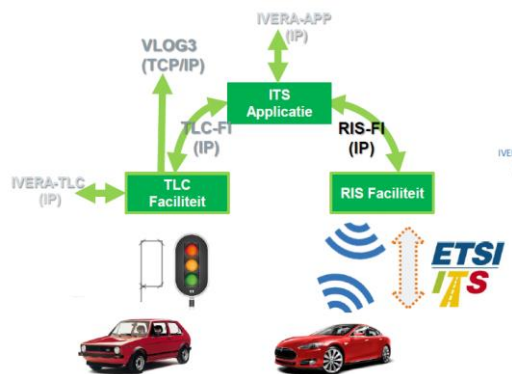


Intelligente Verkeer Regel Installatie (iVRI) – Fase 2

Deliverable 1b: IDD RIS-FI

Interface Design Description RIS-FI



Datum: 27 oktober 2016
Versie: 1.0

VOORWOORD

In mei 2016 is opdracht verstrekt door het Ministerie van Infrastructuur en Milieu via het Beter Benutten Vervolg (BBV) programma aan vier VRA-leveranciers om te komen tot een gezamenlijke definitie van VRA-standaarden ten behoeve van connected en coöperatieve functionaliteit.

Dit document vormt Deliverable 1b van de afgesproken leverdelen in de opdrachtverstrekking, omschreven als "IDD RIS-FI".

Deze deliverable beschrijft in het Engels het koppelvlak van de RIS naar de verschillende mogelijke C-ITS-applicaties.

Dit document is tot stand gekomen door samenwerking van de vier leveranciers in de werkgroep bestaande uit:

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The logo for dymniq, featuring the word "dymniq" in a lowercase, sans-serif font. The letters are colored: 'd' is red, 'y' is orange, 'n' is blue, 'n' is green, 'i' is yellow, and 'q' is red.

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The logo for swarco, featuring the word "swarco" in a bold, blue, sans-serif font. To the right of the text is a stylized graphic element consisting of three orange and blue shapes that resemble a gear or a cluster of three arrows pointing right.

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The logo for Vialis, featuring the word "Vialis" in a blue, sans-serif font. Above the text is a green, curved line that forms a partial circle around the letters.

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The logo for KO HARTOG, featuring the words "KO HARTOG" in a bold, black, sans-serif font. Below the text is the phrase "VERKEERSTECHNIEK B.V." in a smaller, red, sans-serif font. To the right of the text is a stylized graphic element consisting of two red and grey shapes that resemble a person or a figure in motion.

NB. De rest van dit document is geschreven in het Engels om internationale uitwisseling te ondersteunen.

The rest of this deliverable has been written in English to facilitate international exchange.

DOCUMENT CONTROL SHEET

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| 0.2 | 2016-06-20 | WG2 | Use cases added |
| 0.3 | 2016-06-23 | WG2 | Technical description and Exception use cases |
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CONTENT

| | | |
|----------|---|-----------|
| 1 | Introduction | 6 |
| 1.1 | Overview | 6 |
| 1.2 | Version | 7 |
| 1.3 | Purpose and scope | 7 |
| 1.4 | Advice for the reader | 7 |
| 1.5 | Document conventions | 7 |
| 2 | References | 8 |
| 3 | Acronyms, abbreviations and concepts | 9 |
| 4 | Functional description | 11 |
| 4.1 | General | 11 |
| 4.2 | LDM | 11 |
| 4.3 | Message services | 12 |
| 4.4 | RIS-FI | 12 |
| 4.4.1 | <i>General</i> | 12 |
| 4.4.2 | <i>Opening and closing a connection</i> | 13 |
| 4.4.3 | <i>Object ownership</i> | 13 |
| 4.4.4 | <i>Creating a new object</i> | 13 |
| 4.4.5 | <i>Updating an existing object</i> | 13 |
| 4.4.6 | <i>Deleting an existing object</i> | 13 |
| 4.4.7 | <i>Reading objects</i> | 13 |
| 4.4.8 | <i>Monitoring objects</i> | 14 |
| 4.5 | Filtering | 14 |
| 4.6 | Map-Matching | 14 |
| 5 | RIS-FI Objects | 16 |
| 5.1 | Introduction | 16 |
| 5.2 | Object types | 16 |
| 5.3 | Protocol-version | 17 |
| 5.4 | Base | 17 |
| 5.5 | Cause codes | 20 |
| 5.6 | RISFacilities | 32 |
| 5.7 | ItsStation | 33 |
| 5.8 | ItsEvent | 40 |
| 5.9 | Intersection | 42 |
| 5.10 | SignalGroup | 47 |
| 5.11 | Signage | 52 |
| 5.12 | Protocol objects | 52 |
| 6 | Methods | 57 |
| 6.1 | CreateEvents | 57 |
| 6.2 | UpdateObjects | 59 |
| 6.3 | TerminateEvents | 61 |
| 6.4 | RequestObjects | 62 |
| 6.5 | SubscribeObjects | 63 |
| 6.6 | NotifyObjects | 65 |
| 6.7 | UnsubscribeObjects | 66 |

| | | |
|----------|--|-----------|
| 7 | Protocol error handling | 67 |
| 7.1 | Error codes | 67 |
| 8 | Functional use-cases | 68 |
| 8.1 | Monitoring of traffic | 68 |
| 8.2 | Bus priority handling | 69 |
| 8.2.1 | <i>Priority handling based on CAM</i> | 69 |
| 8.2.2 | <i>Priority handling based on SRM</i> | 70 |
| 8.3 | Create an ItsEvent | 71 |
| 8.4 | Update an ItsEvent | 72 |
| 8.5 | Delete an ItsEvent | 73 |
| 8.6 | Monitoring of events | 74 |
| 8.7 | Inform on the signalling status | 75 |
| 9 | Exception handling use-cases | 76 |
| 9.1 | Invalid request | 76 |
| 9.2 | Invalid parameters | 76 |
| 9.3 | Request could not be completed | 76 |
| 9.4 | Not authorized | 76 |
| | Appendix A – Country specific public transport encoding | 77 |
| | Appendix B | 79 |

1 Introduction

1.1 Overview

The iTLC architecture combines the ability to control traffic lights and the ability to communicate to ITS stations such as cars, busses etc. It allows external ITS applications to control or monitor traffic lights via the TLC-FI interface. It also allows ITS applications to monitor or inform ITS stations via the RIS-FI interface.

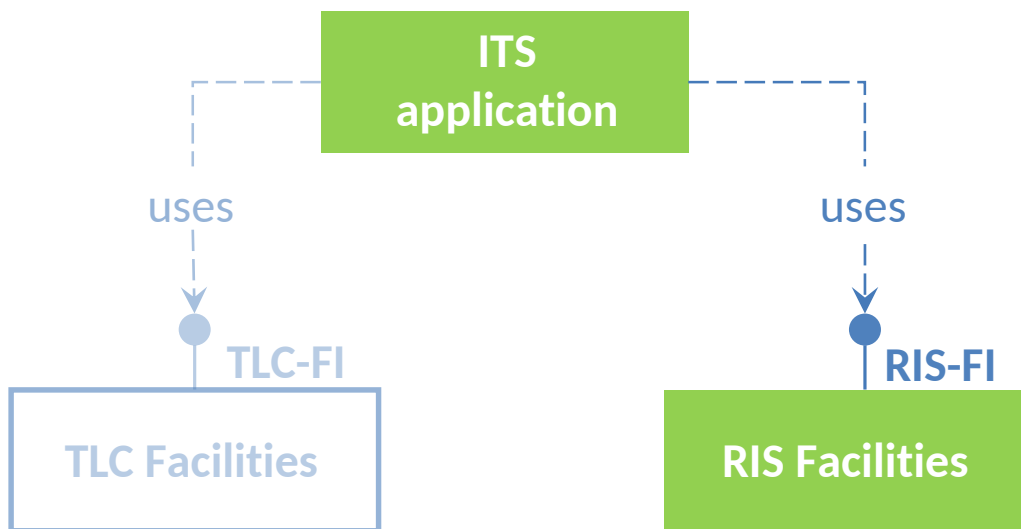


Figure 1 RIS-FI in system over view

The scope of this document is limited to the RIS-FI interface, the faded elements shown in Figure 1 are not in the scope of this document.

The RIS-FI is the interface between the Roadside ITS Station (RIS) and the (external) ITS applications. There is no (technical) interface defined in the ETSI standard, other than a high level description of the LDM and its functionality. However, the underlying ETSI standards regarding ITS G5 messages have been followed

The RIS facilities can communicate with other ITS stations in the neighbourhood via ITS G5 messages. The information received from other ITS stations via ITS G5 messages, and the information received from ITS applications via the RIS-FI interface, is used to assemble a local view on the traffic situation.

Communication can also be performed through other communication media (such as mobile phones). This document does not prescribe any media to be used, only the information that needs to be communicated. However, in the presented examples it is assumed that ITS G5 is used.

Information provided by ITS applications via the RIS-FI is shared with the other ITS stations using ITS G5 messages and information received from other ITS stations via ITS G5 messages is shared with subscribed ITS applications using the RIS-FI.

