

**UK A2M2 Connected Corridor**

**(Phase 0 - TestFest)**

Baseline specification

Document Control

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# Introduction

## Background

InterCor (Interoperable Corridors) is a European project which aims to connect the C-ITS corridor initiatives of the Netherlands C-ITS Corridor (Netherlands-Germany-Austria), the French corridor defined in the SCOOP@F project, and the United Kingdom and Belgian C-ITS initiatives.

The InterCor project plans to achieve a sustainable network of C-ITS corridors providing continuity and serving as a TestBed for Day-One C-ITS service development and beyond.

InterCor is a 3 year project of 30 million Euros co-financed by the European Union under the Connecting Europe Facility. The project aims to enable vehicles and related road infrastructure to communicate data through cellular, ITS G5 or a combination of both networks on road corridors running through the Netherlands, Belgium, the UK and France. The overall goal is to achieve safer, more efficient and more convenient mobility of people and goods.

InterCor TestFests are aimed at streamlining C-ITS implementation by linking the different national initiatives towards a harmonised set of standards supporting a strategic rollout and use of common specifications.

## Objective

This document gives an overview of standardisation needs for C ITS use cases for the roadside interface using ITS-G5 communication and cellular services (Hybrid Services) for deployment for InterCor TestFest in the United Kingdom.

The standards allow a wide range of implementation possibilities. The objective of this report is to limit the possibilities within these standards to those required and feasible for the A2 M2 Connected Corridor project in the U.K (known as profiling).

The objective of this document is to provide a clear reference for actors supplying V-ITS-S systems (also referred to as OBUs), allowing them to build their systems in such a way that they are compatible with R-ITS-S systems (also referred to as RSUs) or developing cellular service implementations for TestFest.

This document furthermore serves as a baseline for harmonisation of the roadside interface across actors supplying R-ITS-S systems (e.g. road operators) as well as actors supplying V-ITS-S systems (e.g. automotive industry).

## Legend

The chapters containing the actual profiles describe how the data frames (DFs), data elements (DEs) and containers in the DENM, IVI, CAM, SPAT and MAP standards are used within the UK use cases.

The description of the DFs and DEs can be found in [DENM], [IVI] and [CAM]. The description of the DEs and DFs in this document makes use of the descriptions in these standards.

The descriptions are accompanied by Excel files, referenced in the appendices. The Excel files show the full DENM [DENM], IVI [IVI] and CAM [CAM] structures and profiled DF and DE. The Excel files show the different statuses of the DFs and DEs as follows:

* Italic: these are optional in the standard;
* Underlined: one of these can be chosen (OR);
* Bold: required by the standard;
* Dark Pink: used;
* Light Pink: not used.

The tables in section 3 use the following references with respect to the 'status' within the profile. Note that the use of 'status' may differ for RWW, IVS, or PVD. For RWW and IVS information the profile choices are made by the road operator (UK), for PVD information the choices are made by others. Also for the CAM excel file the status applies for the UK OBU only.

The tables in section 3 show the fields that **will be used** by the UK profile. In some cases, the values will be set to ‘unavailable’ but the field should be present. They have the following status definitions.

* **Mandatory**. This DF, DE or container is mandatory in the standard and is thus always provided. These fields are highlighted in **bold**.
* **Profiled**. For this DF, DE or container specific choices have been made to use these fields in the UK profile even though they are optional in the standard. This data should be seen in the UK TestFest data. These fields are highlighted in *italics*.

## Abbreviations

|  |  |
| --- | --- |
| **Abbreviation** | **Meaning** |
| AG | Amsterdam Group |
| bPVD | basic Probe Vehicle Data |
| CAM | Cooperative Awareness Message |
| C-ITS | Cooperative ITS |
| C-ITS-S | Central ITS Station (equivalent to Central Unit (CU)) |
| CRW | Collision Risk Warning |
| DE | Data Element |
| DENM | Decentralized Environmental Notification Message |
| DF | Data Frame |
| DZ | Detection Zone |
| GNSS | Global Navigation Satellite System |
| GLOSA | Green Light Optimal Speed Advisory |
| HMI | Human Machine Interface |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISO | International Organization for Standardization |
| ITS | Intelligent Transport System |
| IVI | In-Vehicle Information |
| IVS | In-Vehicle Signage |
| MAP | Map Data Message |
| MoU | Memorandum of Understanding |
| OBU | Onboard Unit (equivalent to V-ITS-S) |
| PVD | Probe Vehicle Data |
| R-ITS-S | Roadside ITS Station (equivalent to Roadside Unit) |
| RSU | Roadside Unit (equivalent to R-ITS-S) |
| RWW | Road Works Warning |
| RZ | Relevance Zone |
| SPAT | Signal Phase And Timing |
| V-ITS-S | Vehicle ITS Station (equivalent to Onboard Unit) |

## References

|  |  |  |
| --- | --- | --- |
| **Reference** | | **Description, URL** |
| [AG-FD] | Amsterdam Group, Road Works Warning Functional  Description, Version 1.0 | |
| [AG-MS] | Amsterdam Group, Message Set and Triggering Conditions for  Road Works Warning Service | |
| [BTP] | ETSI EN 302 636-5-1 V1.2.1 (2014-08). Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol | |
| [C2C] | CAR 2 CAR Communication Consortium; C2C-CC Basic System profile; Version 1.1.0; Date 21.12.2015 (not public). | |
| [CAM] | ETSI EN 302 637-2 v1.3.2 (2014-11). Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service. | |
| [CC] | | ISO 3166-1:2013 Codes for the representation of names of countries and their subdivisions; Part 1: Country codes. |
| [Channel] | ETSI TS 102 724. Harmonized Channel Specifications for Intelligent Transport Systems operating in the 5 GHz frequency band. | |
| [Concept] | RWS, Description of the System Concept, June 2016 | |
| [DCC] | ETSI TS 102 687 (2011-07). Decentralized Congestion Control Mechanisms for ITS-G5 (DCC) | |
| [DENM] | ETSI EN 302 637-3 v1.2.2 (2014-11). Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service. | |
| [Dictionary] | ETSI TS 102 894-2 v1.2.1 (2014-09). Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary | |
| [DSRC] | | ETSI 102 792. Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range. |
| [GN] | ETSI EN 302 636-4-1 V1.2.1 (2014-07). Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality. | |
| [IVI] | ISO TS 19321:2015 (2015-04-15). Dictionary of in-vehicle information (IVI) data structures. | |
| [MoU] | Memorandum of Understanding (MoU) on Cooperative ITS Corridor Joint deployment. | |
| [Num] | | ISO 14816:2005 Road transport and traffic telematics; Automatic vehicle and equipment identification; Numbering and data structure. |
| [RA] | IEEE Registration Authority at <http://standards.ieee.org/develop/regauth/ethertype/eth.txt> | |
| [Radio] | ETSI 302 571. Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU. | |
| [RHS] | ETSI TS 101 539-1 V1.1.1 (2013-08). Intelligent Transport Systems (ITS); V2X Applications; Part 1: Road Hazard Signalling (RHS) application requirements specification. | |
| [RoadSigns] | ISO/TS 14823. Traffic and travel information; Messages via media independent stationary dissemination systems; Graphic data dictionary for pre-trip and in-trip information dissemination systems. Temporal version 21\_July\_2016. <http://standards.iso.org/iso/ts/14823/> | |
| [SHC] | ETSI TS 103 097 V1.1.1 (2013-04). Intelligent Transport Systems (ITS); Security; Security header and certificate formats. | |
| [Standards] | Overview of Standards for First Deployment of C-ITS. | |
| [WLAN] | IEEE 802.11-2012. IEEE Standard for Information technology; Telecommunications and information exchange between systems Local and metropolitan area networks; Specific requirements; Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification. | |

# Scope

This document has a limited scope, it covers C-ITS Day 1 services that will be deployed for the UK A2 M2 Connected Corridor Phase 0 (TestFest) only. This chapter describes the specific scope of this document.

## U.K Situation

The UK hybrid InterCor TestFest is being delivered by Highways England, Transport for London (TfL) and Kent County Council. The scope of the InterCor use cases that will be supported by this UK implementation are as follows, however please note the ‘Winter maintenance – Salting in progress’ use case will not be evaluated in the UK TestFest scenarios:

|  |  |  |
| --- | --- | --- |
| **Service** | **InterCor Use Case** | **Communications** |
| **RWW** | Lane closure or other restrictions | ITS-G5 & cellular |
| Alert planned closure of a road or a carriageway | ITS-G5 & cellular |
| **IVS** | In-vehicle signage dynamic speed limit information | ITS-G5 & cellular |
| In-vehicle signage embedded VMS | ITS-G5 & cellular |
| Dynamic Lane Management - Lane Status information | ITS-G5 & cellular |
| **PVD** | Traffic data collection | ITS-G5 only |
| **GLOSA** | Time-to-green information and speed advice | ITS-G5 & cellular |
| Time-to-red information and speed advice | ITS-G5 & cellular |

## Assumptions

This UK profile is based on the following assumptions:

* Traces and zones are assumed to be carriageway based.
* For DENM messages:
  + all fields in the management container will be used except termination.
  + the ‘location container’ is always used, however within this container traces are not always used.
  + the ‘situation container’ is always used.
  + the ‘alacarte roadworks container’ (including DEs closed lanes, speed limit and traffic flow rule) is used.
* Accurate speed limit information leading into a DENM roadwork warning will be provided by IVI messages although a speed limit value will also be provided in the DENM message for the extent of the roadworks.
* DENM roadworks lane information will be provided in the order assumed by the standard e.g. the first bit in the bit string will be the fastest lane next to the central reservation of the road.
* IVI messages can contain multiple roadsign pictogram codes or extra text for a single location. Extra text will only appear within a message when an undefined blank roadsign pictogram code is used.
* The lane information within an IVI message is specific to a gic part.HMI of the vehicles involved in the UK TestFest will need to interpret the Lane information to display it correctly.
* R-ITS-S (RSUs) will not send on CAM messages to central stations but will log receipt.
* For TestFest it is expected that only CAM messages and no DENM messages will be broadcasted by the vehicles.
* Propagation will not be used for TestFest i.e. single hop broadcast only.

## Use Cases IVS, RWW, PVD, GLOSA

The tables below describe the specific fields of the IVI, DENM, CAM, SPAT and MAP message types that the UK will use to support the IVS, RWW, PVD and GLOSA services. Note only the values being used are shown below. To understand the coverage of the UK profile compared to the standards, please see appendices D, E and F.

# 

# Facility Layer

## In-Vehicle Signage (IVS)

This section describes the profile for the In-Vehicle Signage (IVS) use case. See section 1.3 Legend for the meaning of the references and Annex D for an overview.

### IVS IVI Profile

| ID | IVI standard | | UK Profile | | | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Field | Meaning | Status | Content | Value | |
|  | **Header** | | | | | |
| **IVI 1** | **protocol-Version** | **Version of the protocol.** | **Mandatory** | Fixed value. Current version is 1. | Set to 1. | |
| **IVI 2** | **messageID** | **Indicates the type of message.** | **Mandatory** | Fixed value. Examples are DENM (1), CAM (2), IVI (6), etc. Here (6) is used. | Set to 6. | |
| **IVI 3** | **stationID** | **This is the ID of the station broadcasting the message.** | **Mandatory** | ETSI 102 894-2 states the following:  Identifier of an ITS-Station INTEGER (0..4294967295). The identifier of the ITS-S that generates the ITS message in question.  TfL only have one station (ITS-C) hence generated an ID following the ISO-19091 approach of regulator ID and intersection ID which should work. To generate the Regulator ID the numbers which represent TFL, HE and KCC on a keypad are used and appended values 000001-999999 afterwards.  HE Country A = 43000001  TfL Country A = 83500001  Kent Country A = 52200001  Country B = will use ‘Z’, ‘Z’ so stationID will be 99000001 | 43000001 (HE)  52200001 (Kent)  83500001 (TfL)  99000001 ('ZZ' Country B) | |
|  | **Management container** | | | | | |
| **IVI 4** | **service-ProviderId** | **Identifies the organization that provides the IVI by using the DE Provider; contains a country code according to [CC].**  **Also includes an IssuerIdentifier.** | **Mandatory** | Numbers shall be assigned on national basis. See [Num] for registration.  Dutch have used appended ITA-2 alphabet codes for ‘N’ and ‘L’ to create an 8 bit binary value for country code.  UK can follow suite, using ‘G’ and ‘B’.  Note this will be the same for each partner (TfL, Kent and HE). Also as this needs to be different for Country B, this will use ‘ZZ’ private use code.  In terms of IssuerIdentifier this is as follows:  HE=2000  TfL=31  Country B=99 | Country A Country Code = 01011 10011  Country A IssueIdentifiers:  HE = 2000  TfL=31  Country B (ZZ) =10001 10001  Country B IssueIdentifiers:  ZZ = 99 | |
| **IVI 5** | **ivi-Identification-Number** | **This DE is the identifier of the IVI Structure, as assigned by the Service Provider. This component serves as the ID of the message and can be used by other related messages as a reference.** | **Mandatory** | Will be using one message for the status of all signs on a carriageway gantry. The ID values will be unique for the individual messages.  Note the IVI identification number will change for each ‘New’ message, but will stay the same for ‘Update’ messages. | Set by application. | |
| *IVI 6* | *timestamp* | *This DE is the timestamp of the generation of the IVI message or the last change in information content. The message is valid from this time if validFrom is omitted.* | *Profiled* | Set to millseconds after started of 2004BST 30/08/18 10AM | Set by application. | |
| *IVI 7* | *validTo* | *End time of the validity period of the message duration.* | *Profiled* | After half of the validity period there may be an update setting new validFrom and validTo to keep the IVI going. When done the update stops and the IVI will time out on its own. IVI messages will no longer be displayed when the validTo time is reached.. | Set by application. | |
| **IVI 8** | **iviStatus** | **This component holds the status of the IVI Structure. This can be set to; new, update, cancellation or negation. Is used for message handling.** | **Mandatory** | Can be ‘New’, ‘Update’ and ‘Cancel’. ‘Negate’ is not used. However TestFest is only likely to use ‘New’ and ‘Update’  Clearance to occur when the ValidTo field timestamp expires. It is expected that for each update the ValidTo time will be set to 360 or 720 seconds into the future. | Set by Application | |
|  | **Geographic Location Container** | | | | | |
| *IVI 9* | *Reference-Position* | *Any suitable position which serves as a reference for the definition of a zone.* | *Profiled* | Reference point will be one per message, located at the centre of the carriageway.  For real gantries set the reference position as the centre point of the gantry (lat/lon) per carriageway.  For virtual gantries assume we will just create the data, following the principles for real gantries i.e. centre of carriageway (lat/lon).  The referencePosition will define the start of the relevance zone and end of the detection zone per gantry/virtual gantry.  positionConfidenceEllipsevalues will be set to unavailable (4095 and 3601).  Altitude values will be set to unavailable (800001 and 15) | Lat = provided by data  Lon = provided by data  semiMajorConfidence = 4095  semiMinorConfidence = 4095  semiMajorOrientation = 3601  altitudeValue = 800001  altitudeConfidence = 15 | |
| *IVI 10* | *Parts (1..16)* | *GlcPart (1..16). Up to 16 parts can be defined in one Geographic Location Container.* | *Profiled* | Will be a representation of what is shown on the gantry/virtual gantry e.g. message sign and/or each signal above a lane. | Provided in Data | |
| *IVI 11* | *zoneId* | *Identifier of the definition of the zone, using the DE Zid. Up to 32 IDs can be defined within one IVI structure. There shall be at least 1 zone (i.e. a relevance zone).* | *Profiled* | There will only be two zones per IVI message  The zone labelling will typically be as follows:  Zone 1 = Detection Zone  Zone 2 = Relevance Zone | 1 or 2. | |
| *IVI 12* | *zoneHeading* | *Applicable heading of the zone.* | *Profiled* | Always set to 0 (direction of traffic) | 0 | |
| *IVI 13* | *zone* | *Definition of a zone using the DF Zone consisting of the choice DF Segment, DE PolygonalLine or DF ComputedSegment.* | *Profiled* | Only using polygonalLine Segments with deltaLatitude and deltaLongitude. | Provided in Data | |
| *IVI 14* | *segment/ polygonal/ deltaPositions* | *A sequence of delta positions with respect to the previous position, with latitude and longitude, as coded by the data element deltaPosition. The first point is given as the delta position with respect to the referencePosition in the locationContainer.* | *Profiled* | Multiple delta positions will be provided. Nominally the detection zone will be 500m and the relevance zone 1000m.  The number of delta points will vary depending on the road geometry at the location.  Not using deltaPositionsWithAltitude, absolutePositions and absolutePositionsWithAltitude. | Provided in Data | |
|  | **General IVI Application Container (1..16 GicParts)** | | | | |
| *IVI 15* | *detection-ZoneIds (1..8)* | *List of Identifier(s) of the definition(s) of the Detection Zone(s), using the DE Zid.* | *Profiled* | See Appendix B for zone concept | 1 |
| *IVI 16* | *revelance-ZoneIds (1..8)* | *List of Identifier(s) of the definition(s) of the Relevance Zone(s), to which the IVS Container applies, using the DE Zid.* | *Profiled* | See Appendix B for zone concept | 2 |
| *IVI 17* | *direction* | *Direction of relevance within the relevance zone using the DE direction.* | *Profiled* | See Appendix B for concept | 0 |
| *IVI 18* | *applicable-Lanes (1..8)* | *List of identifiers of the lane(s) to which the IVI Container applies using the DE LaneNumber/LanePosition.* | *Profiled* | The road signs included in RSCode below apply to these lanes. If applicable to all lanes on a carriageway this DE may be absent.  Signal information will be lane specific. Note the relevant section of ETSI 102 894-02 is lanePosition not laneNumber. This needs to be correctly interpreted. The outermost driving lane in the UK is typicxally the fast lane not the slow lane, however have suggested the EU approach is being followed as this is what the standards defines.  So the bit string 0001 sates lane 1 of 4 is closed and lanes 2, 3 and 4 are open. | 1 (outermostDrivingLane)  2 (secondLaneFromOutside)  3 (thirdLaneFromOutside)  4 (fourthLaneFromOutside) |
| **IVI 19** | **iviType** | **Priority of the Container information within the overall context of IVI. This DE is used to determine the priority of the IVI message.** | **Mandatory** | To be set to either 1 or 2. Note there is no use of warning message sets.  1=regulatory Messages  2=traffic-related Information Message | 1 or 2 |
| *IVI 20* | *iviPurpose* | *This informes the receiving ITS-S on how the message should be used. This can be, Safety, Environmental or TrafficOptimisation.* | *Profiled* | Can be 0, 1 or 2  Will use:  0=safety  2=trafficOptimisation | 0 |
| *IVI 21* | *laneStatus* | *Indicates the lane status (e.g. open, closed, mergeR) of the applicableLanes.* | *Profiled* | Will be following the standard. UK regulations would only every use the following:  0=Open  1=Closed  2=Merge Right  3=Merge Left  5=Provisionally Open  For TestFest the values 0, 1 and 2 will be used. | 0, 1, or 2 |
| **IVI 22** | **roadSign-Codes (1..4)** | **This component specifies which road signs are applicable for a Relevance Zone. Road sign codes are dependent on the referenced classification scheme. A sending ITS-S should select the road sign from a catalogue which is known to be supported by a receiving ITS-S. Additional attributes to the road sign code can be added as provided by the options in the Data Frame RSCode.** | **Mandatory** | Codes different to Dutch profile and need to read pictogram code attributes due to MPH vs KPH differences  See Appendix A | See Appendix A |
| **IVI 23** | **RSCode** | **The data frame RSCode shall contain the definition of the road sign code. It allows different options**  **pointing to different pictogram catalogues.** | **Mandatory** | See Appendix A for expected minimum RSCodes from ISO-14823 (2017)  Note these are different to the Dutch codes used.  Also note it is not clear in the standard how the ‘nature’ and ‘serialNumber’ values are produced for the ‘pictogramCategoryCode’, hence have followed the Dutch approach of taking the first digit to be the ‘nature’ value and the next two digits to be the ‘serialNumber’ value. | See Appendix A |
| *IVI 24* | *extraText (1..4)* | *List of text lines associated to the ordered list of road sign codes. Each piece contains language code plus extra, limited-size text in the selected language using the DF text.* | *Profiled* | This is where the free text information will go e.g. “Welcome to country A”  When set the RSCode used will be an undefined code. | Provided by Data |

