subscription of MAP messages
- subscription of SPaT data based on a region (or locode)
- distribution of MAP and SPAT data to subscribers.
  - MAP data initially distributed on subscription time and then on change

Subscription routine of SPaT and MAP service

To support an ecosystem of different data producers and data consumers of MAP & SPaT data, there is a need to define AMQP Application Properties to achieve the desired routing, filtering. The region (locode) will be the start of the subscription request. Today we have JSON and XML up and running but the goal is to support ASN.1 UPER shortly. To be able to support following application headers/properties are added to the AMQP message:

- *x-dsic-identifier (relation), Base64 encoded,*
  - *Example: c3dlY286ZXJpY3Nzb24k, which is "sweco:ericsson$"*
- *x-dsic-content (how), spat/map, version,*
  - *Example: spat/0.0.1 where spat identifies the content , version is MajorVersion.MinorVersion.PatchRelease. Allowed contents are spat, spatem, map & mapem.*

- *x-dsic-locode (where1)*
  - *Example: "SEGOT" or "463*
- *x-dsic-timestamp (when) UTC timestamp*
  - *Example: UTC in seconds*

SPaT Data

Field	Type	Required in Drive Sweden	Mandatory/ Optional in J2735	Comments
timeStamp		**Yes**	Optional	Not accurate enough for latency. Will have to use AMQP headers
intersections		**Yes**	Mandatory	
	Revision	**Yes**	Mandatory	
	Id	**Yes**	Mandatory	
	Id	**Yes**	Optional	
	Region	**Yes**	Optional	Need to be Global unique. "Country number" + "Road authority" Example "461" = Trafikverket in Sweden. "Country number" "45" for Denmark, "46" for Sweden, "47" for Norway and "358" for Finland "Road authority" 1 = Trafikverket 2 = Stockholm 3 = Göteborg 4 = Uppsala 5 = Oslo 6 = Trondheim 7 = Copenhagen 8 = Helsinki
	Status	**Yes**	Mandatory	
	enabledLanes	**Yes**	Optional	
	Moy	**Yes**	Optional	Required to get an absolute point in time.

Field	Type	Required in Drive Sweden	Mandatory/ Optional in J2735	Comments
	Timestamp	**Yes**	Optional	Required milliseconds
	States	**Yes**	Mandatory	
	signalGroup	**Yes**	Mandatory	
	state-time-speed	**Yes**	Mandatory	
	eventState	**Yes**	Mandatory	This is the actual permitted movement
	timing	**Yes**	Optional	Required for GLOSA, TTG and Smart Start/Stop engine. Note: For some intersections it is very hard to give a useful prediction (Vijay comment) it´s better to have ONE timing. Ability to use e.g. 36001 which means UNKNOWN or UNAVAILABLE
	minEndTime	**Yes**	Mandatory	
	likelyTime	**Yes**	Optional	Required for GLOSA, TTG and Smart Start/Stop engine.
	maxEndTime	**Yes**	Optional	Required for Smart Start/Stop Engine (Vijay comment) it´s better to have ONE timing. Ability to use e.g. 36001 which means UNKNOWN or UNAVAILABLE
	confidence	**Yes**	Optional	Required for GLOSA, TTG and Smart Start/Stop engine. If timed traffic signals conf. = 100%
	Speeds	**No**	Optional	This could be interesting to look at as a central GLOSA approach

MAP Data

Field	Type	Required in Drive Sweden	Mandatory /Optional in J2735	Comments
msgIssueRevision		**Yes**	Mandatory	
intersections		**Yes**	Optional	
	revision	**Yes**	Mandatory	
	id	**Yes**	Optional	
	id	**Yes**	Mandatory	
	Region	**Yes**	Optional	Need to be Global unique. Example "461" = Trafikverket in Sweden. "Country number" "45" for Denmark, "46" for Sweden, "47" for Norway and "358" for Finland "Road authority" 1 = Trafikverket 2 = Stockholm 3 = Göteborg 4 = Uppsala 5 = Oslo 6 = Trondheim 7 = Copenhagen 8 = Helsinki
	refPoint	**Yes**	Mandatory	
	laneSet	**Yes**	Mandatory	
	laneId	**Yes**	Mandatory	
	laneAttributes	**Yes**	Mandatory	
	laneType, directionalUse, sharedWith	**Yes**	Mandatory	

Field	Type	Required in Drive Sweden	Mandatory /Optional in J2735	Comments
	LaneWidth	**Yes**	Optional	LaneWidth is a global parameter (Vijay comment) Need also to use dWidth parameter in nodeXY definition
	maneuvers	**NO**	Optional	Align according to C-ITS Delegated act. Use *connectsTo/connectingLane/maneuver* below instead
	nodeList	**Yes**	Mandatory	
	nodes	**Yes**	Mandatory	
	delta	**Yes**	Mandatory	
	connectsTo	**Yes**	Optional	
	signalGroup	**Yes**	Optional	Required if the lane is signalized otherwise should be left out
	connectingLane	**Yes**	Optional	
	maneuver	**Yes**	Optional	