The RIS-FI as described in this document tries to hide the radio level details for the ITS applications, so that these application can implement their use cases more easily.

1.2 Version

This document describes the version 1.0.0 of the RIS-FI.

This version assumes the implementation of the Generic Facilities Interface IDD defined in [Ref 5].

1.3 Purpose and scope

This document describes the interface design of the RIS-FI with respect to

- Functional behaviour.
- RIS object definitions and relations.

Technology used to encapsulate, transport and secure the data is not in-scope of this document. For this information please refer to [Ref 5].

1.4 Advice for the reader

It is advised that the reader understands the contents of the following documents:

- iTLC Architecture as described in *iTLC Architecture WG3 (Deliverable F) v 1.2, jan. 2016* ([Ref 1])
- Requirements in *Beter Benutten Vervolg, project iVRI, Deliverable G2, IRS TLC Facilities Interface v1.2, jan 2016* ([Ref 2]) and
- Interface requirements in *Beter Benutten Vervolg, project iVRI, Deliverable G1, IRS RIS Facilities Interface v1.2, jan 2016* ([Ref 3]).

1.5 Document conventions

In this document, the objects and methods are transport and encoding agnostic. To identify an Object and its attributes, the following format is used:

<Object type name>.<attribute name>

For instance, for the RIS object type Intersection, which has an attribute *status*, this is identified as *Intersection.status*.

2 References

| ID | Reference |
|---------|--|
| [Ref 1] | <i>iTLC Architecture WG3 (Deliverable F) v 1.2, jan. 2016</i> |
| [Ref 2] | <i>Beter Benutten Vervolg, project iVRI, Deliverable G2, IRS TLC Facilities Interface v1.2, jan 2016</i> |
| [Ref 3] | <i>Beter Benutten Vervolg, project iVRI, Deliverable G1, IRS RIS Facilities Interface v1.2, jan 2016</i> |
| [Ref 4] | <i>IDD TLC Facilities Interface v1.0, aug 2016</i> |
| [Ref 5] | <i>IDD Generic Facilities Interface v1.0, jul 2016</i> |
| [Ref 6] | <i>Talking Traffic 1.1, Bijlage 7: Intersection Topology Format versie 0.9, jul 2016</i> |

3 Acronyms, abbreviations and concepts

Acronyms and abbreviations

| | |
|--------------------|---|
| CAM | Cooperative Awareness Message. |
| C-ITS | Cooperative ITS functionality for exchange of data between in-vehicle and/or road side devices making use of either cellular or short range wireless communication. |
| DENM | Decentralized Environmental Notification Message. |
| ETSI | European Telecommunications Standards Institute |
| IDD | Interface Design Description. |
| IRS | Interface Requirements Specification |
| iTLC | Intelligent TLC performing traffic light controller functions and allowing for ITS applications. |
| ITS | Intelligent Transport Systems. |
| ITS G5 | ITS messages broadcasted over the 5GHz radio band supporting GeoNetworking, as specified by ETSI. |
| ITS Station | Functional entity specified by the ITS station reference architecture (see [Ref 1]). |
| ITS-A | ITS Application. |
| ITS-CLA | ITS Control Application. |
| ITS-CRA | ITS Consumer Application. |
| ITS-PRA | ITS Provider Application. |
| IVI | In Vehicle Information (Message on traffic signs and other related traffic information). |
| IVERA | Management protocol for traffic light controllers in the Netherlands (An implementation of a TMS-IF). |
| iVRI | See iTLC. |
| MAP | Message providing the topology of an area. |
| RIS | Roadside ITS Station |
| RSU | Roadside Unit, usually the radio modem. |
| SPAT | Signal Phase and Timing (message providing traffic light information). |
| SRM | Signal Request Message; a priority request. |
| SSM | Signal Status Message; the state of a priority request. |
| TLC | Traffic Light Controller; controls the signals of one or more intersections. |
| TMS | Traffic Management System. |

| | |
|---------------|---|
| TMS-IF | TMS Interface, an interface used by a TMS to manage ITS Applications. |
| UTC | Coordinated Universal Time. |

Concepts

| | |
|------------------------------------|---|
| Traffic Control Application | Application that implements a traffic control algorithm and is able to request signal group states. |
| ITS Control Application | A Traffic Control Application that uses TLC- and/or RIS-interfaces. |
| ITS Application | An application that supports one or more ITS use-cases. Range of possible ITS Applications include an ITS Control Application. |
| TLC Facilities | Component providing facilities of a TLC to users (internal and/or external). Includes amongst others: <ul style="list-style-type: none"> • Access to information from the TLC. • Services to trigger actuators. |
| RIS Facilities | Component providing facilities of a RIS to users (internal and/or external). |

4 Functional description

4.1 General

The RIS consist of two main functional parts and an interface to access this functionality:

- Local Dynamic Map (LDM)
- Message services
- RIS Facilities Interface (RIS-FI)

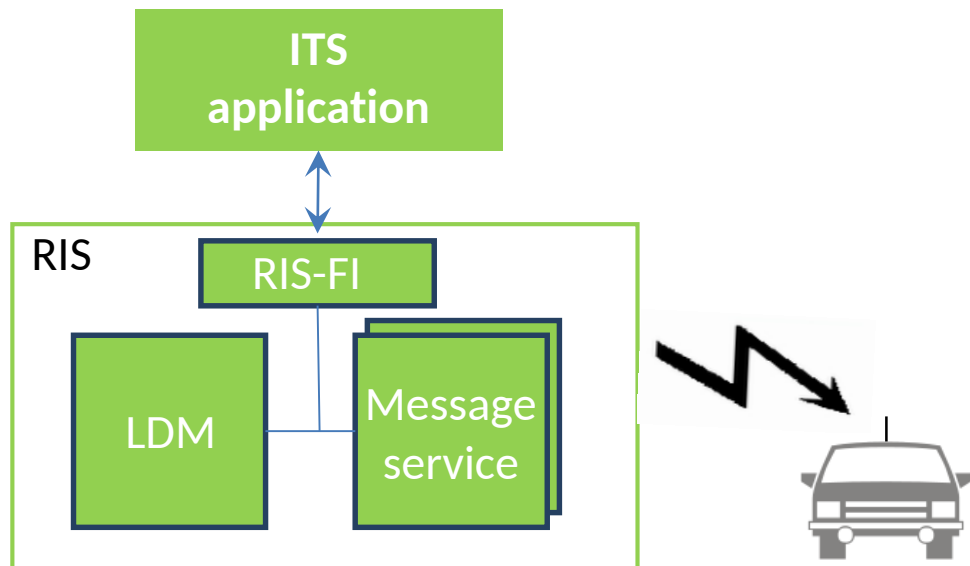


Figure 2 RIS system overview

4.2 LDM

The Local Dynamic Map (LDM) holds the overall view on the traffic state in the area that the Roadside ITS Station (RIS) covers. The LDM contains a set of objects, each with its own set of attributes that represent real-world objects such as cars or traffic lights.

The objects have a limited lifetime and will be deleted if they are not regularly updated. The different type of objects available in the LDM are described in section 5.

All the object instances in the LDM have at least a location, that can be related to the topology, and a timestamp of the last update.

The objects in the LDM are created and updated from two sources:

- ITS G5 messages received from other ITS stations.
- Objects created or updated by ITS applications via the RIS-FI.

The topology is provided by an external source in the format described in [Ref 6], *Talking Traffic 1.1, Bijlage 7: Intersection Topology Format versie 0.9, jul 2016*. It cannot be configured through the RIS-FI.

4.3 Message services

The message services in the RIS are responsible for the transmission and reception of the ITS G5 messages.

Currently the following messages are supported:

- Cooperative Awareness Messages (CAM), which contain information about the ITS stations such as type, position, speed etc.
- Decentralized Environmental Notification Messages (DENM), which contains information about the occurrence of potential dangerous (traffic) situations.
- Signal Phase And Timing (SPAT) messages, which contain information on the status of a traffic light controller and its signal groups at an intersection.
- MapData (MAP) messages, which contain the topology of the area associated with the RIS.
- Signal Request Messages (SRM), which are sent by a vehicle to the RSU to request priority at a signalized intersection.
- Signal Status Messages (SSM), which are sent by an RSU to inform vehicles about the status and activation of previously made prioritization requests.

Currently the following message are not supported, due to the non-final status of the specification documentation:

- In Vehicle Information (IVI) messages, which contain signage information; e.g. speed limits, traffic signs etc.

The information needed for the transmission of these message is provided by ITS applications in the form of objects (see section 5), configured in the RIS. The information that is received from other ITS stations will be made available through the same objects.

4.4 RIS-FI

4.4.1 General

ITS applications can interact with the RIS using the RIS Facilities Interface (abbreviated to RIS-FI).

The base of the RIS-FI consist of an Object model with which ITS applications can interact. These objects represent concepts that are relevant in the RIS environment.

ITS applications can create, update and read these objects when its security profile allows this. ITS application can also delete the objects they have created.

ITS applications can ask to be informed on changes made to the objects that match a set of criteria. A notification is then given to the ITS application when one or more objects are changed that match the selection criteria.

Created objects are not persistent at the RIS. When the RIS is restarted ITS applications must re-create their objects if they are necessary.