## Road Works Warning (RWW)

This section describes the profile for the Road Works Warning (RWW) use case. See section 1.3 Legend for the meaning of the references and Annex E for an overview.

### RWW DENM Profile

| ID | DENM standard |  | UK Profile | | |
| --- | --- | --- | --- | --- | --- |
|  | Field | Meaning | Status | **Content** | **Value** |
|  | **Header** | | | | |
| **RWW 1** | **protocol-Version** | **Version of the protocol.** | **Mandatory** | Fixed value, current version is 1. | Set to 1 |
| **RWW 2** | **messageID** | **Indicates the type of message.** | **Mandatory** | Fixed value, examples are DENM (1), CAM (2), IVI (6), etc. Here (1) is used. | Set to 1. |
| **RWW 3** | **stationID** | **This is the ID of the station broadcasting the message.** | **Mandatory** | ETSI 102 894-2 states the following:  Identifier of an ITS-Station INTEGER (0..4294967295). The identifier of the ITS-S that generates the ITS message in question.  TfL only have one station (ITS-C) hence generated an ID following the ISO-19091 approach of regulator ID and intersection ID which should work. To generate the Regulator ID the numbers which represent TFL, HE and KCC on a keypad are used and appended values 000001-999999 afterwards.  HE Country A = 43000001  TfL Country A = 83500001  Kent Country A = 52200001  Country B = will use ‘Z’, ‘Z’ so stationID will be 99000001 | 43000001 (HE)  52200001 (Kent)  83500001 (TfL)  99000001 ('ZZ' Country B) |
|  | **management container** | | | | |
| **RWW 4** | **actionID** | **The actionID consists of DEs originatingStationID (stationID) and sequenceNumber. The first is set to the ID of the station first encountered by a vehicle. The sequenceNumber starts at the first unused value and is increased for each additional DENM message. Together the elements form a unique identifier for each DENM message.** | **Mandatory** | The originating stationID will be one of the stationID listed in RWW3  The HE simulation service will update the sequence number for each ‘New’ message for TestFest. Note there will be no linked DENMs for TestFest.  The actionID will not change for DENMs relating to the same event. I.e. the actionID will remain the same, even if there are updates for the event / DENM. So for each ‘New’ event the actionID will increment by one but for updates the referencetime will need to be checked. | Set by application |
| **RWW 5** | **detection-Time** | **Timestamp at which an event or event update/termination is detected.**  **The DENM message shall be updated as soon as the functional configuration of the road works layout changes (i.e. position of the trailer, etc.) or when its age is greater than or equal to half of the validity duration. The detectionTime time will thus be updated to extend the time the message is valid.** | **Mandatory** | For the DENM repetition, this DE shall remain unchanged. For the DENM update, this DE shall be the time at which the event update is detected. For the DENM termination, this DE shall be the time at which the termination of the event is detected.  detectionTime is initially set at the start time of the event, then reset after expiration of half of validityDuration. repetitionDuration equal to validityDuration. | Set by Application |
| **RWW 6** | **reference-Time** | **This DE refers to the time at which a new DENM, an update DENM or a cancellation DENM is generated.**  **This DE is maintained by the DEN basic service of the originating ITS-S. The parameter referenceTime is the identifier for DENM update referring to a specific actionID. The referenceTime represents the time at which a DENM is generated by the DEN basic service, after receiving the application request. For each DENM update, the referenceTime shall be updated and the value shall be greater than the referenceTime value of the previous DENM update for the same actionID.** | **Mandatory** | Following the DENM standard, the referenceTime shall be set to the time the DENM message is encoded by the application.  This is the time value at which the message is \*encoded\*  Will change with updates | Set by application. |
| *RWW 7* | *termination* | *This DF is used to cancel the DENM from the originating ITS-S (cancellation) or another ITS-S (negation).* | *Profiled* | Termination will be either when the message times out i.e. validity period has been reached or a termination message is sent from a stationID that has previously sent an active DENM message. | Set by application |
| **RWW 8** | **event-Position** | **This DF is of type ReferencePosition (DF A.124 from [Dictionary]). It contains the coordinates (WGS 84) of the position of the event.** | **Mandatory** | For TestFest Lat/Long coordinates will be provided in the test script data. The following data fields will be provided:  Latitude  Longitude  semiMajorConfidence  semiMinorConfidence  semiMajorOrientation | Latitude = provided in data  Longitude= provided in data  semiMajorConfidence = 4095  semiMinorConfidence = 4095  semiMajorOrientation = 3601 |
| **RWW 9** | **Altitude and confidence DEs.** | **Mandatory** | Altitude and confidence DEs are not used and thus set to the ‘Unavailable’ values | altitudeValue = 80001  altitudeconfidence = 15 |
| *RWW 10* | *relevance-Distance* | *Together with relevanceTrafficDirection, this DE forms the relevance area. The relevance area is a geographic area in which information concerning the event is identified as relevant for use. This DE shall be used by the V-ITS-S to determine the alert point, i.e. the point where the information is actually presented to the road user.* | *Profiled* | Set to 2=lessthan5km | 2 |
| *RWW 11* | *relevance-Traffic-Direction* | *This DF indicates for which traffic direction the message is relevant (from the perspective of the sender).* | *Profiled* | Separate message for each carriageway direction. All messages delivered per carriageway.  Set to 1 (upStreamTraffic). | 1 |
| *RWW 12* | *validity-Duration* | *The time at which the message should be deleted with an offset since detectionTime. The validityDuration is set by the originating ITS-S. Therefore it represents an estimation of how long the event may persist. It implies the duration over which the DENM should be kept at the DEN basic service of the receiving ITS-S and the DENM dissemination be maintained in the relevance area or destination area, until the expiration of validityDuration. This DE may be renewed by the originating ITS-S, if the pre-set expiry time has reached to its limit and the originating ITS-S detects that the event persists. The DE is represented as a time offset in the unit of second since detectionTime.* | *Profiled* | The DE validityDuration is set at a fixed value. The DENM message is stopped when validityDuration is reached.  Half of the validityDuration (360 seconds) shall be used as an update interval from the instation to keep messages dsiplayed  Initially set to 720 (seconds). | Set by application |
| *RWW 13* | *transmission-Interval* | *This DE informs the receiving ITS-Ss about the intended transmission interval of two consecutive DENM transmissions. It is used for the forwarding ITS-S operation.* | *Profiled* | Note Single Hop Broadcast (SHB) only | 1 |
| **RWW 14** | **stationType** | **This defines the type of the station broadcasting the DENM.** | **Mandatory** | New value of 32 selected for instations i.e. where no RSU exist (e.g. broadcasting via cellular only). Its mean will be inStationUnit.  roadSideStation broadcasts will continue to use 15.  Note the standard is deficient here for instations broadcasting via cellular hybrid route.  Set to 15 (roadSideUnit) or 32 (inStationUnit) | 15, 32 |
|  | ***situation container*** | | | | |
| **RWW 15** | **information-Quality** | **This can be set to one of eight different values (0..7). ETSI does not specify what the different values mean.** | **Mandatory** | Mandatory value is likely to be set to “unavailable” value=0 | 0, 1, 2, 3, 4, 5, 6, 7 |
| **RWW 16** | **eventType** | **This DF consists of a DE causeCode and subCauseCode.** | **Mandatory** | Fixed value.  The causeCode is set to:  3= road works.  The subCauseCode is set to:  1 = major roadworks  3 = slowmovingroadmaintence  4 = shortTermStationaryRoadworks | causecode set to 3  subCauseCode set to 1, 3 or 4 |
| *RWW 17* | *eventHistory* | *This is a sequence of points, which together form a path from the eventPosition to the end of the road works or, if it exists, the eventPosition of the next related DENM (downstream). It therefore defines the (length of the) area for which the DENM is valid. Which DENMs are related is defined by the DF referenceDenms. The maximum number of points is 23.* | *Profiled* | HE will use this field  TfL will not use this field  Using 1 path of points per message. The OBU currently considers its distance from the line joining the points, hence the need to consider curved roads. | deltaLatitude = provided in data  deltaLongitude= provided in data  deltaAtlitude = 12800 |
|  | ***location container*** | | | | |
| *RWW 18* | *eventSpeed* | *This DF can be used for mobile road works, determining the speed of the trailer.* | *Profiled* | SpeedValue and speedConfidence used but set to unavailable | speedValue = 16383  speedConfidence = 127 |
| *RWW 19* | *eventPosition-Heading* | *The heading direction of the event.* | *Profiled* | headingValue and headingConfidence used but set to unavailable | headingValue = 3601  headingConfidence = 127 |
| *RWW 20* | *traces* | *First trace point*  *This DF consists of minimum 1, maximum 7 traces of type PathHistory. These traces consist of points describing the path towards the eventPosition. These are used by approaching vehicles to determine whether the DENM is relevant or not.*  *The maximum number of points a trace can hold is assumed to be 40, the minimum number of points is 1.* | *Profiled* | HE will not use this field, advanced warning provided in the IVI messages. However an empty trace field will be provided to ensure standards compliance.  TfL will use this field.  Using 1 trace per message. The OBU currently considers its distance from the line joining the points, hence the need to consider curved roads.  The first trace point is the point closest to the event position. This point is positioned in the middle of the carriageway as far away as possible upstream from the event position, taking into account the curved road. This point is coded as an offset delta position with regard to the event position. | deltaLatitude = provided in data  deltaLongitude= provided in data  deltaAtlitude = 12800 |
| *RWW 21* | *Additional trace points.*  *This DF consists of minimum 1, maximum 7 traces of type PathHistory. These traces consist of points describing the path towards the eventPosition. These are used by approaching vehicles to determine whether the DENM is relevant or not.*  *The maximum number of points a trace can hold is assumed to be 40, the minimum number of points is 1.* | *Profiled* | Using 1 trace per message.  Multiple trace points will be provided. See RWW20 | deltaLatitude = provided in data  deltaLongitude= provided in data  deltaAtlitude = 12800 |
|  | ***alacarte container*** | | | | |
|  | ***roadWorks container (container within alacarte container)*** | | | | |
| *RWW 22* | *closedLanes* | *The closedLanes DF consists of two DEs: hardShoulderStatus and drivingLaneStatus. The hardShoulderStatus indicates whether the (outer) hard shoulder is available for driving, stopping or is closed. The drivingLaneStatus, counting from the outside, is a sequence of bits indicating whether the lane is closed (1) or not (0).* | *profiled* | The Common Data Dictionary [Dictionary] holds the following definition of the drivingLaneStatus data element which is used in the DENM [DENM] standard: “DrivingLaneStatus ::= BIT STRING { outermostLaneClosed(1), secondLaneFromOutsideClosed(2) } (SIZE (1..14))”.  It is assumed that the first bit (LSB, the bit on the right) is a ‘don’t care’ (dc) bit. The value for the outermost driving lane (lane 1) is encoded by the second bit of drivingLaneStatus and so on. All lanes are encoded. The bit string has a constant length, trailing zeros are not omitted. This is in accordance with the Request for Change (number 7296) on this issue, as delivered to ETSI.  hardShoulderStatus = 0 (availableforstopping)  drivingLaneStatus:  0 = Open  1 = Closed | hardShoulderStatus = 0  drivingLaneStatus = bit string so 0001 indiciates that lane 1 is closed and lanes 2, 3 and 4 are open. |
| *RWW 23* | *speedLimit* | *This is the speed limit in km/h. This limit is valid from the startingPointSpeedLimit (see below) up to the last point in the eventHistory.* | *Profiled* | Set to 80 kph.  Note startingPointSpeedLimit not set, hence this speed limit applies from eventPosition. Advanced speed limit information provided via IVI messages. | 80 |
| *RWW 24* | *trafficFlow-Rule* | *This DE indicates whether vehicles shall merge to the left (3) or right (2).* | *Profiled* | Merge to the left (3) or the right (2). | 2 or 3 |

## Green Light Optimised Speed Adaption (GLOSA)

### GLOSA SPAT Profile

The Signal Phase and Timing (SPAT) message is used to convey the current status of one or more signalized intersections. Along with the Map Data (MAP) message (which describes a full geometric layout of an intersection) the receiver of this message can determine the state of the signal phasing and when the next expected phase will occur.

The SPAT message sends the current movement state of each active phase in the system as needed (such as values of what states are active and values at what time a state has begun/does begin earliest, is expected to begin most likely and will end latest). The state of inactive movements is not normally transmitted. Movements are mapped to specific approaches and connections of ingress to egress lanes and by use of the SignalGroupID in the Map message.

The current signal pre-emption and priority status values (when present or active) are also sent. A more complete summary of any pending priority or pre-emption events can be found in the Signal Status message.

The UK (TfL) implementation of the GLOSA service SPAT specification is identical to the Dutch pre-TestFest profile (Dutch C-ITS Corridor Profile v3.0 201705120.1).

| Standard | | | | Profile | | |
| --- | --- | --- | --- | --- | --- | --- |
| Level | | Field | Meaning | Status | Content | Value |
| **Header container (ItsPduHeader - ETSI TS 102 894-2 V1.2.1)** | | | | | | |
|  | **protocol-Version** | | Version of the protocol. | Fixed | Current version is 1. | Set to 1 |
|  | **messageID** | | Indicates the type of message. | Fixed | Examples are denm(1), cam(2), spat(4) etc. | Set to 4. |
|  | **stationID** | | This is the ID of the station broadcasting the message. | Mandatory | A number consisting of the assembly of the RoadRegulatorID and the IntersectionID | Set by application. |

| Standard | | | | | | | Profile | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Level | | Field | Meaning | | | Status | | | Content | Value |
| **Level 0: SPAT** | | | | | | | | | | |
| 0.1 | *timeStamp*  *[MinuteOfTheYear]* | | The MinuteOfTheYear data element expresses the number of elapsed minutes of the current year in the time system being used (typically UTC time). | | | Not used | | | The time stamps used for the ETSI header and the IntersectionStateList data frame make this data element redundant. | - |
| 0.2 | *name*  *[DescriptiveName]* | | The DescriptiveName data element is used to provide a human readable and recognizable name for the feature that follows. | | | Not used | | | The DescriptiveName used for the Intersection-StateList data frame makes this data element redundant. | - |
| 0.3 | **intersections**  **[Intersection-StateList]**  **(1..32)** | | The IntersectionStateList data frame consists of a list data IntersectionState entries. | **IntersectionState**  The IntersectionState data frame is used to convey all the SPAT information for a single intersection. | | Mandatory | | | One IntersectionState for each independent conflict area. | See level 1 |
| 0.4 | *regional*  *[REGION.Reg-SPAT]* | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | | Not used | | | - | - |
|  |  | |  | | |  | | |  |  |
| **Level 1: IntersectionStateList → IntersectionState** | | | | | | | | | | |
| 1.1 | *name*  *[DescriptiveName]* | | The DescriptiveName data element is used to provide a human readable and recognizable name for the feature that follows. | | | Profiled | | | Mandatory in Dutch profile as opposed to standard. Human readable and recognizable for road authority. Maximum 63 characters. Shorter is better. | Set by application |
| 1.2 | **id**  **[Intersection-ReferenceID]** | | The IntersectionReference-ID is a globally unique value set, consisting of an optional RoadRegulatorID and a required IntersectionID assignment, providing an unique mapping to the intersection MAP. | *region*  *[RoadRegulatorID]*  The RoadRegulatorID data element is a globally unique identifier assigned to a regional authority. | | Profiled | | | Mandatory in Dutch profile as opposed to standard. For each road operator a number is provide in: https://www.rijkswaterstaat.nl/apps/geoservices/rwsnl/searchdata.php?wegbeheerder | Set by application |
| **id**  **[IntersectionID ]**  The IntersectionID is used within a region to uniquely define an intersection within that country or region. | | Mandatory | | | The identifier shall be defined by the road operator. | Set by application |
| 1.3 | **Revision**  **[MsgCount]** | | The MsgCount data element is used to provide a sequence number within a stream of messages with the same DSRCmsgID and from the same sender. Depending on the application the sequence number may change with every message or may remain fixed during a stream of messages when the content within each message has not changed from the prior message sent. | | | Mandatory | | | The revision number must be increased by 1 each time the MapData of this intersection changes. The revision numbers of SPAT and MAP much be the same as an indication that the right MAP version is used. | Set by application |
| 1.4 | **status**  **[Intersection-StatusObject]** | | The IntersectionStatusObject data element contains Advanced Traffic Controller (ATC) status information. | | | Mandatory | | | Types:   * **manualControlIsEnabled (0),** * stopTimeIsActivated (1), * **failureFlash (2),** * **preemptIsActive (3),** * signalPriorityIsActive (4), * **fixedTimeOperation (5),** * **trafficDependentOperation (6),** * **standbyOperation (7),** * failureMode (8), * **off (9),** * recentMAPmessageUpdate (10), * recentChangeInMAPassignedLanesIDsUsed (11), * **noValidMAPisAvailableAtThisTime (12),** * **noValidSPATisAvailableAtThisTime (13)**   Bits 14,15 reserved at this time and shall be zero | Set by application |
| 1.5 | *moy*  *[MinuteOfTheYear]* | | The MinuteOfTheYear data element expresses the number of elapsed minutes of the current year in the time system being used (typically UTC time). | | | Profiled | | | Mandatory in profile as opposed to standard. | Set by application |
| 1.6 | *timeStamp*  *[Dsecond]* | | The DSRC second expressed in this data element represents the milliseconds within the current UTC minute. | | | Profiled | | | Mandatory in profile as opposed to standard. | - |
| 1.7 | *enabledLanes*  *[EnabledLaneList]* | | The Enabled Lane List data frame is a sequence of lane IDs for lane objects that are *activated* in the current map configuration. These lanes, unlike most lanes, have their *RevocableLane* bit set to one (asserted). Such lanes are not considered to be part of the current map unless they are in the Enabled Lane List. | LaneID  The LaneID data element conveys an assigned index that is unique within an intersection. It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of specialty lanes. | | Conditional | | | Mandatory in profile for specific situations with dynamic lane configurations, e.g. a lane that is used for different manoeuvres at different times of the day. Otherwise not used.  The valid configuration can be derived from the active variant as indicated by the intersection controller (e.g. VlogIndicator). | Set by application |
| 1.8 | **states**  **[MovementList]**  **(1..255)** | | The MovementList data frame consists of a list of MovementState entries.  Each Movement is given in turn and contains its signal phase state, mapping to the lanes it applies to, and point in time it will end, and it may contain both active and future states | MovementState  The MovementState data frame is used to convey various information about the current or future movement state of a designated collection of one or more lanes of a common type.  It is used in the SPAT message to convey every active movement in a given intersection so that vehicles, when combined with certain map information, can determine the state of the signal phases. | | Conditional | | | Mandatory in case the status (see 1.4) indicates normal operation, i.e. IntersectionStatusObject bit 3 to 6. Otherwise states are not used. | See level 2 |
| 1.9 | *maneuverAssistList*  *[Maneuver-AssistList]*  *(1..6)* | | The ManeuverAssistList data frame consists of a list of ConnectionManeuver-Assist entries. | ConnectionManeuverAssist  The ConnectionManeuver-Assist data frame contains information about the the dynamic flow of traffic for the lane(s) and maneuvers in question (as determined by the LaneConnectionID).  Note that this information can be sent regarding any lane-to-lane movement; it need not be limited to the lanes with active (non-red) phases when sent. | | Not used | | | At this level the values apply to all movements of the intersection. In the Dutch profile this data frame is only used in level 2, where values are assigned to individual movements. | See level 6 |
| 1.10 | *regional*  *[REGION.Reg-IntersectionState]* | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | | Not used | | | Extension allow to transmit activePrioritizations which consists of a sequence of stationID, priorState and signalGroup. Offers an alternative to the SSM message. | - |
|  |  | |  | | |  | | |  |  |
| **Level 2: MovementList 🡪 MovementState** | | | | | | | | | | |
| 2.1 | *movementName*  *[DescriptiveName]* | | The DescriptiveName data element is used to provide a human readable and recognizable name for the MovementState data frame. | | | Profiled | | | Mandatory in profile as opposed to standard. The DescriptiveName data element is set to human readable and recognizable SignalGroupID. For example, fc02, fc21, SG31, SG41, etc. | Set by application |
| 2.2 | **signalGroup**  **[SignalGroupID]** | | The SignalGroupID data element is an *index* used to map between the internal state of one or more signal controllers and a common numbering system that can represent all possible combinations of active states (movements and phases). All possible movement variations are assigned a unique value within the intersection. | | | Mandatory | | | The SignalGroupID data element is used to map to lists of lanes (and their descriptions) to which this MovementState data applies to. | Set by the application |
| 2.3 | **state-time-speed**  **[Movement-EventList]**  **(1..16)** | | The MovementEventList data frame consists of a list of MovementEvent entries. | MovementEvent  The MovementEvent data frame contains details about a single movement. It is used by the movement state to convey one of number of movements (typically occurring over a sequence of times) for a SignalGroupID. | | Mandatory | | | The size of the MovementEventList is subject to the TimeIntervalConfidence. If the time intervals cannot be provided with sufficient confidence\*, no additional MovementEvent will be provided.  \* This threshold will be defined quantitatively in a later stage based on practical experience. | See level 3 |
| 2.4 | *maneuverAssistList*  *[Maneuver-AssistList]*  *(1..6)* | | The ManeuverAssistList data frame consists of a list of ConnectionManeuverAssist entries.  -- This information may also be placed in the IntersectionState when common information applies to different lanes in the same way | ConnectionManeuverAssist  The ConnectionManeuver-Assist data frame contains information about the the dynamic flow of traffic for the lane(s) and maneuvers in question (as determined by the LaneConnectionID).  Note that this information can be sent regarding any lane-to-lane movement; it need not be limited to the lanes with active (non-red) phases when sent. | | Profiled | | | Mandatory in profile as opposed to standard unless the data is not available. Used to convey the queue length. | See level 6 |
| 2.5 | *regional*  *[REGION.Reg-MovementState]* | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | | Not used | | | - | - |
|  |  | |  | | |  | | |  |  |
| **Level 3: MovementEventList 🡪 MovementEvent** | | | | | | | | | | |
| 3.1 | **eventState**  **[Movement-PhaseState]** | | The MovementPhaseState data element provides the overall current state of the movement (in many cases a signal state), including its core phase state and an indication of whether this state is permissive or protected.  It is expected that the allowed transitions from one state to another will be defined by regional deployments. Not all  regions will use all states; however, no new states are to be defined.  Permissive is referred to as a "round ball" while protected implies it has a directional arrow associated with it.  A diagram of the above states is included in Annex B. | | | Mandatory | | | The MovementPhaseState data element can be set to:  Unlit (dark):   1. unavailable e.g. power outage 2. dark e.g. outside of operating hours   Reds:   1. stop-Then-Proceed 2. stop-And-Remain   Greens:   1. permissive-Movement-Allowed 2. protected-Movement-Allowed   Yellows / Ambers:   1. permissive-clearance 2. protected-clearance 3. caution-Conflicting-Traffic e.g. outside of operating hours | Set by application |
| 3.2 | *timing*  *[TimeChange-Details]* | | The TimeChangeDetails data frame conveys details about the timing of a phase within a movement. The core data concept expressed is the time stamp (time mark) at which the related phase will change to the next state. This is often found in the *MinEndTime* element, but the other elements may be needed to convey the full concept when adaptive timing is employed. | | | Profiled | | | Mandatory in profile as opposed to standard (to stress TimeChangeDetails are the main purpose of the SPAT message), unless MovementPhaseState equals 0, 1 or 9, or when the data is not available (e.g. for specific movements). | See level 4 |
| 3.3 | *speeds*  *[AdvisorySpeedList] (1..16)* | | The AdvisorySpeedList data frame consists of a list of AdvisorySpeed entries. | AdvisorySpeed  The AdvisorySpeed data frame is used to convey a recommended traveling approach speed to an intersection from the message issuer for different distances to the stop line and various traveller and vehicle types. | | Profiled | | | Mandatory in profile as opposed to standard in case of physical roadside signage displaying dynamic advisory speeds. Recommended to be used in other cases.  AdvisorySpeed is a general recommendation for the particular SignalGroupID and not tied to one specific MovementPhaseState. Therefore, it is provided only one time, with the first MovementEvent. | See level 5 |
| 3.4 | *regional*  *[REGION.Reg-MovementEvent]* | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | | Not used | | | No extensions are defined in the standards.  Desired extension in profile:   * waitMotivation [WaitMotivation]   Mandatory in case of excessive waiting or sudden increases in waiting time, types:   * Public transport priority (0) * Emergency vehicle priority (1) * Train priority (2) * Bridge open (3) * Vehicle height (4) * Weather (bicycle priority) (5) * Traffic jam (spillback) (6) * Tunnel closure (7) * Metering active (8) * Truck priority (9) * Bicycle platoon priority (10) * Unknown (14) | - |
|  |  | |  | | |  | | |  |  |
| **Level 4: MovementEvent 🡪 TimeChangeDetails** | | | | | | | | | | |
| 4.1 | *startTime  [TimeMark]* | | The StartTime element is used to relate when the phase itself started or is expected to start. This in turn allows the indication that a set of time change details refers to a future phase, rather than a currently active phase.  By this method, timing information about "pre" phase events (which are the short transitional phase used to alert OBEs to an impending green/go or yellow/caution phase) and the longer yellow-caution phase data is supported in the same form as various green/go phases.  In theory, the time change details could be sent for a large sequence of phases if the signal timing was not adaptive and the operator wished to do so. In practice, it is expected only the "next" future phase will commonly be sent. | | Optional | | | For the current phase this TimeMark indicates a time in the past which is hardly relevant. For future phases this TimeMark equals the likelyTime of the preceding phase. Unknown = 36001. | | Set by application |
| 4.2 | **minEndTime** **[TimeMark]** | | The element MinEndTime is used to convey the earliest time possible at which the phase could change, except when unpredictable events relating to a pre-emption or priority call disrupt a currently active timing plan. | | Mandatory | | | Typically, pre-configured as the minimum green/red time. Unknown = 36001. | | Set by application |
| 4.3 | *maxEndTime* *[TimeMark]* | | The element MaxEndTime is used to convey the latest time possible which the phase could change, except when unpredictable events relating to a pre-emption or priority call come into play and disrupt a currently active timing plan. | | Optional | | | Typically, pre-configured as the minimum green/red time. Unknown = 36001. | | Set by application |
| 4.4 | *likelyTime  [TimeMark]* | | The element likelyTime is used to convey the most likely time the phase changes. This occurs between MinEndTime and MaxEndTime and is only relevant for traffic-actuated control programs. | | Profiled | | | Mandatory in profile as opposed to standard (to stress the importance of this TimeMark), unless data is not available (e.g. specific movements). Indicates the expected / predicted end time of the phase. Unknown is 36001. | | Set by application |
| 4.5 | *confidence*  *[TimeInterval-Confidence ]* | | The element confidence is used to convey basic confidence data about the likelyTime. | | Profiled | | | Mandatory in profiles as opposed to standard when likelyTime is provided. In addition, an alternative meaning for the values is defined compared to the standard.  Assuming normal distribution, TimeIntervalConfidence indicates the value equal to once the standard deviation of the likelyTime, in seconds. Note that:  - 68,27% of the cases are expected to be within once the standard deviation of the likelyTime.  - 95,44% of the cases are expected to be within twice the standard deviation of the likelyTime.  - 99,73% of the cases are expected to be within three times the standard deviation of the likelyTime.  0 indicates the likelyTime is certain. 15 indicates ‘unknown’ or that the standard deviation of the LikelyTime is larger than 15. | | Set by application |
| 4.6 | *nextTime* *[TimeMark]* | | The element nextTime is used to express a general (and presumably less precise) value regarding when this phase will next occur. This is intended to be used to alert the OBE when the next green/go may occur so that various ECO driving applications can better manage the vehicle during the intervening stopped time. | | Optional | | | The data element nextTime typically equals likelyTime + the cycle time. Since most signal controllers in the Netherlands use inputs, such as detectors, to dynamically adjust signal timing and phasing, the ‘cycle time’ is not constant and most likely not available. Therefore, this data element is optional. Unknown = 36001.  This data element is mandatory in case the control programs have a constant cycle time. For example, fixed time or semi-fixed time (“half star”) control programs. | | Set by application |
|  |  | |  | | |  | | |  |  |
| **Level 5: MovementEvent 🡪 AdvisorySpeed** | | | | | | | | | | |
| 5.1 | **type**  **[Advisory-SpeedType]** | | The AdvisorySpeedType data element relates the type of travel to which a given speed refers. This element is typically used as part of an AdvisorySpeed data frame for signal phase and timing data. | | Mandatory | | | As the main purpose is (dynamic) green wave the value shall be set to 1. | | 1 |
| 5.2 | *speed*  *[SpeedAdvice]* | | This data element represents the recommended velocity of an object, typically a vehicle speed along a roadway,  expressed in unsigned units of 0.1 meters per second. | | Profiled | | | Mandatory in profile as opposed to standard. If the AdvisorySpeed DF is used this is the primary value.  Typically the SpeedAdvice considers one intersection, however, the application may have computed the speed advice considering multiple intersections. | | Set by application |
| 5.3 | *confidence*  *[SpeedConfidence]* | | The SpeedConfidence data element is used to provide the 95% confidence level for the currently reported value of DE\_Speed, taking into account the current calibration and precision of the sensor(s) used to measure and/or calculate the value. | | Not used | | | As the SpeedAdvice is already described as bandwidth for specific road segments, a confidence value is redundant. | | - |
| 5.4 | *distance*  *[ZoneLength]* | | The ZoneLength data element is used to provide an estimated distance from the stop bar, along the lane centreline back in the lane to which it pertains. It is used in various ways to relate this distance value. When used with clearance zones, it represents the point at which the driver can successfully execute the connection maneuver. It is used in the Clearance Maneuver Assist data frame to relate dynamic data about the lane. It is also used to relate the distance from the stop bar to the rear edge of any queue. It is further used within the context of a vehicle's traveling speed to advise on preferred dynamic approach speeds.  -- Unit = 1 meter,  -- The distance indicates the region for which the advised speed is recommended, it is specified upstream from the stop bar along the connected egressing lane | | Profiled | | | Mandatory in profile as opposed to standards.  The distance indicates the region for which the advised speed is recommended, it is specified upstream from the stop bar in units of 1 meter. The first zone starts at the stop line and ends at the indicated distance. | | Set by application |
| 5.5 | *class*  *[Restriction-ClassID]* | | The RestrictionClass data element defines an intersection-unique value to convey data about classes of users.  The typical use of this element is to map additional movement restrictions or rights (in both the MAP and SPAT messages) to special classes of users (trucks, high sided vehicles, special vehicles etc.). | | Not used | | | Absent implies that the AdvisorySpeed applies to all users of the Movement, or in case of a shared lane to all motor vehicle types. | | - |
| 5.6 | *regional*  *[REGION.Reg-AdvisorySpeed]* | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Not used | | | - | | - |
|  |  | |  | | |  | | |  |  |
| **Level 6: ManeuverAssistList 🡪 ConnectionManeuverAssist** | | | | | | | | | | |
| 6.1 | **connectionID**  **[Lane-ConnectionID]** | | The LaneConnectionID data entry is used to state a connection index for a lane to lane connection (defined in MAP). It is used to relate this connection and any dynamic clearance data sent in the SPAT. | | Mandatory | | | Unique index value. | | Set by application |
| 6.2 | *queueLength* *[ZoneLength]* | | The queueLength data entry is used to state the distance from the stop line to the back edge of the last vehicle in the queue as measured along the lane centre line. | | Optional | | | Highly recommended as queue information can improve the quality of service considerably. To be considered mandatory if available.  Unit = 1 meter, 0 = no queue. Used to improve the in-vehicle calculation of the SpeedAdvice. | | Set by application |
| 6.3 | *available-StorageLength* *[ZoneLength]* | | Distance (e.g. beginning from the downstream stop-line up to a given distance) with a high probability for successfully executing the connecting manoeuvre between the two lanes during the current cycle. Used for enhancing the awareness of vehicles to anticipate if they can pass the stop line of the lane. Used for optimizing the green wave, due to knowledge of vehicles waiting in front of a red light (downstream). | | Not used | | | Out of scope of current use cases. | | - |
| 6.4 | *waitOnStop*  *[WaitOnStopline]* | | The WaitOnStopline data element is used to indicate to the vehicle that it must stop at the stop line and not move past. | | Not used | | | Out of scope of current use cases. | | - |
| 6.5 | *pedBicycleDetect*  *[Pedestrian-BicycleDetect]* | | The PedestrianBicycleDetect data element is used to provide an indication of whether Pedestrians and/or Bicyclists have been detected in the crossing lane. | | Not used | | | Out of scope of current use cases. | | - |
| 6.6 | *regional*  *[REGION.Reg-ConnectionManeuverAssist]* | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Not used | | | Extensions allow to transmit vehicleToLanePositions and rsuGNSSOffset. | | - |