When an ITS application creates or updates an object, the related ITS G5 message will be sent by the corresponding message service and the object is stored in the LDM.

The precise timing and encoding of the message will be determined by the RIS, based on the object and the requirements of the radio channel. Consequently, if a RIS-FI based object has been accepted by the RIS this does not necessarily imply that the radio message has been transmitted, due to the inherent nature of this transmission medium. Therefore it is not possible to provide feedback to the ITS application whether or not the message is actually sent. The LDM will however persist in transmitting messages for the duration of their validity.

4.4.2 Opening and closing a connection

The procedures for opening, maintaining and closing a connection to the RIS-FI are described in detail in [Ref 5], *IDD Generic Facilities Interface v1.0, jul 2016*.

4.4.3 Object ownership

Objects are owned by the system that created them. For objects created based on incoming ITS G5 messages the owner will be the RIS. Also the objects created by configuration (such as topology) will be owned by the RIS.

Objects created by an ITS application will be owned by that application, i.e. they are linked to the ApplicationUsername of the application.

4.4.4 Creating a new object

In general, each newly created object in the LDM has a reference position and a validity time. The validity time of an object is either configured in the RIS or is an attribute of the object itself. For example; ItsStation objects will have a validity determined by the LDM based on configuration, SignalGroup and ItsEvent objects have an attribute to specify the validity.

Currently only ItsEvent objects can be created by an ITS application. The RIS-FI will return an ObjectID if creation was successful.

4.4.5 Updating an existing object

When updating an existing object, the ObjectID and the (writable) attributes to be updated must be provided. Not all object data has to be provided, according to the following rules:

- If an attribute is provided, its value will be updated.
- If an attribute is not provided, the current value will remain.
- If an optional attribute is provided with a null value, the attribute will be removed.

An ITS application can only update objects it owns, e.g. objects it created. However, an ITS application can get credentials assigned during the authentication process that allow that application to write (update) the state of configured objects, such as the signal group states.

4.4.6 Deleting an existing object

An ITS application can request to delete an object identified by its ObjectID from the LDM. If the object exists, and it is owned by the application, it will be deleted from the LDM.

4.4.7 Reading objects

ITS applications can request the LDM for objects of a given object types that (optionally) match certain selection criteria (see also section 4.5). The LDM will return a set of matching objects, or an empty set if none can be matched to the selection criteria.

4.4.8 Monitoring objects

ITS applications can monitor objects by taking a subscription on objects of an object type that (optionally) match certain selection criteria (see also section 4.5). By default, changes made on objects that match the selection criteria will trigger a notification of these objects to be sent to the subscriber. However, an ITS application can request, with a subscription, to be notified periodically instead of event-based.

4.5 Filtering

The top level RIS-FI objects can be requested directly with the method “RequestObjects” or can be monitored by taking a subscription with the method “SubscribeObjects” for the corresponding object type.

The set of objects returned as a result of the request or in a notification to a subscriber can be filtered by applying selection criteria. If no filter is given, all objects of the requested object type will be returned.

This filter mechanism is meant as a pre-selection on the objects returned by the RIS to the ITS application. Therefore, the filter capabilities are limited to comparison on simple attribute types; e.g. Integer, Float, Boolean and String. The existence of (optional) attributes can be filtered by applying a null-check. There is a maximum of two attributes that can be used in a filter, which is sufficient for the use cases presented in this document. More complex filtering has to be done by the ITS application itself and is not provided by the RIS-FI as a compromise between performance and complexity.

4.6 Map-Matching

Received Cooperative Awareness Messages (CAM) will result in the creation (or update) of an ItsStation object. This object contains an attribute that holds the map-matching result.

The RIS performs map-matching by taking the reference position of the ITS station and projects that onto the intersection topology, as shown in Figure 3.

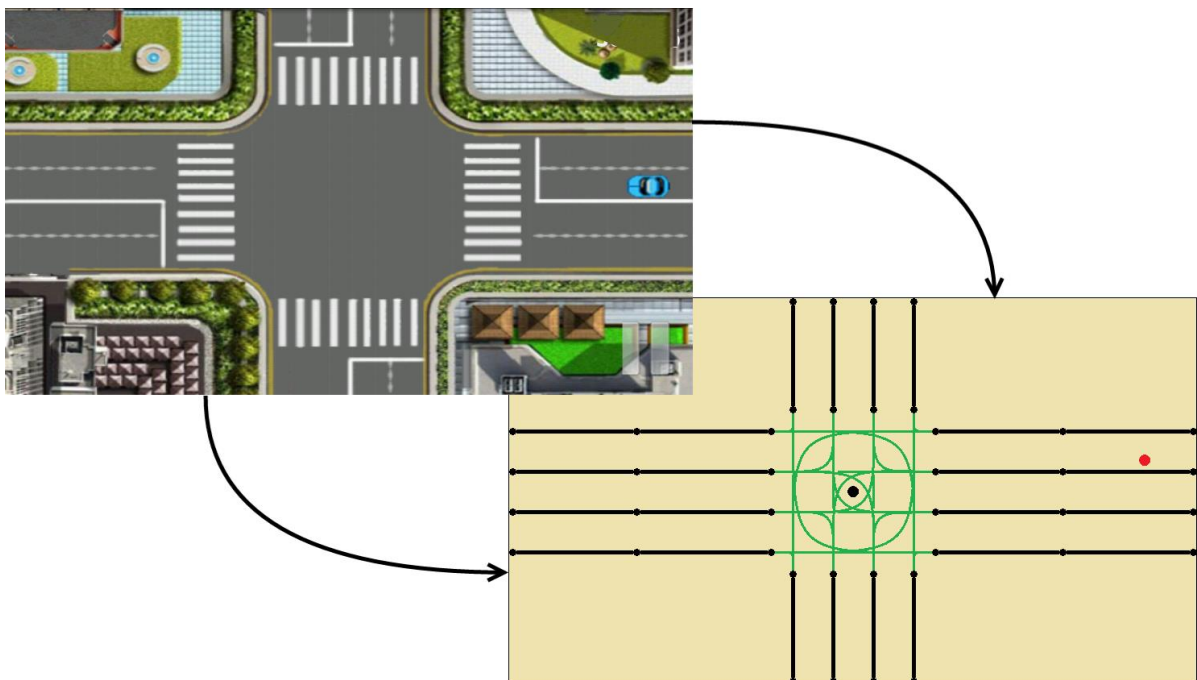


Figure 3 Projection of a vehicle onto the topology

Next only the Lanes that have the same (driving) direction as the ITS station are considered. For these lanes the distance to the stop line (or the start of the lane) and the path offset are calculated.

The path offset is the distance between the ITS station and the orthogonal projection on the path describing the Lane, as shown in Figure 4.

Multiple Map-Match result may be returned for each calculated offset that is within the, at the RIS configured, maximum offset.

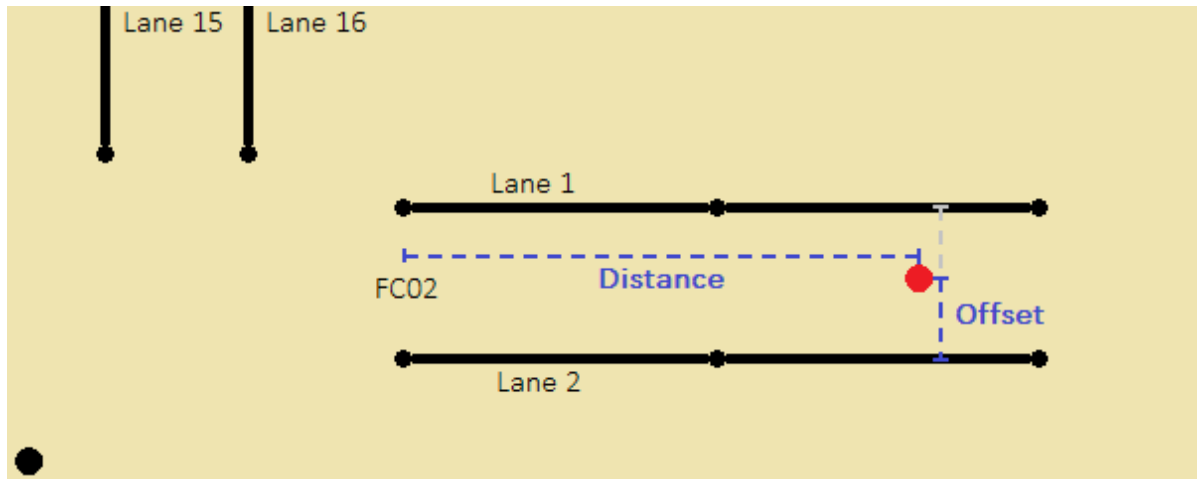


Figure 4 Path offset and distance of a Map-Match

5 RIS-FI Objects

5.1 Introduction

The RIS-Facilities contains a geographical, consistent and real-time view of the world around the RIS. This view contains information that ranges from static data such as road topology elements to mapped dynamic objects such as vehicles.

ITS-Applications can use this view as provided by the RIS-FI to gather all information needed about the surroundings around the RIS.