### GLOSA MAP Profile

The Map Data (MAP) message conveys information about the physical geometry of one of more intersections. It is used with the SPAT message to convey information to a vehicle with an OBU as to the time of the next ‘green’ or ‘red’ signal. The UK (TfL) implementation of the GLOSA service MAP specification is identical to the Dutch pre-TestFest profile (Dutch C-ITS Corridor Profile v3.0 201705120.1).

| Standard | | | | | Profile | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Level | Field | Meaning | | Status | | Content | Value |
| **Header container (ItsPduHeader - ETSI TS 102 894-2 V1.2.1)** | | | | | | | |
|  | **protocol-Version** | Version of the protocol. | | Mandatory | | A fixed number to identify the current version of the message contents. | 1 |
|  | **messageID** | Indicates the type of message. | | Mandatory | | A number to identify MAP messages | 5 |
|  | **stationID** | This is the ID of the station broadcasting the message. | | Mandatory | | A number consisting of the assembly of the RoadRegulatorID and the IntersectionID | Set by application. |
| **Level 0: MapData** | | | | | | | |
| 0.1 | *timestamp*  *[MinuteOfTheYear]* | The MinuteOfTheYear data element expresses the number of elapsed minutes of the current year in the time system being used (typically UTC time). | | Not Used | | Because map data is static, the transmission latency is not relevant. | - |
| 0.2 | **msgIssueRevision**  **[MsgCount]** | The msgIssueRevision data element is used to provide a revision related to the issued standard, to be able to identify the compatibility. | | Mandatory | | Other than the IntersectionGeometry, this element is used to indicate the revision number of the defining standard. 0 = ISO/TS 19091:2016(E) | 0 |
| 0.3 | *layerType*  *[LayerType]* | The LayerType data element is used to uniquely identify the type of information to be found in a layer of a geographic map fragment such as an intersection. | | Optional | | This profile assumes that MapData is always used to describe intersections. In that case LayerType is intersectionData. | Set by application |
| 0.4 | *layerID*  *[LayerID]* | The LayerID data element is used to uniquely identify the layers of a geographic map fragment such as an intersection. Used to identify the number of MapData messages needed to describe the complete topology. | | Conditional | | Mandatory in profile if two MapData messages are needed. Then the LayerID of the first is set to 21, and the second to 22. If the complete topology fits into one MapData message, this field is not used. | Set by application |
| 0.5 | *intersections*  *[Intersection-GeometryList]* *(1..32)* | The IntersectionGeometry-List data frame consists of a list of Intersection-Geometry entries. | IntersectionGeometry  A complete description of an intersection's roadway geometry and its allowed navigational paths (independent of any additional regulatory restrictions that may apply over time or from user classification). | Conditional | | Mandatory in profile in case of intersection. The MapData message is always used to transfer the intersection topology. Therefore the geometry is mandatory.  One IntersectionGeometry for each independent conflict area. That is:   * If controlled: having own stop lines and signal heads for all conflicting directions. * Lanes between conflict areas are not connecting-lanes (volgrichting) of another intersection. | See level 1 |
| 0.6 | *roadSegments*  *[RoadSegmentList]* *(1..32)* | The RoadSegmentList data frame consists of a list of RoadSegment entries. | RoadSegment  The RoadSegment data frame is a complete description of a RoadSegment including its geometry and its allowed navigational paths (independent of any additional regulatory restrictions that may apply over time or from user classification) and any current disruptions such as a work zone or incident event. | Future Use | |  | See level 2 |
| 0.7 | *dataParameters*  *[DataParameters]* | The DataParameters data frame is used to provide basic (static) information on how a map fragment was processed or determined. |  | Mandatory | | - | - |
| *processMethod* | Not used | | - |  |
| *processAgency* | Mandatory | | Used to indicate the creator of the MapData. | Set by application |
| *lastCheckedDate* | Mandatory | | Used to indicate the date the source data was last checked. | Set by application |
| *geoidUsed* | Not used | | - |  |
| 0.8 | *restrictionList*  *[RestrictionClassList]* *(1..254)* | The RestrictionClassList data frame is used to enumerate a list of user classes which belong to a given assigned index. | RestrictionClassAssignment  The RestrictionClass-Assignment data frame is used to assign (or bind) a single RestrictionClassID data element to a list of all user classes to which it applies. A collection of these bindings is conveyed in the RestrictionClassList data frame in the MAP message to travelers. The established index is then used in the lane object of the MAP message, in the ConnectTo data frame, to qualify to whom a signal group ID applies when it is sent by the SPAT message about a movement. | Conditional | | When restrictions are used within the intersection topology their restriction classes must be defined here. | See level 3 |
|  | *regional*  *[REGION.Reg-MapData]* | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Not Used | | The European extension ‘MapData-addGrpC’ defines the 3D location of the signal heads. This is not used. | - |
| **Level 1: IntersectionGeometryList → IntersectionGeometry** | | | | | | | |
| 1.1 | *name*  *[Descriptive-Name]* | The DescriptiveName data element is used to provide a human readable and recognizable name for the IntersectionGeometry data frame. | | Profiled | | Mandatory in Dutch profile as opposed to standard. Human readable and recognizable for road authority. Maximum 63 characters. Shorter is better. | Set by application |
| 1.2 | **id**  **[Intersection-ReferenceID]** | The IntersectionReference-ID is a globally unique value set, consisting of an optional RoadRegulatorID and a required IntersectionID assignment, providing an unique mapping to the intersection MAP. | *region*  *[RoadRegulatorID]*  The RoadRegulatorID data element is a globally unique identifier assigned to a regional authority. | Profiled | | Mandatory in Dutch profile as opposed to standard. For each road operator a number is provide in: https://www.rijkswaterstaat.nl/apps/geoservices/rwsnl/searchdata.php?wegbeheerder | Set by application |
| **id**  **[IntersectionID ]**  The IntersectionID is used within a region to uniquely define an intersection within that country or region. | Mandatory | | The identifier shall be defined by the road operator. | Set by application |
| 1.3 | **revision**  **[MsgCount ]** | The MsgCount data element is used to provide a sequence number within a stream of messages with the same DSRCmsgID and from the same sender. Depending on the application the sequence number may change with every message or may remain fixed during a stream of messages when the content within each message has not changed from the prior message sent. | | Mandatory | | The revision number must be increased by 1 each time the MapData of this intersection changes. The revision numbers of SPAT and MAP much be the same as an indication that the right MAP version is used. | Set by application |
| 1.4 | **refPoint** **[Position3D]** | The Position3D data frame provides a precise location in the WGS-84 coordinate system, from which short offsets may be used to create additional data using a flat earth projection centred on this location. | | Mandatory | | Serves to decode the offsets, the centre of an intersection (conflict area) is used. | See level 12 |
| 1.5 | *laneWidth*  *[LaneWidth]* | The LaneWidth data element conveys the width of a lane in units of 1 cm. | | Mandatory | | Mandatory in profile as opposed to standard. The default lane width is 3 meters. | 300 |
| 1.6 | *speedLimits*  *[SpeedLimitList]* *(1..9)* | The SpeedLimitList data frame consists of a list of SpeedLimit entries. | RegulatorySpeedLimit  The RegulatorySpeedLimit data frame is used to convey a regulatory speed about a lane, lanes, or roadway segment. | Profiled | | Mandatory in profile as opposed to standard. The global speed limit used within this intersection. Can be overridden on GenericLane level.  If one limit applies to all vehicles, only one value is used, with SpeedLimitType set to vehicleMaxSpeed. An additional value may be used for other types. | See level 4 |
| 1.7 | **[laneSet]**  **LaneList** **(1..255)** | The LaneList data frame consists of a list of GenericLane entries. | GenericLane  The GenericLane data frame is used for all types of lanes, e.g. motorized vehicle lanes, crosswalks, medians. The GenericLane describes the basic attribute information of the lane. | Mandatory | | All lanes relevant for traffic shall be described, also lanes without a SignalGroup. The ‘multipleLanesTreatedAsOneLane’ as part of LaneSharing shall not be used. Only lanes fully independent from the intersection (e.g. parallel road) may be excluded. | See level 5 |
| 1.8 | *preemptPriorityData*  *[PreemptPriorityList]* *(1..32)* | The PreemptPriorityList data frame consists of a list of RegionalSignalControl-Zone entries. | SignalControlZone | Not Used | | Not defined yet in the standards. | - |
| 1.9 | *regional*  *[REGION.Reg-IntersectionGeometry]* | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Not used | | No extension are defined in standard. | - |
| **Level 2: RoadSegmentList 🡪 RoadSegment** | | | | | | | |
| 2.1 | *name*  *[Descriptive-Name]* | The DescriptiveName data element is used to provide a human readable and recognizable name for the RoadSegment data frame. | | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| 2.2 | **id**  **[RoadSegment-ReferenceID]** | The RoadSegmentReferenceID data frame is used to convey the RoadSegmentID which is unique to a given road segment of interest, and also the RoadRegulatorID assigned to the region in which it is operating (when required). | *region*  *[RoadRegulatorID]*  The RoadRegulatorID is a globally unique identifier assigned to an entity responsible for assigning Intersection IDs in the region over which it has such authority. | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| **id**  **[RoadSegmentID]**  The RoadSegmentID is used to uniquely define a section of roadway within a country or region. | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| 2.3 | **revision** **[MsgCount]** | The MsgCount data element is used to provide a sequence number within a stream of messages with the same DSRCmsgID and from the same sender. Depending on the application the sequence number may change with every message or may remain fixed during a stream of messages when the content within each message has not changed from the prior message sent. | | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| 2.4 | **refPoint** **[Position3D]** | The Position3D data frame provides a precise location in the WGS-84 coordinate system, from which short offsets may be used to create additional data using a flat earth projection centered on this location. | | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| 2.5 | *laneWidth*  *[LaneWidth]* | The LaneWidth data element conveys the width of a lane. | | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| 2.6 | *speedLimits*  *[SpeedLimitList]* *(1..9)* | The SpeedLimitList data frame consists of a list of SpeedLimit entries. | RegulatorySpeedLimit  The RegulatorySpeedLimit data frame is used to convey a regulatory speed about a lane, lanes, or roadway segment. | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| 2.7 | **roadLaneSet**  **[RoadLaneSetList]** **(1..255)** | The RoadLaneSetList data frame consists of a list of GenericLane entries used to describe a segment of  roadway. | GenericLane  The GenericLane data frame is used for all types of lanes, e.g. motorized vehicle lanes, crosswalks, medians. The GenericLane describes the basic attribute information of the lane. | Future Use | | For application at intersections, the RoadSegmentList is not used. | - |
| 2.8 | *regional*  *[REGION.Reg-RoadSegment]* | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Future Use | | For application at intersections, the RoadSegmentList is not used. No extensions are defined in the standard. | - |
| 3.1 | **id**  **[RestrictionClassID]** | The RestrictionClass data element defines an intersection-unique value to convey data about classes of users.  The mapping used varies with each intersection and is defined in the MAP message if needed. The defined mappings found there are used to determine when a given class is meant. The typical use of this element is to map additional movement restrictions or rights (in both the MAP and SPAT messages) to special classes of users (trucks, high sided vehicles, special vehicles etc.). There is the general presumption that in the absence of this data, any allowed movement extends to all users. | | Mandatory | | A number is defined for each restriction class required for the intersection. | Set by application  Starts at 0 |
| 3.2 | **users**  **[Restriction-UserTypeList]** **(1..16)** | The RestrictionUserTypeList data frame consists of a list of RestrictionUserType entries. | | Conditional | | Lists all users where this RestrictionClass applies to. For example busses and taxis. | See level 12 |
| **Level 4/11: SpeedLimitList 🡪 RegulatorySpeedLimit** | | | | | | | |
| 4.1 | **type**  **[SpeedLimitType]** | The SpeedLimitType data element relates the type of speed limit to which a given speed refers. | | Mandatory | | Types:   * unknown, * maxSpeedInSchoolZone, * maxSpeedInSchoolZoneWhenChildrenArePresent, * maxSpeedInConstructionZone, * vehicleMinSpeed, * **vehicleMaxSpeed,** * vehicleNightMaxSpeed, * truckMinSpeed, * truckMaxSpeed, * truckNightMaxSpeed, * vehiclesWithTrailersMinSpeed, * vehiclesWithTrailersMaxSpeed, * vehiclesWithTrailersNightMaxSpeed   Only vehicleMaxSpeed is mandatory, all other types are optional. | Set by application |
| 4.2 | **speed**  **[Velocity]** | This data element represents the velocity of an object, typically a vehicle speed or the recommended speed of travel along a roadway, expressed in unsigned units of 0.02 meters per second. When used with motor vehicles it may be combined with the transmission state to form a data frame for use. | | Mandatory | | The maximum speed in m/s in units of 0.02 m/s. | Set by application |
| **Level 5: LaneList 🡪 GenericLane** | | | | | | | |
| 5.1 | **laneID**  **[LaneID]** | The LaneID data element conveys an assigned index that is unique within an intersection. It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of specialty lanes. | | Mandatory | | Each lane gets a unique number within the intersection. It is tempting to use the Dutch lane numbering scheme here, but the value is limited to 255. Therefore LaneIDs typically are numbered continuously starting at 1, but other methods are permitted as long as not additional meaning is put on the number which cannot be guaranteed. | Set by application  Start at 1 |
| 5.2 | *name*  *[DescriptiveName]* | The DescriptiveName data element is used to provide a human readable and recognizable name for the GenericLane data frame. | | Profiled | | Mandatory in profile as opposed to standard. By default the number of signal head is used, otherwise (incl. egress lanes) a random name/number can be used. In case multiple signal heads serve one lane, the vehicle signal head is used. | Set by application |
| 5.3 | *ingressApproach* *[ApproachID]* | The ApproachID data element is used to relate the index of an approach, either ingress or egress within the subject lane. | | Profiled | | Mandatory in profile for ingress lanes as opposed to standard. Number used to group all approaching lanes of an arm into one group. This value is used to find all other lanes of an arm when driving on one of them, for example before the road fans out. Cycling and pedestrians lanes crossing an approach have the same ApproachID as the approach they cross (therefore should be excluded to find all vehicle driving lanes). | Start at 1. Identical to Arm number (start East with 1 and increase clockwise). |
| 5.4 | *egressApproach* *[ApproachID]* | The ApproachID data element is used to relate the index of an approach, either ingress or egress within the subject lane. | | Profiled | | Mandatory in profile for egress lanes as opposed to standard.  Cycling and pedestrian lanes which overlap an ingress and egress approach, have both ApproachID’s assigned. | Start at 1. Identical to Arm number (start East with 1 and increase clockwise). |
| 5.5 | **laneAttributes**  **[LaneAttributes]** | The LaneAttributes data frame holds all of the constant attribute information of any lane object (as well as denoting the basic lane type itself) within a single structure. Constant attribute information are those values which do not change over the path of the lane, such as the direction of allowed travel. Other lane attribute information can change at or between each node. | **directionalUse**  **[LaneDirection]**  The LaneDirection data element is used to denote the allowed direction of travel over a lane object. By convention,  the lane object is always described from the stop line outwards away from the intersection. Therefore, the ingress direction is from the end of the path to the stop line and the egress direction is from the stop line outwards. | Mandatory | | Set according to the layout of the intersection. Do not use both ways (ingress and egress) for vehicle lanes; this can be used for pedestrians or bidirectional bicycle paths.  Bitstring (size = 2), with bits as defined:  Ingresspath (0)  Egresspath (1) | Set by application |
| **sharedWith**  **[LaneSharing]**The LaneSharing data element is used to denote the presence of other user types (travel modes) who have an equal right to access and use the lane. The typical use is to alert the user of the MAP data that additional traffic of another mode may be present in the same spatial lane. | Mandatory | | To be filled according to the allowed traffic.  With bits as defined:  overlappingLaneDescriptionProvided (0)  ~~multipleLanesTreatedAsOneLane (1)~~  -- not permitted in profile as all lanes shall be described.  otherNonMotorizedTrafficTypes (2)  individualMotorizedVehicleTraffic (3)  busVehicleTraffic (4)  taxiVehicleTraffic (5)  pedestriansTraffic (6)  cyclistVehicleTraffic (7)  trackedVehicleTraffic (8)  ~~pedestrianTraffic (9)~~ use 6 instead (error) | Set by application |
| **laneType**  **[LaneTypeAttributes]**  The LaneTypeAttributes data frame is used to hold attribute information specific to a given lane type. It is typically used in the LaneAttributes data frame as part of an overall description of a lane object. | Mandatory | | To be filled according to the allowed traffic. | See level 6 |
| *regional*  *[REGION.Reg-LaneAttributes]*  The element is used for additional "regional information”. | Not Used | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | - |
| 5.6 | *maneuvers*  *[AllowedManeuvers]* | The AllowedMovements data element relates the allowed (possible) maneuvers from a lane, typically a motorized vehicle lane. It should be noted that in practice these values may be further restricted by vehicle class, local regulatory environment and other changing conditions. | | Not Used | | Use the AllowedManeuvers from ConnectingLane instead because this allows to specify the maneuvers related to a signal head. | - |
| 5.7 | **nodeList**  **[NodeListXY]** | The NodeListXY data structure provides the sequence of signed offset node point values for determining the Xs and Ys (and possibly Width or Zs when present), using the then current Position3D object to build a path for the centreline of the subject lane type. Each X,Y point is referred to as a Node Point. The straight line paths between these points are referred to as Segments. | **nodes**  **[NodeSetXY]** **(2..63)**  The NodeSetXY data frame consists of a list of Node entries using XY offsets.  A lane made up of two or more XY node points and any attributes defined in those nodes. | Used  Mandatory | | Each lane is described by a list of nodes, starting at the stop line (or closest to the intersection for egress lanes). The length of each lane is subject to the following rules:   * Lanes of different intersections may not overlap. * Lanes may not run over the conflict zone of a controlled intersection (use a ConnectionTrajectory instead). * Ingress lanes must be at least 300 m and at best 1000 m long, except when violating the rules above or when the lane ends. * Egress lanes must be at least 100 m long, except when violating the rules above or when the lane ends. Note: an ingress lane may be connected to an ingress lane of another intersection. In that case, the ingress lane of the other intersection must continue to the conflict area of the current intersection. * Only pedestrian lanes must be several meters long, equal to the width of the sidewalk or island. * When lanes fan out, the lane before the fan out must be the through traffic lane (i.e. the main road) (in most cases the straight direction).   Simple lanes can be adequately described with only two node points, while lanes with curvature may require more points. The center line obtained when connecting the nodes must never differ more than 1/4th of the lanewidth from the actual center line of the lane. However, the 2nd node must be perpendicular to the stop line to allow for correct map-matching. | See level 7 |
| **computed**  **[ComputedLane]**  The ComputedLane data frame is used to contain information needed to compute one lane from another (hence the name). The new lane is expressed as an X,Y offset from the first point of the source lane. Any attribute information found within the node of the source lane list cannot be changed and must be reused.  A lane path computed by translating the data defined by another lane | Not used | | The chance lanes have exactly the same shape is very small, except for multi-lane roads. Moreover, all lanes shall described individually (also see row 1.7). | See level 8 |
| 5.8 | *connectsTo*  *[ConnectsToList]* *(1..16)* | The ConnectsToList data structure is used in the generic lane descriptions to provide a sequence of other defined lanes to which each lane connects beyond its stop point. | Connection  The Connection data structure is used in the ConnectsToList data frame to provide data about how the stop line at the end of a single lane connects to another lane beyond its stop point. | Profiled | | Mandatory in profile as opposed to standard, for ingress lanes with a signal group.   * Each ingress lane of an intersection must be connected to an egress lane of the current intersection *or* an ingress lane of the (another) intersection. * All egress lanes of the intersection should be described, either as egress lane of the current intersection OR as ingress lane of another intersection if this intersection is described within the same MAP. * It is not allowed to connect to ingress lanes of another section which is not described in this MAP. * Pedestrian lanes are defined as bi-directional ingress lanes, the Connection connects to the ingress lane at the other side of the road. | See level 9 |
| 5.9 | *overlays*  *[OverlayLaneList]* *(1..5)* | The OverlayLaneList data frame is a sequence of lane IDs which refers to lane objects that overlap or overlay the current lane's spatial path. | LaneID  The LaneID data element conveys an assigned index that is unique within an intersection. It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of specialty lanes. | Not used | | Out of scope. | - |