To be able to provide simple access to this view, so-called RIS-Objects are available at the RIS-FI. Together, all instances of RIS-Objects provide the real-time updated consistent view.

The RIS-Objects available at RIS-FI are described in this chapter.

5.2 Object types

The following objects are provided by the RIS-FI; some of them are directly related to ITS G5-messages:

| Object | Description | Related ITS G5 message |
|---------------|--|------------------------|
| RISFacilities | Provides information about the RIS itself. | - |
| ItsStation | Describes an ITS-Station, like 'Car' or 'Bicycle'. | CAM |
| ItsEvent | Contains information about the occurrence of a traffic event, like weather conditions or dangerous situations. | DENM |
| Intersection | Describes geometry and topology of an intersection and contains the state of the TLC controlling the intersection. | SPAT/MAP |
| SignalGroup | Contains the state, and predicted states, of a signal group as controlled by the TLC. | SPAT/SRM/SSM |
| Signage* | Describes signage information e.g. speed limits, traffic signs etc. | IVI |

Information provided by RIS-FI should be easily usable by an ITS-Application to achieve simple application logic; e.g. mapping several geographical positions (WGS84-coordinates) onto a topology-element shall be implemented by the RIS Facilities and is not considered a function implemented by every ITS Application.

The relationships amongst various instances of ItsStations and the topology is described by using instances of the MapMatch Object.

Not all the features of the DENM protocol are provided. The corresponding ItsEvent object represents the subset of DENM possibilities that are relevant for TLC related ITS applications.

Note that received SPAT/MAP from other ITS stations, or another RIS nearby, are not processed and therefore not available at the RIS-FI. Only received CAM and DENM will be processed and made available at the RIS-FI. All messages will of course be sent by the RIS, but an ITS application cannot create an ItsStation object that would result in a CAM.

* Signage is left out of the scope of this document because at the time of writing the IVI specification is not yet finalized.

5.3 Protocol-version

The definition of RIS-FI Objects in this document is defined as version 1.0.0 of the RIS-FI. It also uses generic object types from [Ref 5], *IDD Generic Facilities Interface v1.0, jul 2016* and object types from [Ref 4], *IDD TLC Facilities Interface v1.0, aug 2016* (these object types are indicated with an asterisk).

5.4 Base

This section contains the basic attribute type definitions of various RIS-FI objects. These types can be derived from simple types, such as integers and strings, but can also be objects themselves.

RISObjectType

| | |
|------------------|--|
| Descriptive name | RISObjectType |
| Definition | This list contains all the different object types for the RIS-FI. This is an implementation of the abstract type ObjectType. |
| Representation | Integer |
| Range | ENUM { RISFacilities (0) ItsStation (1) ItsEvent (2) Intersection (3) SignalGroup (4) Signage (5) } |
| Unit | N/A |

Acceleration

| | |
|------------------|---|
| Descriptive name | Acceleration |
| Definition | Vehicle acceleration at the longitudinal direction in the centre of the mass of the empty vehicle. Negative values indicate that the vehicle is slowing down. Positive values indicate that the vehicle is speeding up. When the information is not available, the value shall be set to null. |
| Representation | Float |
| Range | -16.0 to 16.0 |
| Unit | meter / second ² |

Area

| | |
|------------------|--|
| Descriptive name | Area |
| Definition | <p>This object describes a geographical area, specified by a geometric shape.</p> <p>The MajorAxis is the distance between the centre point and the short side of the geometric shape (perpendicular bisector of the short side).</p> <p>The Angle is the azimuth angle of the long side of the geometric shape.</p> <p>For a circle the MajorAxis and MinorAxis have the same value (and Circular has the value "true").</p> <p>When the attribute Circular has the value "false" the area will represent a rectangular area, instead of a circular area.</p> |
| Representation | <pre>{ Location centre Length majorAxis Length minorAxis Heading angle Boolean circular }</pre> |
| Range | N/A |
| Unit | N/A |

Duration

| | |
|------------------|---------------------------------------|
| Descriptive name | Duration |
| Definition | Duration of a traffic event validity. |
| Representation | Integer |
| Range | 0 to 86400 |
| Unit | seconds |

Interval

| | |
|------------------|--|
| Descriptive name | Interval |
| Definition | Time interval between two consecutive message transmissions. |
| Representation | Integer |
| Range | 0 to 10000 |
| Unit | Milliseconds |

Heading

| | |
|------------------|--|
| Descriptive name | Heading |
| Definition | Orientation of a heading with regards to the WGS84 North, clockwise. When the information is not available, the value shall be set to null. |
| Representation | Float |
| Range | 0.0 to 359.9 |
| Unit | degrees |

Path

| | |
|------------------|---|
| Descriptive name | Path |
| Definition | This object describes a path with a set of path points. Points are defined in order starting at the closest distance from the reference location of the path (e.g. the stop line). |
| Representation | { Location points[] } |
| Range | N/A |
| Unit | N/A |

Punctuality

| | |
|------------------|--|
| Descriptive name | Punctuality |
| Definition | Time difference that indicates the punctuality for public transport vehicles. Negative values indicate early arrival. |
| Representation | Integer |
| Range | -3600 to 3600 |
| Unit | seconds |

SubscriptionID

| | |
|------------------|---|
| Descriptive name | SubscriptionID |
| Definition | An identifier that is unique for a subscription with the RIS Facilities. This is a specific type of ObjectID used to identify subscriptions. |
| Representation | See ObjectID |
| Range | See ObjectID |
| Unit | See ObjectID |

5.5 Cause codes

Within the cooperative messages, incidents and traffic events are indicated by cause codes. These codes consist of a direct cause of a detected event and a sub type of the direct cause. Refer to Appendix B for more information.

SubCauseCode (abstract)

| | |
|------------------|--|
| Descriptive name | SubCauseCode |
| Definition | An abstract object type to group sub causes of traffic events. |
| Representation | Integer |
| Range | N/A |
| Unit | N/A |

CauseCode

| | |
|------------------|--|
| Descriptive name | CauseCode |
| Definition | This list contains all the possible traffic event types. |
| Representation | Integer |
| Range | <pre> ENUM { unknown (0) trafficCondition (1) accident (2) roadworks (3) adverseWeatherCondition-Adhesion (6) hazardousLocation-SurfaceCondition (9) hazardousLocation-ObstacleOnTheRoad (10) hazardousLocation-AnimalOnTheRoad (11) humanPresenceOnTheRoad (12) wrongWayDriving (14) rescueAndRecoveryWorkInProgress (15) adverseWeatherCondition-ExtremeWeatherCondition (17) adverseWeatherCondition-Visibility (18) adverseWeatherCondition-Precipitation (19) slowVehicle (26) dangerousEndOfQueue (27) vehicleBreakdown (91) postCrash (92) humanProblem (93) stationaryVehicle (94) emergencyVehicleApproaching (95) hazardousLocation-DangerousCurve (96) collisionRisk (97) signalViolation (98) dangerousSituation (99) } </pre> |
| Unit | N/A |

CollisionRiskSubCauseCode

| | |
|------------------|--|
| Descriptive name | CollisionRiskSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "collisionRisk" (97). |
| Representation | Integer |
| Range | ENUM { unavailable (0) longitudinalCollisionRisk (1) crossingCollisionRisk (2) lateralCollisionRisk (3) vulnerableRoadUser (4) } |
| Unit | N/A |

DangerousEndOfQueueSubCauseCode

| | |
|------------------|--|
| Descriptive name | DangerousEndOfQueueSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "dangerousEndOfQueue" (27). |
| Representation | Integer |
| Range | ENUM { unavailable (0) suddenEndOfQueue (1) queueOverHill (2) queueAroundBend (3) queueInTunnel (4) } |
| Unit | N/A |

DangerousSituationSubCauseCode

| | |
|------------------|--|
| Descriptive name | DangerousSituationSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type “dangerousSituation” (99). |
| Representation | Integer |
| Range | ENUM { unavailable (0) emergencyElectronicBrakeEngaged (1) preCrashSystemEngaged (2) espEngaged (3) absEngaged (4) aebEngaged (5) brakeWarningEngaged (6) collisionRiskWarningEngaged (7) } |
| Unit | N/A |

EmergencyVehicleApproachingSubCauseCode

| | |
|------------------|--|
| Descriptive name | EmergencyVehicleApproachingSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type “emergencyVehicleApproaching” (95). |
| Representation | Integer |
| Range | ENUM { unavailable (0) emergencyVehicleApproaching (1) prioritizedVehicleApproaching (2) } |
| Unit | N/A |

HazardousLocation-AnimalOnTheRoadSubCauseCode

| | |
|------------------|---|
| Descriptive name | HazardousLocation-AnimalOnTheRoadSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "hazardousLocation-AnimalOnTheRoad" (11). |
| Representation | Integer |
| Range | <pre> ENUM { unavailable (0) wildAnimals (1) herdOfAnimals (2) smallAnimals (3) largeAnimals (4) } </pre> |
| Unit | N/A |

HazardousLocation-DangerousCurveSubCauseCode

| | |
|------------------|---|
| Descriptive name | HazardousLocation-DangerousCurveSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "hazardousLocation-DangerousCurve" (96). |
| Representation | Integer |
| Range | <pre> ENUM { Unavailable (0) dangerousLeftTurnCurve (1) dangerousRightTurnCurve (2) multipleCurvesStartingWithUnknownTurningDirection (3) multipleCurvesStartingWithLeftTurn (4) multipleCurvesStartingWithRightTurn (5) } </pre> |
| Unit | N/A |

HazardousLocation-ObstacleOnTheRoadSubCauseCode

| | |
|------------------|--|
| Descriptive name | HazardousLocation-ObstacleOnTheRoadSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "hazardousLocation-ObstacleOnTheRoad" (10). |
| Representation | Integer |
| Range | ENUM { unavailable (0) shedload (1) partsOfVehicles (2) partsOfTyres (3) bigObjects (4) fallenTrees (5) hubCaps (6) waitingVehicles (7) } |
| Unit | N/A |

HazardousLocation-SurfaceConditionSubCauseCode

| | |
|------------------|---|
| Descriptive name | HazardousLocation-SurfaceConditionSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "hazardousLocation-SurfaceCondition" (9). |
| Representation | Integer |
| Range | ENUM { unavailable (0) rockfalls (1) earthquakeDamage (2) sewerCollapse (3) subsidence (4) snowDrifts (5) stormDamage (6) burstPipe (7) volcanoEruption (8) fallingIce (9) } |
| Unit | N/A |

HumanPresenceOnTheRoadSubCauseCode

| | |
|------------------|---|
| Descriptive name | HumanPresenceOnTheRoadSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "humanPresenceOnTheRoad" (12). |
| Representation | Integer |
| Range | ENUM { unavailable (0) childrenOnRoadway (1) cyclistOnRoadway (2) motorcyclistOnRoadway (3) } |
| Unit | N/A |

HumanProblemSubCauseCode

| | |
|------------------|---|
| Descriptive name | HumanProblemSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "humanProblem" (93). |
| Representation | Integer |
| Range | ENUM { unavailable (0) glycemiaProblem (1) heartProblem (2) } |
| Unit | N/A |

PostCrashSubCauseCode

| | |
|------------------|--|
| Descriptive name | PostCrashSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "postCrash" (92). |
| Representation | Integer |
| Range | ENUM { unavailable (0) accidentWithoutECallTriggered (1) accidentWithECallManuallyTriggered (2) accidentWithECallAutomaticallyTriggered (3) accidentWithECallTriggeredWithoutAccessToCellularNetwork (4) } |
| Unit | N/A |

RescueAndRecoveryWorkInProgressSubCauseCode

| | |
|------------------|--|
| Descriptive name | RescueAndRecoveryWorkInProgressSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "rescueAndRecoveryWorkInProgress" (15). |
| Representation | Integer |
| Range | ENUM { unavailable (0) emergencyVehicles (1) rescueHelicopterLanding (2) policeActivityOngoing (3) medicalEmergencyOngoing (4) childAbductionInProgress (5) } |
| Unit | N/A |

RoadworksSubCauseCode

| | |
|------------------|---|
| Descriptive name | RoadworksSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "roadworks" (3). |
| Representation | Integer |
| Range | ENUM { unavailable (0) majorRoadworks (1) roadMarkingWork (2) slowMovingRoadMaintenance (3) shortTermStationaryRoadworks (4) streetCleaning (5) winterService (6) } |
| Unit | N/A |

SignalViolationSubCauseCode

| | |
|------------------|--|
| Descriptive name | SignalViolationSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "signalViolation" (98). |
| Representation | Integer |
| Range | ENUM { unavailable (0) stopSignViolation (1) trafficLightViolation (2) turningRegulationViolation (3) } |
| Unit | N/A |

SlowVehicleSubCauseCode

| | |
|------------------|---|
| Descriptive name | SlowVehicleSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "slowVehicle" (26). |
| Representation | Integer |
| Range | ENUM { unavailable (0) maintenanceVehicle (1) vehiclesSlowingToLookAtAccident (2) abnormalLoad (3) abnormalWideLoad (4) convoy (5) snowplough (6) deicing (7) saltingVehicles (8) } |
| Unit | N/A |

StationaryVehicleSubCauseCode

| | |
|------------------|--|
| Descriptive name | StationaryVehicleSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "stationaryVehicle" (94). |
| Representation | Integer |
| Range | ENUM { unavailable (0) humanProblem (1) vehicleBreakdown (2) postCrash (3) publicTransportStop (4) carryingDangerousGoods (5) } |
| Unit | N/A |

TrafficConditionSubCauseCode

| | |
|------------------|---|
| Descriptive name | TrafficConditionSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "trafficCondition" (1). |
| Representation | Integer |
| Range | ENUM { unavailable (0) increasedVolumeOfTraffic (1) trafficJamSlowlyIncreasing (2) trafficJamIncreasing (3) trafficJamStronglyIncreasing (4) trafficStationary (5) trafficJamSlightlyDecreasing (6) trafficJamDecreasing (7) trafficJamStronglyDecreasing (8) } |
| Unit | N/A |

VehicleBreakdownSubCauseCode

| | |
|------------------|---|
| Descriptive name | VehicleBreakdownSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "vehicleBreakdown" (91). |
| Representation | Integer |
| Range | ENUM { unavailable (0) lackOfFuel (1) lackOfBatteryPower (2) engineProblem (3) transmissionProblem (4) engineCoolingProblem (5) brakingSystemProblem (6) steeringProblem (7) tyrePuncture (8) } |
| Unit | N/A |

WrongWayDrivingSubCauseCode

| | |
|------------------|--|
| Descriptive name | WrongWayDrivingSubCauseCode |
| Definition | This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type "wrongWayDriving" (14). |
| Representation | Integer |
| Range | ENUM { unavailable (0) wrongLane (1) wrongDirection (2) } |
| Unit | N/A |

5.6 RISFacilities

The RISFacilities object provides information about the RIS itself.

RISFacilities

| | | |
|------------------|---|----------|
| Descriptive name | RISFacilities | |
| Definition | This object describes the RIS Facilities. | |
| Access | Consumer | Provider |
| | R | R |
| Representation | { FacilitiesID [†] id Location location FacilitiesInformation* info ObjectID<Intersection> intersections[] } | |
| Range | N/A | |
| Unit | N/A | |

[†] This type is defined in [Ref 4], *IDD TLC Facilities Interface v1.0, aug 2016*.

5.7 ItsStation

The ItsStation object is an abstraction of the Cooperative Awareness Message (CAM). When a CAM is received by the RIS the corresponding attributes of the ItsStation object are written. After the RIS has performed the map-matching process the results are written to the “matches” attribute.

ItsStation

| | | | |
|------------------|--|----------------|-------|
| Descriptive name | ItsStation | | |
| Definition | This object describes properties of a ItsStation. The ID is the same as the string representation of the StationID of the corresponding CAM. | | |
| Access | Consumer | Provider | |
| | R | R | |
| Representation | { | | |
| | ObjectID | id | |
| | StationType | stationType | |
| | Timestamp | locationTime | |
| | VehicleRole | role | |
| | Length | length | |
| | Length | width | |
| | Location | location | |
| | Heading | heading | |
| | Speed | speed | |
| | Acceleration | acceleration | |
| | RoleAttributes | roleAttributes | |
| | MapMatch | matches[] | <OPT> |
| | } | | |
| Range | N/A | | |
| Unit | N/A | | |

DangerousGoods

| | |
|------------------|--|
| Descriptive name | DangerousGoods |
| Definition | This list contains the possible types of dangerous goods that can be carried by a (heavy) vehicle according to the European Agreement concerning the International Carriage of Dangerous Goods by Road. |
| Representation | Integer |
| Range | <pre> ENUM { explosives1 (0) explosives2 (1) explosives3 (2) explosives4 (3) explosives5 (4) explosives6 (5) flammableGases (6) nonFlammableGases (7) toxicGases (8) flammableLiquids (9) flammableSolids (10) substancesLiableToSpontaneousCombustion (11) substancesEmittingFlammableGasesUponContactWithWater (12) oxidizingSubstances (13) organicPeroxides (14) toxicSubstances (15) infectiousSubstances (16) radioactiveMaterial (17) corrosiveSubstances (18) miscellaneousDangerousSubstances (19) } </pre> |
| Unit | N/A |

MapMatch

| | |
|------------------|--|
| Descriptive name | MapMatch |
| Definition | <p>This object describes a map-matching result of an ItsStation onto a Lane of an Intersection.</p> <p>The Distance represents the distance to the start of the lane (stop-line) along the path of the Lane, and the Offset represents the perpendicular distance to the path of the Lane. See also section 4.6.</p> |
| Representation | <pre>{ ObjectID<Intersection> intersection Integer lane ObjectID<SignalGroup> signalGroup <OPT> Length distance Length offset }</pre> |
| Range | N/A |
| Unit | N/A |

PublicTransport

| | |
|------------------|---|
| Descriptive name | PublicTransport |
| Definition | <p>This object describes the additional attributes of a vehicle that is used to operate public transport service.</p> <p>The attributes presented here are encoded within the CAM. Refer to Appendix A - Country specific public transport encoding for more details.</p> |
| Representation | <pre>{ Boolean embarkation Integer lineNr Integer serviceNr Integer journeyNr Integer companyNr Punctuality punctuality }</pre> |
| Range | N/A |
| Unit | N/A |