| 5.10 | *Regional*  *[REGION.Reg-GenericLane]*  *(1..4)* | The element REGION.Reg-GenericLane is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Conditional | | Mandatory in case of curved connection trajectory, otherwise not used.  ‘ConnectionTrajectory-addGrpC’ can be used to describe the path across the conflict area of the intersection.  ConnectionTrajectory-addGrpC ::= SEQUENCE {  nodes [NodeSetXY],  -- As defined in row 5.7.  connectionID [LaneConnectionID]  -- Desired extension (not used in this  -- version of the profile)  ...  } | - |
| **Level 6: LaneTypeAttributes** | | | | | | | |
| 6.1 | vehicle  [LaneAttributes-Vehicle] | The LaneAttributes-Vehicle data element relates specific properties found in a vehicle lane type. This data element provides a means to denote that the use of a lane is restricted to certain vehicle types. | | Used | | Containing attributes of vehicle lane type.   * **isVehicleRevocableLane (0)** * **isVehicleFlyOverLane (1)** * **hovLaneUseOnly (2)** * **restrictedToBusUse (3)** * **restrictedToTaxiUse (4)** * **restrictedFromPublicUse (5)** * hasIRbeaconCoverage (6) * **permissionOnRequest (7)** | Set by application |
| 6.2 | crosswalk  [LaneAttributes-Crosswalk] | The LaneAttributes-Crosswalk data element relates specific properties found in a crosswalk lane type. | | Used | | Containing attributes of crosswalk lane type.   * crosswalkRevocableLane (0) * **bicyleUseAllowed (1)** * isXwalkFlyOverLane (2) – dan beschrijven we die niet * fixedCycleTime (3) * biDirectionalCycleTimes (4) * hasPushToWalkButton (5) * **audioSupport (6)** * **rfSignalRequestPresent (7)** * unsignalizedSegmentsPresent (8) | Set by application |
| 6.3 | bikeLane  [LaneAttributes-Bike] | The LaneAttributes-Bike data element relates specific properties found in a bicycle lane type. | | Used | | Containing attributes of bike lane type.   * bikeRevocableLane (0) * **pedestrianUseAllowed (1)** * isBikeFlyOverLane (2) * fixedCycleTime (3) * biDirectionalCycleTimes (4) * **isolatedByBarrier (5)** * unsignalizedSegmentsPresent (6) | Set by application |
| 6.4 | sideWalk  [LaneAttributes-Sidewalk] | The LaneAttributes-Sidewalk data element relates specific properties found in a sidewalk lane type. | | Not Used | | Containing attributes of sidewalk lane type. Sidewalks are not considered in the profile. | Set by application |
| 6.5 | median  [LaneAttributes-Barrier] | The LaneAttributes-Barrier data element relates specific properties found in a Barrier or Median lane type (a type of lane object used to separate traffic lanes). | | Not Used | | Containing attributes of barrier lane type. Barriers are not considered in the profile. | Set by application |
| 6.6 | striping  [LaneAttributes-Striping] | The LaneAttributes-Striping data element relates specific properties found in various types of ground striping lane types. This includes various types of painted lane ground striping and iconic information needs to convey information in a complex intersection. Typically, this consists of visual guidance for drivers to assist them to connect across the intersection to the correct lane. Such markings are typically used with restraint and only under conditions when the geometry of the intersection makes them more beneficial than distracting. | | Not Used | | Containing attributes of striping lane type.  Striping is not considered in the profile. | Set by application |
| 6.7 | trackedVehicle  [LaneAttributesTrackedVehicle] | The LaneAttributes-TrackedVehicle data element relates specific properties found in a tracked vehicle lane types (trolley and train lanes). The term “rail vehicle” can be considered synonymous. In this case, the term does not relate to vehicle types with tracks or treads. | | Used | | Containing attributes of tracked vehicle lane type.   * spec-RevocableLane (0) * spec-commuterRailRoadTrack (1) * **spec-lightRailRoadTrack (2)** -- i.e. - tram * **spec-heavyRailRoadTrack (3)**  -- i.e. train * **spec-otherRailType (4)** -- i.e. trolleybus | Set by application |
| 6.8 | parking  [LaneAttributes-Parking] | The LaneAttributes-Parking data element relates specific properties found in a vehicle parking lane type. | | Not Used | | Containing attributes of parking lane type. Parking is not considered in the profile. | Set by application |
| **Level 7: NodeSetXY 🡪 NodeXY** | | | | | | | |
| 7.1 | **delta**  **[NodeOffsetPointXY]** | The NodeOffsetPointXY data frame presents a structure to hold different sized data frames for a single node point in a lane. | node-XY1  [Node-XY-20b]  A 20-bit node type with offset values from the last point in X and Y. Node is within 5.11m of last node. | Used | | Applied as appropriate, subject to distance to previous node point. | Set by application. |
| node-XY2  [Node-XY-22b]  A 22-bit node type with offset values from the last point in X and Y. Node is within 10.23m of last node. | Used | | Applied as appropriate, subject to distance to previous node point. | Set by application. |
| node-XY3  [Node-XY-24b]  A 24-bit node type with offset values from the last point in X and Y. Node is within 20.47m of last node. | Used | | Applied as appropriate, subject to distance to previous node point. | Set by application. |
| node-XY4  [Node-XY-26b]  A 26-bit node type with offset values from the last point in X and Y. Node is within 40.96m of last node. | Used | | Applied as appropriate, subject to distance to previous node point. | Set by application. |
| node-XY5  [Node-XY-28b]  A 28-bit node type with offset values from the last point in X and Y. Node is within 81.91m of last node. | Used | | Applied as appropriate, subject to distance to previous node point. | Set by application. |
| node-XY6  [Node-XY-32b]  A 32-bit node type with offset values from the last point in X and Y. Node is within 327.67m of last node. | Used | | Applied as appropriate, subject to distance to previous node point. | Set by application. |
| node-LatLon  [Node-LLmD-64b]  A 64-bit node type with lat-long values expressed in standard SAE one tenth of a micro degree. May only be used if the offset is more than 327.67 m from the previous point. | Used | | Applied as appropriate, subject to distance to previous node point. | Set by application |
| regional  [REGION.Reg-NodeOffsetPointXY] | Not used | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. No extensions are defined in the standard. | - |
| 7.2 | *attributes*  *[NodeAttributeSetXY]* | The NodeAttributeSetXY is a data frame used to convey one or more changes in the attribute set which occur at the node point at which it is used. | *localNode*  *[NodeAttributeXYList]* *(1..8)*  The NodeAttributeXYList data frame consists of a list of NodeAttributeXY entries. Attribute states which pertain to this node point. | Conditional | | Mandatory in profile as opposed to standard, if applicable. Up to 8 node attributes can be described:  (0) reserved  **(1) stopline**  (2) roundedCapStyleA  (3) roundedCapStyleB  **(4) mergePoint**  **(5) divergePoint**  (6) downstreamStopLine  (7) downstreamStartNode  **(8) closedToTraffic**  (9) safeIsland  (10) curbPresentAtStepOff  (11) hydrantPresent  Desired extension (not used in this version of the profile):  **(12) yield** | Set by application |
| *disabled* *[SegmentAttributeXYList]* *(1..8)*  The disabled data frame consists of a list of SegmentAttribute-XY entries. Attribute states which are disabled at this node point. | Conditional | | Mandatory in profile as opposed to standard, if applicable. Up to 8 segment attributes can be described:  (0) reserved  **(1) doNotBlock**  **(2) whiteLine**  -- only few metres upstream stop line  **(3) mergingLaneLeft**  **(4) mergingLaneRight**  (5) curbOnLeft  (6) curbOnRight  (7) loadingzoneOnLeft  (8) loadingzoneOnRight  **(9) turnOutPointOnLeft**  **(10) turnOutPointOnRight**  -- 9/10: in case a lane overlaps with a conflict area caused by a small side road  (11) adjacentParkingOnLeft  (12) adjacentParkingOnRight  **(13) adjacentBikeLaneOnLeft**  **(14) adjacentBikeLaneOnRight**  -- 13/14: in case of shared lane but with marked bicycle part.  **(15) sharedBikeLane**  **(16) bikeBoxInFront**  -- 16: typical use OFOS  (17) transitStopOnLeft  **(18) transitStopOnRight**  **(19) transitStopInLane**  **(20) sharedWithTrackedVehicle**  **(21) safeIsland**  (22) lowCurbsPresent  (23) rumbleStripPresent  (24) audibleSignalingPresent  (25) adaptiveTimingPresent  (26) rfSignalRequestPresent  (27) partialCurbIntrusion  **(28) taperToLeft**  **(29) taperToRight**  **(30) taperToCenterLine**  -- 28-30 shall only be used with merging point (not diverging points).  (31) parallelParking  (32) headInParking  (33) freeParking  (34) timeRestrictionsOnParking  (35) costToPark  (36) midBlockCurbPresent  (37) unEvenPavementPresent | Set by application |
| *enabled* *[SegmentAttributeXYList]* *(1..8)*  The enabled data frame consists of a list of SegmentAttribute-XY entries. Attribute states which are enabled at this node point and which remain enabled until disabled or the lane ends. | Conditional | | Mandatory in profile as opposed to standard, if applicable. Up to 8 segment attributes can be described. See previous. | Set by application |
| *data*  *[LaneDataAttributeList]* *(1..8)*  The LaneDataAttributeList data frame consists of a list of LaneDataAttribute entries. Attributes which require an additional data values some of these are local to the node point, while others persist with the provided values until changed and this is indicated in each entry. | Conditional | | Mandatory in profile as opposed to standard, if applicable. Only used to indicate speedLimits, if they are different than the global speed limit of the Intersection. | See level 10 |
| *dWidth* *[Offset-B10]*  A value added to the current lane width at this node and from this node onwards. | Conditional | | Mandatory in profile as opposed to standard, if applicable considering step size of 25 cm. The current lane width is defined on the top level (default 3 meters). The actual lane width is to be rounded in steps of 25 cm and then added to the default 3 meters here. E.g. a lane width of 338 cm results in a dWidth of 50 cm. | Set by application. |
| *dElevation* *[Offset-B10]*  A value added to the current Elevation (i.e. the elevation at the previous node) which applies at this node and from this node onwards. | Conditional | | The current elevation is defined on the top level as part of the reference position. Mandatory if the road gradient, compared to the previous node, is more than 2%, which is considered the minimum gradient which affects the road capacity. | Set by application. |
| *regional*  *[REGION.Reg-NodeAttributeSetXY]* | Not used | | The element is used for additional "regional information”, as defined in ISO/PDTS 19091.  ‘Control-addGrpC’, allows to specify public transport specific points (sign-in, sign-out etc.; PtvRequestType). This is not used because cooperative intersections should track the public transport vehicles continuously. | - |
| **Level 8: NodeSetXY 🡪 ComputedLane** | | | | | | | |
| 8.1 | **referenceLaneId**  **[LaneID]** | The LaneID data element conveys an assigned index that is unique within an intersection. It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of specialty lanes. | | Not used | | ComputedLane is not used in the profile. | - |
| 8.2 | **offsetXaxis** | A path X offset value for translations of the path's points when creating translated lanes. The values found in the reference lane are all offset based on the X and Y values from the coordinates of the reference lane's initial path point. | small  [DrivenLineOffsetSm]  The DrivenLineOffsetSmall data element is an integer value expressing the offset in a defined axis from a reference lane number from which a computed lane is offset. The measurement is taken from the reference lane center line to the new center line, independent of any width values. | Not used | | ComputedLane is not used in the profile. | - |
| large  [DrivenLineOffsetLg]  The DrivenLineOffsetLarge data element is an integer value expressing the offset in a defined axis from a reference lane number from which a computed lane is offset. The measurement is taken from the reference lane center line to the new center line, independent of any width values. |
| 8.3 | **offsetYaxis** | A path X offset value for translations of the path's points when creating translated lanes. The values found in the reference lane are all offset based on the X and Y values from the coordinates of the reference lane's initial path point. | small  [DrivenLineOffsetSm]  The DrivenLineOffsetSmall data element is an integer value expressing the offset in a defined axis from a reference lane number from which a computed lane is offset. The measurement is taken from the reference lane center line to the new center line, independent of any width values. | Not used | | ComputedLane is not used in the profile. | - |
| large  [DrivenLineOffsetLg]  The DrivenLineOffsetLarge data element is an integer value expressing the offset in a defined axis from a reference lane number from which a computed lane is offset. The measurement is taken from the reference lane center line to the new center line, independent of any width values. |
| 8.4 | *rotateXY*  *[Angle]* | The data element Angle is used to describe an angular measurement in units of degrees. This data element is often used as a heading direction when in motion. | | Not used | | ComputedLane is not used in the profile. | - |
| 8.5 | *scaleXaxis* *[Scale-B12]* | Value for translations or zooming of the path's points. The values found in the reference lane are all expanded or contracted based on the X and Y and width values from the coordinates of the reference lane's initial path point. The Z axis remains untouched. | | Not used | | ComputedLane is not used in the profile. | - |
| 8.6 | *scaleYaxis* *[Scale-B12]* | Value for translations or zooming of the path's points. The values found in the reference lane are all expanded or contracted based on the X and Y and width values from the coordinates of the reference lane's initial path point. The Z axis remains untouched. | | Not used | | ComputedLane is not used in the profile. | - |
| 8.7 | *regional*  *[REGION.Reg-ComputedLane]* | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Not used | | Subject to ISO/PDTS 19091. No extensions are defined in the standard. | - |
| **Level 9: ConnectsToList 🡪 Connection** | | | | | | | |
| 9.1 | **connectingLane**  **[ConnectingLane]** | The ConnectingLane data frame ties a single lane to a single maneuver needed to reach it from another lane. It is typically used to connect the allowed maneuver from the end of a lane to the outbound lane so that these can be  mapped to the SPAT message to which both lanes apply. | **lane**  **[LaneID]**  The LaneID data element conveys an assigned index that is unique within an intersection. It is used to refer to that lane by other objects in the intersection map data structure. Lanes may be ingress (inbound traffic) or egress (outbound traffic) in nature, as well as barriers and other types of specialty lanes. | Mandatory | | LaneID expresses the lane the current lane connects to. If IntersectionReferenceID is filled, the lane belongs to another intersection. | Set by application |
| *maneuver*  *[AllowedManeuvers]*  The AllowedManeuvers data element relates the allowed (possible) maneuvers from a lane, typically a motorized vehicle lane. | Profiled | | Mandatory in profile as opposed to standard. Used to describe the allowed movements related to the signal head. SignalGroupID and Restrictions apply to this movement only.   * **maneuverStraightAllowed (0)** * **maneuverLeftAllowed (1)** * **maneuverRightAllowed (2)** * **maneuverUTurnAllowed (3)** * maneuverLeftTurnOnRedAllowed (4) * maneuverRightTurnOnRedAllowed (5) * maneuverLaneChangeAllowed (6) * maneuverNoStoppingAllowed (7) * **yieldAllwaysRequired (8)** * goWithHalt (9) * caution (10) * reserved1 (11) | Set by application |
| 9.2 | *remoteIntersection*  *[Intersection-ReferenceID]* | The IntersectionReference-ID is a globally unique value set, consisting of an optional RoadRegulatorID and a required IntersectionID assignment, providing an unique mapping to the intersection MAP. | *region*  *[RoadRegulatorID]*  The RoadRegulatorID data element is a globally unique identifier assigned to a regional authority. | Profiled | | IntersectionReferenceID is mandatory if the ConnectingLane is part another intersection.  RoadRegulatorID is mandatory in profile as opposed to standard. | Set by application |
| **id**  **[IntersectionID ]**  The IntersectionID is used within a region to uniquely define an intersection within that country or region. | Mandatory | | If the lane connects to another intersection the IntersectionID is mandatory. | Set by application |
| 9.3 | *signalGroup*  *[SignalGroupID ]* | The SignalGroupID data element is an index used to map between the internal state of one or more signal controllers and a common numbering system that can represent all possible combinations of active states (movements and phases). All possible movement variations are assigned a unique value within the intersection.  The SignalGroupID data element is used to match the signal group send by the SPAT message for this lane/maneuver. | | Conditional | | Mandatory if the lane is controlled by a signal. Please note that the range for the SignalGroupID is such that the common Dutch number scheme could contain too high numbers. Therefore SignalGroupIDs must be numbered continuously starting at 1 (see SPAT profile). | Set by application |
| 9.4 | *userClass*  *[RestrictionClassID]* | The RestrictionClass data element defines an intersection-unique value to convey data about classes of users. The typical use of this element is to map additional movement restrictions or rights (in both the MAP and SPAT messages) to special classes of users (trucks, high sided vehicles, special vehicles etc.). | | Conditional | | Mandatory if Connection or AdvisorySpeed (SPaT) is valid for a specific class only, for example public transport. | Set by application |
| 9.5 | *connectionID*  *[LaneConnectionID]* | The LaneConnectionID data entry is used to state a connection index for a lane to lane connection. It is used to relate this connection and any dynamic clearance data sent in the SPAT. | | Mandatory | | Mandatory in profile as opposed to standard. Can be used to uniquely identify one connection, for example to support a priority request.  To each Connection a unique (within intersection) LaneConnectionID must be added, only Connections with the same manoeuvre and SignalGroup can have the same LaneConnectionID. LaneConnectionIDs must be numbered continuously, starting at 0. | Set by application |
| **Level 10: LaneDataAttributeList 🡪 LaneDataAttribute** | | | | | | | |
| 10.1 | pathEndPointAngle [DeltaAngle] | The DeltaAngle data element provides the final angle used in the last point of the lane path. Used to "cant" the stop line of the lane. | | Not used | | Too detailed for day-1 use. | - |
| 10.2 | laneCrownPointCenter [RoadwayCrownAngle] | The RoadwayCrownAngle data element relates the gross tangential angle of the roadway surface with respect to the local horizontal axis and is measured at the indicated part of the lane. Its typical use is to relate data used in speed warning and traction calculations for the lane segment or roadway segment in which the measurement is taken. | | Not used | | Too detailed for day-1 use. | - |
| 10.3 | laneCrownPointLeft [RoadwayCrownAngle] | The RoadwayCrownAngle data element relates the gross tangential angle of the roadway surface with respect to the local horizontal axis and is measured at the indicated part of the lane. Its typical use is to relate data used in speed warning and traction calculations for the lane segment or roadway segment in which the measurement is taken. | | Not used | | Too detailed for day-1 use. | - |
| 10.4 | laneCrownPointRight [RoadwayCrownAngle] | The RoadwayCrownAngle data element relates the gross tangential angle of the roadway surface with respect to the local horizontal axis and is measured at the indicated part of the lane. Its typical use is to relate data used in speed warning and traction calculations for the lane segment or roadway segment in which the measurement is taken. | | Not used | | Too detailed for day-1 use. | - |
| 10.5 | laneAngle [MergeDiverge-NodeAngle] | The angle at which another lane path meets the current lanes at the node point. Typically found in the node attributes and used to describe the angle of the departing or merging lane. | | Not used | | Too detailed for day-1 use. | - |
| 10.6 | speedLimits  [SpeedLimitList] (1..9) | The SpeedLimitList data frame consists of a list of SpeedLimit entries. | RegulatorySpeedLimit | Profiled | | Mandatory if speed limit differs from the general speed limit defined at top level (e.g. for side road as opposed to main road). | See level 4/11 |
| 10.7 | regional  [REGION.Reg-LaneDataAttribute] | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Not used | | No extensions are defined in the standards.  Desired extensions:  maxVehicleHeight [VehicleHeight] – type as defined in J2735.  maxVehicleWeight [VehicleMass] – type as defined in J2735. | - |
| **Level 11: RestrictionUserTypeList 🡪 RestrictionUserType** | | | | | | | |
| 11.1 | basicType  [RestrictionAppliesTo] | The RestrictionAppliesTo data element provides a short list of common vehicle types which may have one or more special movements at an intersection, i.e. the movement is restricted to the indicated types only. In general, these movements are not visible to other traffic with signal heads, but the SPAT data reflects the state of the movement. Various restricted movements at an intersection can be expressed using this element to indicate where the movement applies. | | Used | | Out of a set of most commonly used types:  (0) none  **(1) equippedTransit**  **(2) equippedTaxis**  **(3) equippedOther**  **(4) emissionCompliant**  **(5) equippedBicycle**  **(6) weightCompliant**  **(7) heightCompliant**  **(8) pedestrians**  **(9) slowMovingPersons**  **(10) wheelchairUsers**  **(11) visualDisabilities**  **(12) audioDisabilities**  **(13) otherUnknownDisabilities** | Set by application |
| 11.2 | regional  [REGION.Reg-RestrictionUserType] | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Used | | ‘RestrictionUserType-addGrpC’ can be used to set EmissionType as a user restriction, i.e. the restricted users are allowed to use a movement or lane. Emission types are euro1…euro6.  Desired extension (not used in this version of the profile):  fuelType [FuelType] – type as defined in J2735. | Set by application |
| **Level 12: Position3D** | | | | | | | |
| 12.1 | **lat**  **[Latitude]** | The geographic latitude of an object, expressed in 1/10th integer micro degrees, as a 31 bit value, and with reference to the horizontal datum then in use. The value 900000001 shall be used when unavailable. | | Mandatory | |  | Set by application |
| 12.2 | **long**  **[Longitude]** | The geographic longitude of an object, expressed in 1/10th integer micro degrees, as a 32-bit value, and with reference to the horizontal datum then in use. The value 1800000001 shall be used when unavailable. | | Mandatory | |  | Set by application |
| 12.3 | *elevation*  *[Elevation]* | The data element represents the geographic position above or below the reference ellipsoid (typically WGS-84). The number has a resolution of 1 decimetre and represents an asymmetric range of positive and negative values. | | Not used | | DE is replaced by ETSI altitude in REGION-Reg-Position3D. | - |
| 12.4 | *regional*  *[REGION.Reg-Position3D]* | The element is used for additional "regional information”, as defined in ISO/PDTS 19091. | | Conditional | | Altitude as described in ETSI TS 102 894-2 V1.2.1 (2014-09).  Altitude ::= SEQUENCE {  altitudeValue AltitudeValue,  altitudeConfidence AltitudeConfidence  }  Mandatory in profile as opposed to standard  if the road gradient within the scope of the intersection is more than 2%.  altitudeConfidence is not used in profile, therefore indicated as unavailable = 15. | Set by application |