RoleAttributes

| Descriptive name | RoleAttributes | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------|---|---|-------------|---|---|---|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Definition | <p>This object defines the role-dependent attributes of an ItsStation.</p> <p>The attributes marked with “M” are mandatory and the attributes marked with “O” are optional for ItsStations with the corresponding VehicleRole value.</p> <p>The attributes marked with “-” are not applicable for those with the corresponding VehicleRole value.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Representation | <pre>{ Boolean lightBarActivated Boolean sirenActivated CauseCode incidentIndication SubCauseCode incidentSubIndication PublicTransport publicTransport SpecialTransport specialTransport DangerousGoods dangerousGoods }</pre> | <table border="1"> <thead> <tr> <th colspan="7">VehicleRole</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>M</td> <td>-</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> </tr> <tr> <td>-</td> <td>M</td> <td>-</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> </tr> <tr> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>O</td> <td>O</td> </tr> <tr> <td>-</td> <td>-</td> <td>-</td> <td>O</td> <td>-</td> <td>O</td> <td>O</td> </tr> <tr> <td>M</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>-</td> <td>M</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>-</td> <td>-</td> <td>M</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> </tbody> </table> | VehicleRole | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | - | M | - | M | M | M | M | - | M | - | M | M | M | M | - | - | - | - | - | O | O | - | - | - | O | - | O | O | M | - | - | - | - | - | - | - | M | - | - | - | - | - | - | - | M | - | - | - | - |
| VehicleRole | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | M | - | M | M | M | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | M | - | M | M | M | M | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | - | - | - | - | O | O | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | - | - | O | - | O | O | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| M | - | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | M | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - | - | M | - | - | - | - | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Range | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Unit | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

SpecialTransport

| | |
|------------------|---|
| Descriptive name | SpecialTransport |
| Definition | <p>This object describes the different classifications of special transport types.</p> <p>For the classifications that apply to the special cargo being transported the corresponding attribute values are set to "true", the other attributes shall have a value of "false".</p> |
| Representation | <pre>{ Boolean heavyLoad Boolean excessWidth Boolean excessLength Boolean excessHeight }</pre> |
| Range | N/A |
| Unit | N/A |

StationType

| | |
|------------------|---|
| Descriptive name | StationType |
| Definition | This list contains all the different station types for an ItsStation. |
| Representation | Integer |
| Range | ENUM { 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) } |
| Unit | N/A |

VehicleRole

| | |
|------------------|---|
| Descriptive name | VehicleRole |
| Definition | <p>This list contains all the different vehicle roles for an ItsStation.</p> <p>A vehicle can be assigned a role which identifies a certain expected behaviour. This assigned role also determines the additional RoleAttributes of an ItsStation.</p> |
| Representation | Integer |
| Range | <pre> ENUM { default (0) <i>Default vehicle role as indicated by the vehicle type.</i> publicTransport (1) <i>Vehicle is used to operate public transport service.</i> specialTransport (2) <i>Indication for special transport, e.g. oversized trucks.</i> dangerousGoods (3) <i>Vehicle used for dangerous goods transportation.</i> roadwork (4) <i>Vehicle used to realize roadwork or road maintenance mission.</i> rescue (5) <i>Vehicle used for rescue purposes, e.g. as a towing service.</i> emergency (6) <i>Vehicle used for emergency mission, e.g. ambulance, fire brigade.</i> safetyCar (7) <i>Vehicle is used for public safety, e.g. patrol.</i> agriculture (8) <i>Vehicle is used for agriculture, e.g. farm tractor.</i> commercial (9) <i>Vehicle is used for transportation of commercial goods.</i> military (10) <i>Vehicle is used for military purpose.</i> roadOperator (11) <i>Vehicle is used in road operator missions.</i> taxi (12) <i>Vehicle is used to provide an authorized taxi service.</i> } </pre> |
| Unit | N/A |

5.8 ItsEvent

The ItsEvent object is an abstraction of the Decentralized Environmental Notification Message (DENM). An ITS-Application can request the RIS for dissemination of DENM by writing an ItsEvent object. Also when a DENM is received by the RIS the corresponding attributes of the ItsEvent object are written.

ItsEvent

| | | | |
|------------------|--|--------------------|-------|
| Descriptive name | ItsEvent | | |
| Definition | <p>This object describes a detected event, like weather conditions or dangerous situations. The id is the same as the string representation of the ActionID of the corresponding DENM (an underscore is used as field separator).</p> <p>When no DestinationArea is specified, a circle around EventPosition with a radius of RelevanceDistance will be taken.</p> <p>When no RepetitionInterval is specified, the corresponding DENM is broadcasted only once. Otherwise the RepetitionInterval specifies the time between between two consecutive message transmissions.</p> | | |
| Access | Consumer | Provider | |
| | R | R/W | |
| Representation | { | | |
| | ObjectID | id | |
| | Timestamp | detectionTime | |
| | CauseCode | eventType | |
| | SubCauseCode | eventSubType | |
| | Location | eventPosition | |
| | Duration | validityDuration | |
| | Length | relevanceDistance | |
| | TrafficDirection | trafficDirection | |
| | Path | traces[] | |
| | Area | destinationArea | <OPT> |
| | Interval | repetitionInterval | <OPT> |
| | } | | |
| Range | N/A | | |
| Unit | N/A | | |

TrafficDirection

| | |
|------------------|---|
| Descriptive name | TrafficDirection |
| Definition | <p>This list contains all the different traffic directions that are relevant to information indicated in an ItsEvent.</p> <p>Upstream traffic corresponds to the incoming traffic; towards the event, and downstream traffic corresponds to the departing traffic; away from the event.</p> |
| Representation | Integer |
| Range | <pre>ENUM { allTrafficDirections (0) upstreamTraffic (1) downstreamTraffic (2) oppositeTraffic (3) }</pre> |
| Unit | N/A |

5.9 Intersection

The Intersection object is an abstraction of the MapData message. It describes the intersection geometry that is derived from the topology as specified in [Ref 6], *Talking Traffic 1.1, Bijlage 7: Intersection Topology Format versie 0.9, jul 2016*.

Intersection

| | | | |
|------------------|---|-------------------|---------------|
| Descriptive name | Intersection | | |
| Definition | <p>This object describes the topology of an intersection. It also contains the (dynamic) information about the traffic light controller state.</p> <p>The ID of this object should be equal to the ID of the corresponding Intersection object as received from the TLC-FI.</p> | | |
| Access | Consumer | Provider | |
| | R | R/W | |
| Representation | { | | <i>Access</i> |
| | ObjectID | id | R |
| | String | name | R |
| | Location | referencePosition | R |
| | Speed | speedLimit | <OPT> R |
| | Lane | lanes[] | R |
| | ObjectID<SignalGroup> | signalGroups[] | R |
| | IntersectionState | status | R/W |
| | } | | |
| Range | N/A | | |
| Unit | N/A | | |

AllowedManeuvers

| | |
|------------------|---|
| Descriptive name | AllowedManeuvers |
| Definition | This list contains the allowed (possible) maneuvers from a lane connected to another lane . |
| Representation | Integer |
| Range | <pre> { <i>Description</i> straight (0) <i>A Straight movement is allowed in this lane.</i> leftTurn (1) <i>A Left Turn movement is allowed in this lane.</i> rightTurn (2) <i>A Right Turn movement is allowed in this lane.</i> uTurn (3) <i>A U Turn movement is allowed in this lane.</i> leftTurnOnRed (4) <i>A Stop, and then proceed when safe movement is allowed in this lane.</i> rightTurnOnRed (5) <i>A Stop, and then proceed when safe movement is allowed in this lane.</i> laneChange (6) <i>A movement which changes to an outer lane on the egress side is allowed in this lane (example: left into either outbound lane).</i> noStopping (7) <i>The vehicle should not stop at the stop line (example: a flashing green arrow).</i> yieldAllways (8) <i>The allowed movements above are not protected (example: a permanent yellow condition).</i> goWithHalt (9) <i>After making a full stop, may proceed.</i> caution (10) <i>Proceed past stop line with caution.</i> } </pre> |
| Unit | N/A |

Connection

| | |
|------------------|--|
| Descriptive name | Connection |
| Definition | <p>This object describes the connection between two lanes.</p> <p>The Lane attribute is the lane number where the Lane in question is connected to. This can (optionally) be at another Intersection.</p> <p>If a SignalGroup is specified, the connection is guarded by that signal group.</p> <p>The Maneuver attribute indicates what kind of movement is represented by this connection.</p> |
| Representation | <pre>{ Integer lane ObjectID<Intersection> intersection <OPT> ObjectID<SignalGroup> signalGroup <OPT> AllowedManeuvers maneuver <OPT> }</pre> |
| Range | N/A |
| Unit | N/A |