## Probe Vehicle Data (PVD)

### PVD CAM Profile

This chapter describes the profile for CAM [CAM] for the Traffic Data Collection Probe Vehicle Data (PVD) use case. See section 1.3 Legend for the meaning of the references and Appendix F for an overview. Note the UK TestFest will be receiving CAM messages via ITS-G5 communications only for those vehicles that are broadcasting CAM messages. The messages will be logged by the RSU but will not be forwarded onto the Central Station.

| ID | CAM standard | | UK Profile | | |
| --- | --- | --- | --- | --- | --- |
|  | Field | Meaning | Status | Content | Value |
|  | **header** | | | | |
| **PVD 1** | **protocolVersion** | **Version of the protocol. Current version is 1, thus field is set to 1.** | **Mandatory** |  | 1 |
| **PVD 2** | **messageID** | **Indicates the type of message. Examples are DENM (1), CAM (2), IVI (6), etc. Here 2 is used.** | **Mandatory** |  | 2 |
| **PVD 3** | **stationID** | **This is the ID of the station (vehicle) broadcasting the message.** | **Mandatory** | ETSI 102 894-2 states the following:  Identifier of an ITS-Station INTEGER (0..4294967295)  ISO17419 defines process for registering ITS-S equipment and managing unique ID’s What is the method for generating these and who is the trusted authority in this regard? How is uniqueness maintained? (probably not an issue for TestFest) | Set by application |
|  | **cam** | | | | |
| **PVD 4** | **generationDeltaTime** | Timestamp belonging to the referencePosition. | **Mandatory** | Time corresponding to the time of the reference position in the CAM, considered as time of the CAM generation.  The value of the DE shall be wrapped to 65 536. This value shall be set as the remainder of the corresponding value of TimestampIts divided by 65536 as below:  generationDeltaTime = TimestampIts mod 65 536  TimestampIts represents an integer value in milliseconds since 2004-0101T00:00:00:000Z  As defined in ETSI TS 102 894-2 [2]. | Set by application |
|  | **Basic container** | | | | |
| **PVD 5** | **stationType** | **Station type of the originating ITS-S.**  **StationType ::= INTEGER {unknown(0), pedestrian(1), cyclist(2), moped(3), motorcycle(4), passengerCar(5), bus(6), lightTruck(7), heavyTruck(8), trailer(9), specialVehicles(10), tram(11), roadSideUnit(15)} (0..255)** | **Mandatory** | This DE can be 0 or 4 – 10. Other values indicate vehicles that are not allowed on the highway.  Expecting values of 0, 5 or 10 for the UK OBUs | Set by application |
| **PVD 6** | **referencePosition** | **Latitude** | **Mandatory** | This DF is of type ReferencePosition (DF A.124 from [Dictionary]). It contains the coordinates (WGS 84) of the ITS station (vehicle). | Set by application |
| **PVD 7** | **Longitude** |
| **PVD 8** | **positionConfidenceElipse** | **Mandatory** | Unavailable | 4095 |
| **PVD 9** | **Altitude** | **Mandatory** | Unavailable | 3601 |
|  | **highFreqContainer** | | | | |
| **PVD 10** | **heading** | **headingValue** | **Mandatory** | The (compass) direction of the vehicle, in 1/10th of a degree | Set by Application |
| **PVD 11** | **headingConfidence** | **Mandatory** | Set by Application | Set by Application |
| **PVD 12** | **speed** | **speedValue** | **Mandatory** | Speed of the vehicle in cm/s. Set by Application | Set by Application |
| **PVD 13** | **speedConfidence** | **Mandatory** | Set by Application | Set by Application |
| **PVD 14** | **driveDirection** |  | **Mandatory** | The direction the vehicle is travelling in: forward (0), backward (1) or unavailable (2). | Set by Application |
| **PVD 15** | **vehicleLength** | **vehicleLenghtValue** | **Mandatory** | Length of the vehicle in steps of 10 cm (1 equals 10 cm). Setting to ‘unavailable’. | Set by Application |
| **PVD 16** | **vehicleLenghtConfidenceIndication** | **Mandatory** | setting to ‘unavailable’. | Set by Application |
| **PVD 17** | **vehicleWidth** |  | **Mandatory** | The vehicle width in 10 cm steps (1 equals 10 cm). Required by the standard but not part of the wish list. Setting to ‘unavailable’. | Set by Application |
| **PVD 18** | **Longitudinal-Acceleration** | **longitudinalAccelerationValue** | **Mandatory** | The longitudinal (forward / backward) acceleration of the vehicle in steps of 0.1 m/s2. Setting to ‘unavailable’. | Set by Application |
| **PVD 19** | **longitudinalAccelerationConfidence** | **Mandatory** | setting to ‘unavailable’. | Set by Application |
| **PVD 20** | **curvature** |  | **Mandatory** | The curvature of the vehicle trajectory. Required by the standard but not part of the wish list. Setting to ‘unavailable’. | Set by Application |
| **PVD 21** | **curvatureCalculation-Mode** |  | **Mandatory** | The calculation mode for the curvature. Required by the standard but not part of the wish list. Setting to ‘unavailable’. | Set by Application |
| **PVD 22** | **yawRate** |  | **Mandatory** | The rate the vehicle is spinning around its centre of mass. Required by the standard but not part of the wish list. Setting to ‘unavailable’. | Set by Application |

# 

# Network& Transport Layer

This section explains how the different message sets received from the Facilities Layer are handled by the Network&Transport (N&T) Layer, (‘source’ operations) and handed over via information on BTP destination port.

The protocols used by the Network&Transport layer are Basic Transport Protocol [BTP] and GeoNetworking [GN]. Other Network&Transport layer protocols like TCP/UDP/IP(v6) are not in scope of this document.

The data elements of the BTP and GN protocols used for DENM and IVI message sets are sent by the C-ITS-S (C-ITS-S as source) are described in this section.

The deployment of the R-ITS-S networks as described in this section is based on the following:

* All messages related to ‘events’ that are sent by a R-ITS-S are assumed to be relevant for V-ITS-S within communication range, and should be processed by the internal Facilities/Applications functions of the V-ITS-S. For this reason the destination area for GBC messages is set to a circle around the R-ITS-S with a radius larger than the max. communication range of the R-ITS-S (typical 400m @23 dBm) and set to 1.000 m around. In this way all V-ITS-S within communication range are automatically also in the destination area and will process the message in the Facilities/Application layer.
* The geographical routing of events is controlled by a C-ITS-S (Central Unit, CU), so the most appropriate R-ITS-S for events is selected by a central C-ITS-S system. This approach is different from vehicles where ‘events’ are always related to the physical vehicle, and the physical location of the V-ITS-S. For a R-ITS-S network, with communication nodes that are directly connected to a (physical) information system along a highway, this approach is regarded as most efficient and simple.
* The R-ITS-S does not request multi-hop operation, all messages are sent with a MHL=1 or via SHB. The advantage is that the initial deployment is simplified, and predictable. In a later phase this might change, e.g. at higher penetration rates (>5%).

The rest of this section explains the parameters used in the different message sets of the use cases of the ITS Corridor. This section gives references to the C2C Basic System Profile specification [C2C]. Although this C2C specification is not public and may not be available to all, it is considered highly relevant as a reference.

The table gives an overview of the main data elements used for the different messages at the N&T layer, where the R-ITS-S is the ‘source’ of the message. The GN forwarding operations of the R-ITS-S are explained in chapter ‘Access Layer’.

## Basic Transport Protocol

Basic Transport Protocol shall be applied as transport protocol according to the ETSI specification [BTP].

| **Element** | **Content** | **Profile status** | **Value** | **Comment** |
| --- | --- | --- | --- | --- |
| Next Header (NH) | BTP-B for non-interactive packet transport. | Profiled | BTP-B (2) |  |
| Destination port | Set to values as described in [BTP]. | Profiled | CAM = (2001) | Not used. According to the standard all ITS-S shall send CAM messages. However, the R-ITS-S has no physical relevance, since the R-ITS-S does not participate in traffic and position, speed and heading are irrelevant for e.g. collision avoidance. The details for CAM by an R-ITS-S are not fully specified in [CAM]. CAM messages are therefore not used for R-ITS-S. |
| This requirement is similar to RS\_BSP\_275 [C2C]. |
| DENM = (2002) | This requirement is similar to RS\_BSP\_276 [C2C]. |
| IVI = (2006) | Specific to R-ITS-S. Not included in [BTP]. |
| Destination port info |  | Profiled | Set to value 0 | This requirement is similar to RS\_BSP\_274 [C2C]. |

## GeoNetworking

GeoNetworking (GN) shall be applied as networking protocol according to the ETSI specification [GN]. Default protocol constants of the GN protocol not overwritten in this profile shall be set as specified in Annex G of [GN]. The table underneath provides an overview of GN protocol constants for this R-ITS-S profile.

| **Element** | **Content** | **Profile status** | **Value** | **Comment** |
| --- | --- | --- | --- | --- |
| Basic Header | | | | |
| Version |  |  |  | Version 0 (1.2.1) |
| Next Header (NH) | The Next Header field shall be set to Secured Packet for all packets. | Profiled | Secured Packet (2) |  |
| LifeTime (LT) | The LifeTime (LT) field of all GBC packets shall be set to the minimum of validityDuration and repetitionInterval. The value of the LifeTime field shall not exceed the itsGnMaxPacket-Lifetime, specified in Annex G of [GN]. | Profiled | Equal to min(validity-Duration, repetition-Interval). | This requirement is similar to RS\_BSP\_259 [C2C]. |
| Common Header | | | | |
| Next Header (NH) | BTP-B headers shall be employed for ITS messages where the R-ITS-S is the ‘source’ of the message sent towards V-ITS-S. | Profiled | BTP-B (2) | Section 7.3 from [BTP] requirement is similar to RS\_BSP\_273 [C2C] |
| Header Type (HT) |  | Profiled | SinglehopBroadcast | Singlehopbroadcast (SHB) |
| Header Sub Type (HST) | Circular area. | Profiled | Ceoanycast\_Circle (0) | For DENM and IVI. |
| Traffic Class (TC): Store-Carry-Forward (SCF) | Store-carry-forward shall be disabled. Consequently, the SCF bit of the Traffic Class (TC) field of the Common Header of GBC packets shall be set to 0. | Profiled | Disabled (0) | This requirement differs from C2C RS\_BSP\_260. The GBC messages of a R-ITS-S (source) are sent with MHL=1 for DENM / IVI packets. An R-ITS-S will not request forwarding operations from the V-ITS-S, either direct or via ‘stored-carry-forward’. |
| Traffic Class (TC): Channel Offload | Channel offload shall always be disabled for GN packets (for the DENM and IVI messages). Consequently, the channel offload bit of the TC field of the Common Header of all packets shall be set to 0. | Profiled | Disabled (0) | This requirement is similar to RS\_BSP\_262 [C2C]. |
| Traffic Class (TC): TC ID | The DENM and IVI messages shall always be sent via the CCH-channel. A R-ITS-S shall use the mapping of Traffic Class ID (TC ID) to Access Categories, as specified in clause 8, table 5 of [GN]. | Profiled | DENM = (1) or (3)  IVI = (2) or (3) | The DENM priority is defined by the related use case as specified in [RHS], [ICRW] and [LCRW]. The traffic class is not included in the DENM message, but passed from the Applications and Facilities layer to the Network&Transport layer, as defined in [GN], Annex I.  The Amsterdam Group [AG-FD] / [AG-MS] defines that the value for repetitionInterval shall be set in accordance with the applicable Decentralized Congestion Control (DCC) algorithm [DCC], implying that the value shall be in the range between 0.1 and 0.5 sec. Simultaneously the repetition interval (TTX) for Traffic Class (TC) 1 has been defined to be between 95ms and 250ms, depending on the channel load. It is assumed that both rules together imply that the value for repetitionInterval shall be between 0.1 and 0.25 sec.  This profile assumes that although for DENM the TC value (1) and for IVI the TC value (2) is the optimal value for the long term, for ‘day 1’ the value (3), which implies a higher repetition interval and a lower broadcasting frequency, is more appropriate. For ‘day 1’ therefore a TC value of (3) and a broadcasting frequency of 1 Hz for both DENM and IVI may be used. |
| Flags | The Flags value shall be set to the GN protocol constant itsGnIsMobile. | Profiled | Equal to itsGnIsMobile | This parameter is Stationary (0) for R-ITS-S. |
| Max Hop Limit (MHL) | Maximum hop limit. | Profiled | DENM = (1)  IVI = (1) | It is assumed that R-ITS-S are placed at selected pre-defined positions, so equipped vehicles (with V-ITS-S) will receive I2V messages in a consistent way without the need for multi-hop support by V-ITS-S. |
| Extended Header | | | | |
| Source Position Vector: GN Address: Source Station Type (ST) (itsStationType) | Data element ST (Station Type) of the GN address in the Source Position Vector of the GBC header. The station type in the GN source address shall be identical to the station type in DENMs. For IVIs the station type shall be set to RoadSideUnit (15). | Profiled | RoadSideUnit (15) |  |
| Source Position Vector: GN Address: ITS Country Code (SCC) | Country specific. | Profiled |  | Address: ITS CountryCode removed in ETSI EN 302 636-4-1 V1.3.1 hence needs checking |
| Source Position Vector: GN Address: Lat/Long | Position of the R-ITS-S | Profiled | Set by application. |  |
| Source Position Vector: Position Accuracy Indicator (PAI) | A R-ITS-S shall send beacon messages, according to [GN], clause 9.2.3. A R-ITS-S may only send messages with the Position Accuracy Indicator (PAI) set to 1. | Profiled | (1) | This requirement is similar to RS\_BSP\_269 [C2C]. The position accuracy of a R-ITS-S shall be better than 40 m 2drms (twice distance root-mean-squared) in all 3 dimensions. |
| Source Position Vector: Speed (S) | Assuming stationary R-ITS-S. | Profiled | (0) |  |
| Source Position Vector: Heading (H) | Assuming stationary R-ITS-S. | Profiled | (0) |  |
| GeoAreaPos: Lat/Long | For DENM and IVI this shall be the position of the R-ITS-S. | Profiled | Position of the R-ITS-S |  |
| Distance a | 1000 m. | Profiled | (1000) |  |
| Distance b | 0 m. | Profiled | (0) |  |
| Angle | 0 degrees | Profiled | (0) |  |
| Protocol constants | | | | |
| itsGnLocalAddr-ConfMethod | The data elements of the GN address will be derived from the N&T layer management entity. The GN address configuration of a R-ITS-S shall not use ‘Anonymous’. | Profiled | Managed (1) |  |
| itsGnIsMobile | This parameter is used in the data element Flags of the GN Common Header. | Profiled | Stationary (0) for R-ITS-S |  |
| itsGnIfType | GN shall only be used with itsGnIfType = ITS-G5 (1). | Profiled | ITS-G5 (1) | This requirement is similar to RS\_BSP\_414 [C2C]. |
| itsGnSecurity | GN packets shall include security header and certificate formats, according to [SHC]. | Profiled | Enables (1) | this requirement is similar to RS\_BSP\_251 [C2C]. |
| itsGnMaxGeo-AreaSize | The maximum size of geographical areas in GBC or GBA shall be 80 km². | Profiled | (80) | This requirement is similar to RS\_BSP\_255 [C2C]. |
| itsGnDefault-TrafficClass |  | Profiled | (0x03) |  |
| itsGnGeo-Broadcast-Forwarding-Algoritm | A R-ITS-S shall not request GN forwarding operations from V-ITS-S, either direct or via Store-Carry-Forward. A R-ITS-S shall forward GN messages received from V-ITS-S’s as specified in [GN]. The multi-hop operation mode (forwarding operation) shall be supported by implementing the forwarding algorithm specified in the Annex E.3 [GN]. Consequently, the GN protocol constant itsGnGeoBroadcastForwardingAlgoritm shall be set to the value 2 (Contention Based Forwarding, CBF). | Profiled | Contention Based Forwarding (CBF) (2) | This requirement is similar to RS\_BSP\_266 [C2C]. |
| Duplicate packet detection | | | | |
| Algorithm | Duplicate packet detection shall be used. Consequently, the algorithm specified in A.2 and A.3 of [GN] shall be used for detecting duplicate packets. | Profiled | As in A.2, A.3 of [GN] | This requirement is similar to RS\_BSP\_268 [C2C]. |

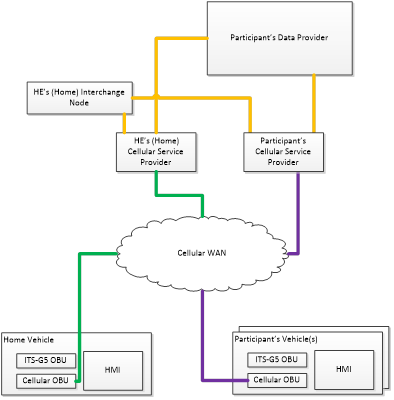
# Security Entity

This section has been produced in order to provide a security view to the Baseline Specification. It provides the relevant security details that underpin interoperability requirements for participation. It also provides further information on the process to obtain cryptographic material required to achieve interoperability with the TestFest environment.

Certificates will be made available for TestFest and revoked at the end of TestFest

The security specification being used is ETSI standard 103 097 V1.2.1.

## Option 1: Participant’s own Data Provider



IF2 communication between the participant’s CSP and the home interchange node to allow the participant’s cellular OBU to receive Country A information and/or IF2 communication between the participant’s CSP and the foreign interchange node to a Simulation of a new country using the participant’s own data provider, cellular service provider and cellular OBU. This could be configured to replace the simulated Country B or introduce a new geographical boundary as Country C.

Interoperability requirements:

IF2 communication from the participant’s data provider/interchange node to the Home CSP to allow the UK Cellular OBUs to communicate in the new Country B OR an IF2 communication between the data provider/interchange node with both Home and Foreign CSP to allow both cellular OBUs to communicate in the new country C.

Allow the participant’s cellular OBU to receive Country B information.

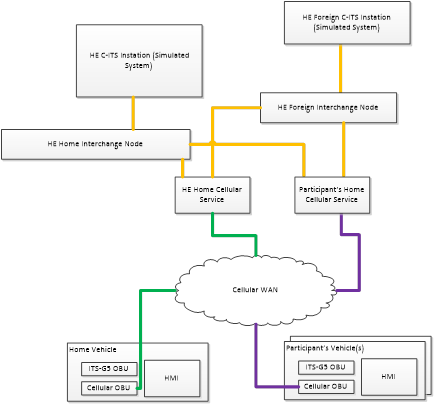
Security profile:

It is the Participant’s responsibility to ensure that it has conducted a risk assessment secure its own equipment and the communications between said assets.

AMQP over TLS v1.2

TLS configuration details available on request e.g. supported cipher suites.

## Option 2: Participant’s Cellular Service Provider and Cellular OBU



Similar to Option 1, but without the provision of a Participant’s Data Provider. The InterCor partner will participate with their own cellular-connected OBU connecting back to their own Cellular Service provider.

Interoperability requirements:

The participant will require connectivity to a Highways England data source to receive the C-ITS data in AMQP format. This will require connectivity to either or both interchange nodes:

The HE Home Interchange Node or;

The HE Foreign Interchange Node

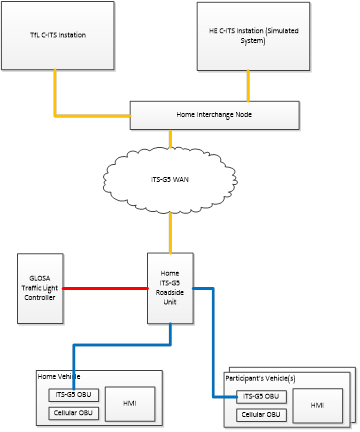
Security Profile:

It is the Participant’s responsibility to ensure that it has conducted a risk assessment secure its own equipment and the communications between said assets.

AMQP over TLS v1.2

TLS configuration details available on request e.g. supported cipher suites.

## Option 3: Participant with ITS-G5 OBU



InterCor partner participation with its own vehicle equipped with an ITS-G5 OBU.

Interoperability requirement:

In order to send and receive ITS-G5 C-ITS messages with the RSUs and other vehicle OBUs, it is necessary for the participant to implement consistent standards and be part of the same certificate trust domain. This will ensure that the participant equipment and other TestFest assets can sign and validate messages.

Security profile:

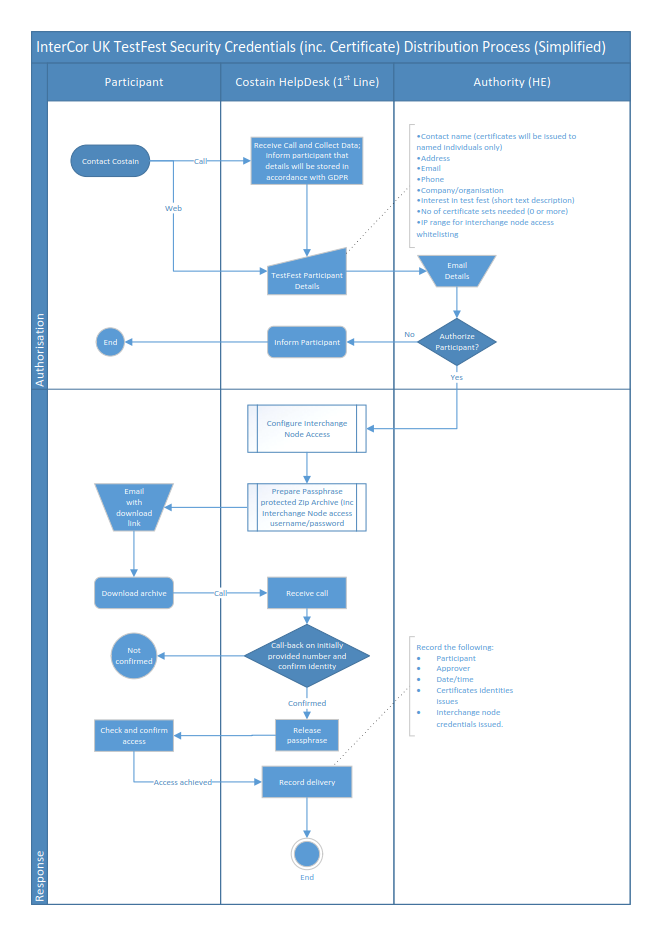
Highways England will be establishing a dedicated trust domain for the duration of the trial. A manual key distribution process will be established and will require participants to enrol before receiving the certificates for TestFest. A Terms of Use/Acceptable Use Policy must be signed by each participant before certificates are issued

ETSI 103 097 v1.2.1 will be used as the standard for message certificate formats

ETSI 102 941 v1.1.1 will be used as the Trust and Privacy Standard

Each participant device will be provided on Authorisation Ticket for the duration of the TestFest There will be no Certificate Revocation Lists (CRLs) used There will be no Certificate Trust Lists (CTLs) used.