Lane

| | |
|------------------|--|
| Descriptive name | Lane |
| Definition | <p>This object describes the basic attribute information of a lane.</p> <p>The LaneNr is an unique number within the intersection.</p> <p>The Nodes are defined starting closest to the centre (position) of the intersection going outwards.</p> <p>Connections are defined by the Lane(s) this Lane is connected to.</p> |
| Representation | <pre>{ Integer laneNr LaneDirection direction Path nodes Connection connectsTo[] }</pre> |
| Range | N/A |
| Unit | N/A |

IntersectionState

| | | |
|------------------|---|--|
| Descriptive name | IntersectionState | |
| Definition | <p>This object contains the traffic controller status information that may be sent to local OBUs as part of the SPAT process.</p> <p>All applicable states will be set to the value “true” by the ITS application that provides this information. All other attributes must have the value “false”.</p> | |
| Representation | <pre>{ Boolean manualControllsEnabled Boolean stopTimelsActivated Boolean failureFlash Boolean preemptIsActive Boolean signalPriorityIsActive Boolean fixedTimeOperation Boolean trafficDependentOperation Boolean standbyOperation Boolean failureMode Boolean off }</pre> | <p><i>Description</i></p> <p><i>Timing reported is per programmed values, etc. but person at cabinet can manually request that certain intervals are terminated early (e.g. green).</i></p> <p><i>All counting/timing has stopped.</i></p> <p><i>To be used for any detected hardware failures, e.g. conflict monitor as well as for police flash.</i></p> <p><i>Schedule of signals is based on time only (i.e. the state can be calculated).</i></p> <p><i>Operation is based on different levels of traffic parameters (requests, duration of gaps or more complex parameters).</i></p> <p><i>Partially switched off or partially amber flashing.</i></p> <p><i>Controller has a problem or failure in operation.</i></p> <p><i>Controller is switched off.</i></p> |
| Range | N/A | |
| Unit | N/A | |

LaneDirection

| | |
|------------------|---|
| Descriptive name | LaneDirection |
| Definition | This list contains all the different (driving) directions of a Lane. |
| Representation | Integer |
| Range | ENUM { none (0) ingress (1) egress (2) bothWays (3) } |
| Unit | N/A |

5.10 SignalGroup

The SignalGroup object is an abstraction of the Signal Phase and Timing (SPAT) message. It describes the movement states of each signal group of an intersection, including any active or pending priority events.

SignalGroup

| | | | |
|------------------|---|-------------------|-----------|
| Descriptive name | SignalGroup | | |
| Definition | <p>This object describes the various information about the current or future movement state of a designated collection of one or more lanes under a signal group.</p> <p>The ID must be unique within the RIS. Therefore this is constructed from the ID of the intersection the signal group belongs to, followed by an underscore, and the ID of the corresponding SignalGroup object as received from the TLC-FI.</p> <p>The Predictions should be ordered in time; first entry is the first state to be activated.</p> <p>The ValidityDuration indicated for which duration the corresponding SPAT will be broadcasted.</p> | | |
| Access | Consumer | Provider | |
| | R | R/W | |
| Representation | { | | Access |
| | ObjectID | id | R |
| | SignalGroupState [†] | state | R/W |
| | SignalGroupPrediction [†] | predictions[] | R/W |
| | Duration | validityDuration | R/W |
| | SpeedProfile | speedProfiles[] | <OPT> R/W |
| | ActivePrioritization | prioritizations[] | <OPT> R/W |
| | PrioritizationRequest | requests[] | <OPT> R |
| | } | | |
| Range | N/A | | |
| Unit | N/A | | |

[†] This type is defined in [Ref 4], *IDD TLC Facilities Interface v1.0, aug 2016*.

ActivePrioritization

| | |
|------------------|--|
| Descriptive name | ActivePrioritization |
| Definition | This object describes the response status of a prioritization request as send to a vehicle in the form of a Signal Status Message (SSM). It relates the prioritization state to the vehicle that requested prioritization. |
| Representation | { ObjectID<ItsStation> itsStation PrioritizationState prioState } |
| Range | N/A |
| Unit | N/A |

AdvisoryType

| | |
|------------------|--|
| Descriptive name | AdvisoryType |
| Definition | This list contains the different types of advices a given speed refers to. |
| Representation | Integer |
| Range | ENUM { none (0) greenwave (1) ecoDrive (2) transit (3) } |
| Unit | N/A |

PrioritizationRequest

| | |
|------------------|--|
| Descriptive name | PrioritizationRequest |
| Definition | This object describes a prioritization request as send from a vehicle in the form of a Signal Request Message (SRM). It relates the intersection and signal group to the vehicle that requests prioritization. |
| Representation | <pre>{ ObjectID<ItsStation> itsStation PriorityRequestType requestType ObjectID<Intersection> intersection Integer inBoundLane <i>The value 0 shall be used when the lane ID is not available or not known.</i> }</pre> |
| Range | N/A |
| Unit | N/A |

PrioritizationState

| | |
|------------------|--|
| Descriptive name | PrioritizationState |
| Definition | This list contains the possible states of a prioritization request. |
| Representation | Integer |
| Range | ENUM { unknown (0) <i>Unknown state.</i> requested (1) <i>This prioritization request was detected by the traffic controller.</i> processing (2) <i>Checking request (request is in queue, other requests are prior).</i> watchOtherTraffic (3) <i>Cannot give full permission, therefore watch for other traffic. Note that other requests may be present.</i> granted (4) <i>Intervention was successful and now prioritization is active.</i> rejected (5) <i>The prioritization request was rejected by the traffic controller.</i> maxPresence (6) <i>The request has exceeded maxPresence time. Used when the controller has determined that the requester should then back off and request an alternative.</i> reserviceLocked (7) <i>Prior conditions have resulted in a reservice locked event: the controller requires the passage of time before another similar request will be accepted.</i> } Unit |
| Unit | N/A |

PriorityRequestType

| | |
|------------------|---|
| Descriptive name | PriorityRequestType |
| Definition | This list contains the enumeration to indicate if a request (found in the SRM) represents a new service request, a request update, or a request cancellation. |
| Representation | Integer |
| Range | ENUM { none (0) request (1) update (2) cancellation (3) } |
| Unit | N/A |

SpeedProfile

| | |
|------------------|---|
| Descriptive name | SpeedProfile |
| Definition | <p>This object describes a recommended traveling approach speed to an intersection.</p> <p>The Distance indicates the region for which the advised speed is recommended. It is specified as the distance from the stop line, along the centre path of the lane. This region can be cut short when another SpeedProfile, with a shorter Distance, is defined.</p> <p>An advised Speed with a value of 0.0 m/s indicates that no reasonable speed can be advised, e.g. for the region of a waiting queue.</p> |
| Representation | { Length distance Speed speed } |
| Range | N/A |
| Unit | N/A |

5.11 Signage

The Signage object is an abstraction of the In-Vehicle Information service message (IVI). However, the relevant specification documents for this service are not finalized at the time of writing. Therefore, the contents of the Signage object are to be defined in another version of this document.

5.12 Protocol objects

This section contains the objects that are used for executing the methods as described in section 6.

Comparator

| | |
|------------------|---|
| Descriptive name | Comparator |
| Definition | This object defines the possible comparison operators that can be used when filtering objects. |
| Representation | String |
| Range | CHOICE { "==" <i>Equals.</i> "<" <i>Less than.</i> "<=" <i>Less than or equal to.</i> "!=" <i>Not equal to.</i> ">" <i>Greater than.</i> ">=" <i>Greater than or equal to.</i> } |
| Unit | N/A |

ObjectContent (abstract)

| | |
|------------------|--|
| Descriptive name | ObjectContent |
| Definition | <p>Abstract object type to group all data of RIS objects. The contents are defined by the object, indicated by the RISObjectType, itself containing all attributes that are requested within the request parameters.</p> <p>The ObjectID will always be returned regardless of the requested parameters. The rest of the content are the requested attributes of one of the following object types: ItsStation, ItsEvent, Intersection or SignalGroup.</p> |
| Representation | N/A |
| Range | N/A |
| Unit | N/A |

ObjectFilter

| | |
|------------------|---|
| Descriptive name | ObjectFilter |
| Definition | <p>This object defines the selection criteria of objects.</p> <p>When no Selection is given, all the objects of the given Type will be present.</p> <p>The optional "and" attribute can be used to create a filter for two top-level object attributes.</p> |
| Representation | <pre>{ ObjectType type SelectionCriteria selection <OPT> SelectionCriteria and <OPT> }</pre> |
| Range | N/A |
| Unit | N/A |

ObjectNotification

| | |
|------------------|--|
| Descriptive name | ObjectNotification |
| Definition | <p>This object describes a state change of one or more RIS objects matching a subscription.</p> <p>The ticks attribute defines the moment at which the notification was created by the RIS.</p> <p>The expired attribute is used to notify the subscriber of the expired (or deleted) objects it is subscribed to.</p> |
| Representation | <pre>{ SubscriptionID subscription ObjectContent objects[] ObjectID expired[] Ticks ticks }</pre> |
| Range | N/A |
| Unit | N/A |

ObjectReport

| | |
|------------------|---|
| Descriptive name | ObjectReport |
| Definition | <p>An object describing the data of one or more RIS objects. The ObjectReport represents the contents of the RIS object within the scope of the requested parameters.</p> <p>The ticks attribute defines the moment at which the report was created by the RIS.</p> |
| Representation | <pre>{ ObjectContent objects[] Ticks ticks }</pre> |
| Range | N/A |
| Unit | N/A |