## Enrolment Process



* ERTICO manages participant registration. Once registration is closed, the participant will be instructed to contact Costain for refining and approval by Highways England.
* After the first pass, further information is requested from the selected participants. This information includes participant type (cellular/ITS-G5); name, contact details, number of devices etc. Note: it is important that participants provide a suitable contact number and email address that they can access within the UK. This will be used to authenticate participants as part of the issuing process.
* An Acceptable Usage Policy / Terms of Use policy will be issued to participants as part of the registration process. This document will need to be signed by each participant and returned for approval
* Highways England will review participant information and signed AUP/ToU. Provided that participants are authorised and have completed the documentation, they will be granted.
* Should the request be from an unauthorised person then the request will be denied. If the request omits any information, it will be sent back to the participant for update.

Request denied – End of Process

* Once approval has been granted by Highways England, information will be provided by Highways England’s suppliers to the participant on how to access the issued certificates. Certificates will be placed into a time-limited file transfer service as an encrypted archive (AES 256 zip). Participants are expected to have appropriate software to decrypt. Highways England’s Service Desk will email temporary account details to the requestor using the contact details provided in step 2 and provided the passphrase to the encrypted file via the registered telephone.
* The participant will then be able to log into the time-limited transfer service to download the encrypted certificates and decrypt with the passphrase provided.
* Process completed.

# Hybrid C-ITS Services

## Introduction

The IF2 interface being used is as follows ‘InterCor\_2.1b\_IF2\_specs-v1.0 final’.

Subscribers to the UK IF2 services should follow the process below.

Email the Costain service desk ([technologysupport@costain.com](mailto:technologysupport@costain.com)) and provide the following information:

* Contact name
* Address
* Email
* Phone
* Company/organisation
* Interest in TestFest (short text description)
* IP range for interchange node access whitelisting
* If OBU certificate are also required please specify how many

Please note the following information relates to the UK IF2 interface.

* Zoom levels 15-17 will be used to defines a subscription region i.e. OBU’s will receive information in these areas.
* Zoom level 18 will be used to define a dissemination area e.g. Detection Zone and Relevance Zone.
* The alogrithm used to generate the routing key is the one used by the Bing Maps Tile System (<https://msdn.microsoft.com/en-us/library/bb259689.aspx>). A validation tool is provided which converts WGS 84 format lat/lon co-ordinates into quadtrees using this algorithm (<https://a2m2-map.costain.technology>).

## Payloads

The UIN InterCor IF2 AMQP broker is payload agnostic. Payloads (IVI, DENM, MAP and SPAT messages) received from the UIN are published “as is” to IF2 data consumers. The actual validity of the baseline message structure is not asserted by IF2. It is the responsibility of the C-ITS service to publish the payloads in conformance to ETSI message specifications.

## UIN address

The Unified Interchange Node InterCor Broker can be reached at:

|  |  |  |  |
| --- | --- | --- | --- |
| Country | FQDN | IP | TCP port |
| A | a2m2-in-mq-a.costain.technology | 52.151.86.229 | 5602 |
| B | a2m2-in-mq-b.costain.technology | 52.151.95.107 | 5602 |

## IP White listing

UIN InterCor IF2 AMQP connections over the public internet are only possible from white listed IP addresses. IP address whitelisting can be requested by submitting a request to [technologysupport@costain.com](mailto:technologysupport@costain.com).

## Encryption

Only TLS encrypted AMQP connections are supported. The server certificate will be signed by a certificate chain based on the DigiCert Global Root CA root certificate. <https://dl.cacerts.digicert.com/DigiCertGlobalRootCA.crt>

## Authentication

AMQP connections are authenticated by AMQP “plain” authentication. Username and password can be requested by contacting [technologysupport@costain.com](mailto:technologysupport@costain.com).

## Connection limit

In order to protect the operational integrity of the UIN, the IF2 AMQP broker deployment will enforce a connection limit per virtual host. It will not be possible to establish a new AMQP connection once this limit has been reached. Since this limit is not per account, a rogue consumer implementation could saturate the limit and prevent other consumers to connect. Therefor we urge consumers to take extra care in their implementation and prevent accidental build-up of AMQP connections. The following "fair use" policy is in affect for consumers:

|  |  |
| --- | --- |
| AMQP virtual host | Maximum number of concurrent AMQP connections per account |
| production | 2 |
| test | 5 |

## Virtual hosts

|  |  |
| --- | --- |
| AMQP virtual host | UID domain |
| production | a2m2-in-mq-a.costain.technology  a2m2-in-mq-b.costain.technology |
| test | a2m2-in-mq-a.costain.technology |

## Exchanges

|  |  |
| --- | --- |
| Name | Description |
| IVI | Exchange on which IVI payloads will be published |
| DENM | Exchange on which DENM payloads will be published |
| CAM | Exchange on which CAM payloads will be published |
| SPAT | Exchange on which SPAT payloads will be published |
| MAP | Exchange on which MAP payloads will be published |

## Queues

As defined by the InterCor IF2 specification (ref[1]), queues should be created by the clients as non-durable, exclusive and auto-delete. Additionally, clients must also configure the queue maximum length and should configure their maximum message time-to-live. In order to safe guard operational limits the UIN InterCor IF2 AMQP broker deployment will additionally enforce upper limits for queue parameters.

|  |  |
| --- | --- |
| Queue parameter | Upper limit |
| x-expires | 1000 |
| x-max-length | 1000 |
| x-max-length-bytes | 1048576 |
| x-message-ttl | 60000 |

## DENM routing key

InterCor IF2 specification (ref[1]) describes the following routing key:

<message type>.<message version>.<provider>.<subtype id>.{quadtree path}

|  |  |  |
| --- | --- | --- |
| Key Part | Implementation | Example Values |
| Message Type | Static “DENM” (DENM Profile Version) | DENM |
| Message Version | Static “1\_2\_1” | 1\_2\_1 |
| Provider | HE value “SIM”  TFL value tbc “TFL” | SIM  TFL |
| Subtype ID | Sequence Number | 40327 |
| Quad Tree Path | Quadtree path based on eventPosition of DENM | 0.3.1.3.1.3.0.3.1.3.1.1.1.1.2.1.1.0 |

## IVI routing key

InterCor IF2 specification (ref[1]) describes the following routing key:

<message type>.<message version>.<provider>.<subtype id>.{quadtree path}

|  |  |  |
| --- | --- | --- |
| Key Part | Implementation | Example Values |
| Message Type | Static “IVI” | IVI |
| Message Version | Static “1\_2\_1” (IVI Profile Version) | 1\_2\_1 |
| Provider | HE value “SIM”  TFL value tbc “TFL” | SIM  TFL |
| Subtype ID | Sequence Number | 11713 |
| Quad Tree Path | Quadtree path based on referencePosition of IVI | 0.3.1.3.1.3.0.3.1.1.3.3.3.3.2.2.1.2 |

## SPAT routing key

InterCor IF2 specification (ref[1]) describes the following routing key:

<message type>.<message version>.<provider>.<subtype id>.{quadtree path}

|  |  |  |
| --- | --- | --- |
| Key Part | Implementation | Example Values |
| Message Type | Static “SPAT” | SPAT |
| Message Version | Static “1\_2” (SPAT Profile Version) | 1\_2 |
| Provider | e.g. TFL  value tbc” | TBC |
| Subtype ID | Static “SPAT” value | SPAT |
| Quad Tree Path | quad tree path based on MAP refPoint  MapData.IntersectionGeometry.RefPoint  If MAP defines multiple intersections the refPoint of the first intersection is used | 0.3.1.3.1.3.0.3.1.1.3.3.3.3.2.2.1.2 |

## MAP routing key

InterCor IF2 specification (ref[1]) describes the following routing key:

<message type>.<message version>.<provider>.<subtype id>.{quadtree path}

|  |  |  |
| --- | --- | --- |
| Key Part | Implementation | Example Values |
| Message Type | Static “MAP” | MAP |
| Message Version | Static “1\_2” (MAP Profile Version) | 1\_2 |
| Provider | e.g. TFL  value tbc” | TBC |
| Subtype ID | Static “MAP” | MAP |
| Quad Tree Path | quad tree path based on "last known" MAP refPoint  MapData.IntersectionGeometry.RefPoint  If MAP defines multiple intersections the refPoint of the first intersection is used | 0.3.1.3.1.3.0.3.1.1.3.3.3.3.2.2.1.2 |

## Message Properties

InterCor IF2 specification (ref[1]) describes the following message properties: “ttl”,”lat”,”lon”. These are set by the information provider. Since the AMQP message model defines predefined “fields” and user definable headers, the following table describes how these properties are implemented:

|  |  |
| --- | --- |
| Property | Implementation |
| ttl | As AMQP message “expiration” field  Time to Live in milliseconds  Always 60000 for MAP  Always 10000 for SPAT  Always 720000 for IVI (TfL and HE should have same implementation)  Always 720000 for DENM (TfL and HE should have same implementation) |
| lat | As AMQP message header "lat"  MAP refPoint latitude  *MapData.IntersectionGeometry.RefPoint.lat*  If MAP defines multiple intersections the refPoint of the first intersection is used |
| lon | As AMQP message header "lon"  MAP refPoint longitude  *MapData.IntersectionGeometry.RefPoint.long*  If MAP defines multiple intersections the refPoint of the first intersection is used |

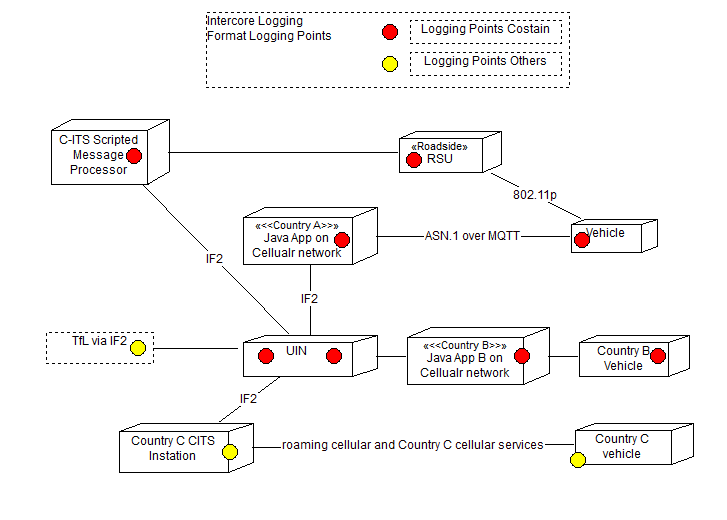
## Message republishing

|  |  |  |
| --- | --- | --- |
| Message type/exchange | Republish Interval | Remarks |
| MAP | 60000 milliseconds | If a new MAP is published the republishing of the previous MAP is cancelled |
| SPAT | <no republishing> | By time a SPAT is published a new SPAT is ready to publish hence no republishing |
| IVI | 720000 milliseconds | Set to 12 minutes to aid in-case a message is missed |
| DENM | 720000 milliseconds | Set to 12 minutes to aid in-case a message is missed |

# Data logging format

To enable quantitative verification and validation of the UK TestFest, log data needs to be collected, analysed and evaluated from all roadside and in-vehicle devices engaged in the hybrid TestFest. This includes both the UK partners and non-UK attendees.

The figure below indicates where logging will take place.



To analyse the use cases, defined in section 2.3, log data is needed on the following:

* Sent and received messages on the Central Station, RSU, Unified Interchange Node (UIN) IF2 interface, Java application, OBU and HMI to measure communication performance, including CAM, IVI, DENM, SPAT and MAP messages, including:
  + The contents of SPAT and MAP messages logged on the RSUs will be used as the reference situation on signal phases and timings for verification of the functionality and performance of in-vehicle GLOSA services;
  + The contents of IVI and DENM messages logged on the Central Station, UIN, Java Application, RSUs, OBU and HMI. These will be used as the reference situation to verify the functionality and performance of in-vehicle IVI services;
  + The contents of CAM messages logged on the RSUs will be used as the reference situation to verify the functionality and performance of in-vehicle OBU PVD services;
* Application events, decisions and actions from the in-vehicle devices to verify service and message specifications;
* Presentation and revocation of information presented on the HMI to determine if the correct information was provided to the driver at the right time.

InterCor partners are expected to provide logging in one of the agreed data formats after every session. In (Netten, 2018) the formats are defined for communication, application and HMI logging that can be processed automatically and shared through a repository to provide quantitative input for the debriefings and to share results with all participants.

Other partners are encouraged to also provide and share data logging in the debriefings and the repository. At the start of each day empty USB sticks will be handed out for partners to store logs on. These should be returned at the end of each day and will returned cleaned at the start of the next day after logs have been extracted.

Graphical representation of the logs will be performed either using tools used for previous TestFests or new dashboards created in Business Intelligence (BI) dashboard tools.

The logging files recorded during the UK TestFest will be shared post TestFest via an online document repository.

# Appendices

# Appendix A: Roadside Codes

For the UK the following choices with respect to the roadsign codes have been made [RoadSigns]. No distinction is made between signs which are accompanied by flashers and which are not.

Note that the attributes in the UK are different for the maximum regulatory speeds. Receiving systems will need to use this information to ensure the correct information is displayed.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sign** | | **Codes** | | **Attributes** | | **Pictogram** |
| **Full Name** | **Description** | **Service Category Code** | **Pictogram Code** | **Sign-speedLimits (SPE): speedLimitMax (SPM)** | **Sign-speedLimits: Unit** |  |
| Clear Lane Left | Notice of clear lane to left | 13 | 661 | N/A | N/A |  |
| Clear Lane Right | Notice of clear lane to right | 13 | 662 | N/A | N/A |  |
| Lane closed | Notice of lane closure | 13 | 659 | N/A | N/A |  |
| End of all restrictions by electronic signs | Notice of end of all restrictions by electronic signs | 13 | 663 | N/A | N/A |  |
| End of all local prohibition imposed on moving vehicles | End of restrictions | 12 | 611 | N/A | N/A | National speed limit applies |
| Maximum speed limited to the figure indicated | Notice that the maximum speed for motor vehi-  cles is regulated | 12 | 557 | 020 | milesperh |  |
| Maximum speed limited to the figure indicated | Notice that the maximum speed for motor vehi-  cles is regulated | 12 | 557 | 030 | milesperh |  |
| Maximum speed limited to the figure indicated | Notice that the maximum speed for motor vehi-  cles is regulated | 12 | 557 | 040 | milesperh |  |
| Maximum speed limited to the figure indicated | Notice that the maximum speed for motor vehi-  cles is regulated | 12 | 557 | 050 | milesperh |  |
| Maximum speed limited to the figure indicated | Notice that the maximum speed for motor vehi-  cles is regulated | 12 | 557 | 060 | milesperh |  |
| Maximum speed limited to the figure indicated | Notice that the maximum speed for motor vehi-  cles is regulated | 12 | 557 | 070 | milesperh |  |
| Pass this side (right side) | Pass to the right | 12 | 718 | N/A | N/A |  |
| Pass this side (left side) | Pass to the left | 12 | 719 | N/A | N/A |  |
| Reserved Code | Used when extraText field is set on own without other rsCodes as the rsCodes are a Mandatory field. Also can be used to set blank rsCodes. | 13 | 180 | N/A | N/A | Blank |

## 

# Appendix B: Traces and Zones

**Zones – IVI Message**



**Traces – DENM Message**



# Appendix C: Bibliography

Netten, B. (2018). *InterCor Common Log Format version 0.7.7.*

# Appendix D: IVI Profile

See profiles excel document.

# Appendix E: DENM Profile

See profiles excel document.

# Appendix F: CAM Profile

See profiles excel document.

# Appendix G: SPAT Profile

See profiles excel document

# Appendix H: MAP Profile

See profiles excel document