ObjectUpdate

| | |
|------------------|--|
| Descriptive name | ObjectUpdate |
| Definition | <p>This object is used to define object (state) updates. All attribute types of this object are defined in [Ref 5].</p> <p>The different updates are in the update attribute. The ticks attribute defines the tick that can be used as reference to the ticks in the state attributes.</p> <p>The time attribute defines the reference time that corresponds to the ticks value.</p> |
| Representation | <pre>{ ObjectStateUpdate update[] Timestamp time Ticks ticks }</pre> |
| Range | N/A |
| Unit | N/A |

RequestFilter

| | |
|------------------|--|
| Descriptive name | RequestFilter |
| Definition | <p>This object defines the selection and presentation criteria of a request. It determines the content of the ObjectReport.</p> <p>When no Report is given, all the attributes of the object will be present. Only top level attributes of the objects defined in RISObjectType can be used in the Report.</p> |
| Representation | <pre>{ ObjectFilter filter String report[] <OPT> }</pre> |
| Range | N/A |
| Unit | N/A |

SelectionCriteria

| | |
|------------------|--|
| Descriptive name | SelectionCriteria |
| Definition | <p>This object defines the selection filter on (top-level) object attributes. The filter can only be used for attributes that consist of simple types; Integer, Float, Boolean, String or null. For attributes that consist of objects themselves, only the existence can be filtered ("==" or "!=" null).</p> <p>When no Comparator is given, by default the "==" comparison is used.</p> |
| Representation | <pre>{ String attribute <SimpleType> value Comparator comparator <OPT> }</pre> |
| Range | N/A |
| Unit | N/A |

SubscriptionFilter

| | |
|------------------|--|
| Descriptive name | SubscriptionFilter |
| Definition | <p>This object defines the selection and presentation criteria of a subscription. It determines the content of the ObjectNotification.</p> <p>When no NotificationInterval is specified, the ObjectNotification objects are reported as soon as a state change is detected. When a NotificationInterval is specified, the ObjectNotification objects are only reported once every NotificationInterval, including only the last known state of the objects.</p> <p>When no Report is specified, all the attributes of the objects in the ObjectNotification will be present.</p> |
| Representation | <pre>{ ObjectFilter objects Duration notificationInterval <OPT> String report[] <OPT> }</pre> |
| Range | N/A |
| Unit | N/A |

6 Methods

6.1 CreateEvents

This method is used to create a new ItsEvent object with a given set of attributes.

Request:

| Method: CreateEvents | | |
|----------------------|--------------|---|
| Parameter name | Type | Description |
| params | ObjectReport | For each ItsEvent all the mandatory attributes, except the ObjectID, must be provided. Optional attributes can be omitted if their value is unavailable. The ObjectID(s) of the created ItsEvent(s) will be returned by the RIS. |

Result:

| Parameter name | Type | Description |
|----------------|-----------------|---|
| result | ObjectReference | The ObjectID as generated by the RIS. This serves as a reference for future updates on the event. |

Error:

| Parameter name | Type | Description |
|----------------|-------------------|-------------------|
| code | ProtocolErrorCode | See error codes. |
| message | String | Optional message. |

Example

```
{
  "method": "CreateEvents",
  "params": {
    "objects": [
      {
        "detectionTime": 1468914482126,
        "eventType": 92,
        "eventSubType": 0,
        "eventPosition": {
          "latitude": 52.0243508,
          "longitude": 5.1412147,
          "elevation": 5.0
        },
        "validityDuration": 900,
        "relevanceDistance": 800,
        "trafficDirection": 1,
        "traces": [
          {
            points: [
              {
                "latitude": 52.0238990,
                "longitude": 5.1375616
              },
              {
                "latitude": 52.0239930,
                "longitude": 5.1375619
              }
            ]
          }
        ]
      },
      {
        "destinationArea": {
          "center": {
            "latitude": 52.0243508,
            "longitude": 5.1412147
          },
          "majorAxis": 900,
          "minorAxis": 900,
          "angle": 0,
          "circular": true
        },
        "repetitionInterval": 1000
      }
    ],
    "ticks": 1808
  },
  "id": 27,
  "jsonrpc": "2.0"
}
```

```

{
  "result": {
    "type": 2,
    "ids": [ "71004_5" ]
  },
  "id": 27,
  "jsonrpc": "2.0"
}

```

6.2 UpdateObjects

This method is used to update the writable attributes of RIS objects when a change is detected.

The objects that can be updated are: ItsEvent, Intersection and Signalgroup.

Not all the writable attributes of an object need to be provided with an update.

The following rules apply:

- The update to all objects in one method invocation is atomic.
- Attributes that are not supplied will keep their current value.
- Optional attributes that are set to null are removed.

Request:

| Method: UpdateObjects | | |
|-----------------------|--------------|--|
| Parameter name | Type | Description |
| params | ObjectUpdate | The ObjectUpdate object is used here to provide the objects and the attributes that need to be updated. In order to generate absolute times for the signal group predictions from the ticks received from the TLC-FI, the reference time of these ticks needs to be provided. |

Result:

| Parameter name | Type | Description |
|----------------|------|--|
| result | - | On successful removal an empty object is returned. |

Error:

| Parameter name | Type | Description |
|----------------|-------------------|-------------------|
| code | ProtocolErrorCode | See error codes. |
| message | String | Optional message. |

Example (see next page)

```

{
  "method": "UpdateObjects",
  "params": {
    "update": [
      {
        "objects": {
          "type": 2,
          "ids": [ "71004_5" ]
        },
        "states": [
          {
            "detectionTime": 1468914487454,
            "eventPosition": {
              "latitude": 52.024404,
              "longitude": 5.1415781
            },
            "validityDuration": 600,
            "relevanceDistance": 450,
            "trafficDirection": 0,
            "repetitionInterval": 2000
          }
        ]
      },
      {
        "objects": {
          "type": 4,
          "ids": [ "103_FC02", "103_FC08" ]
        },
        "states": [
          {
            "state": 6,
            "validityDuration": 1,
            "predictions" : {
              "state": 3
              "likely": 3712
            }
          },
          {
            "state": 4,
            "validityDuration": 1,
            "predictions" : {
              "state": 6
              "likely": 1463
            }
          }
        ]
      }
    ],
    "time": 1468914487673,
    "ticks": 1380
  },
  "id": 28,
  "jsonrpc": "2.0"
}

```

```
{
  "result": {},
  "id": 28,
  "jsonrpc": "2.0"
}
```

6.3 TerminateEvents

This method is used to terminate (remove) a previous created ItsEvent.

Request:

| Method: TerminateEvents | | |
|-------------------------|-----------------|--|
| Parameter name | Type | Description |
| params | ObjectReference | The ObjectID, that was returned as reference by the RIS, of the ItsEvent to be terminated. |

Result:

| Parameter name | Type | Description |
|----------------|------|--|
| result | - | On successful removal an empty object is returned. |

Error:

| Parameter name | Type | Description |
|----------------|-------------------|-------------------|
| code | ProtocolErrorCode | See error codes. |
| message | String | Optional message. |

Example

```
{
  "method": "TerminateEvent",
  "params": {
    "type": 2,
    "ids": [ "71004_5" ]
  },
  "id": 29,
  "jsonrpc": "2.0"
}
```

```
{
  "result": {},
  "id": 29,
  "jsonrpc": "2.0"
}
```

6.4 RequestObjects

This method is used to request objects from the RIS of the current traffic state.

The requesting application is provided with an ObjectReport object containing the objects that match the request filter.

Request:

| Method: SubscribeObjects | | |
|--------------------------|---------------|---|
| Parameter name | Type | Description |
| params | RequestFilter | The request filter describing what type of objects are requested to and how to report them. |

Result:

| Parameter name | Type | Description |
|----------------|--------------|--|
| result | ObjectReport | Array containing the data of the object(s) matching the request filter. Only the attributes defined in the report are returned. |

Error:

| Parameter name | Type | Description |
|----------------|-------------------|-------------------|
| code | ProtocolErrorCode | See error codes. |
| message | String | Optional message. |

Example (request all ItsStations with a length greater than 4.5 meters)

```
{
  "method": "RequestObjects",
  "params": {
    "objects": {
      "type": 1,
      "selection": {
        "attribute": "length",
        "value": 4.5,
        "comparator": ">"
      }
    },
    "report": [ "stationType", "speed", "matches" ]
  },
  "id": 5,
  "jsonrpc": "2.0"
}
```

```

{
  "result": {
    "objects": [
      {
        "id": "373552793"
        "stationType": 6,
        "speed": 13.8,
        "matches" : [
          {
            "intersection" : "103",
            "lane": 2,
            "signalgroup": "103_FC01",
            "distance" : 73.8,
            "offset" : 3.1
          }
        ]
      },
      {
        "id": "56946"
        "stationType": 7,
        "speed": 22.2,
        "matches" : [
          {
            "intersection" : "103",
            "lane": 12,
            "distance" : 27,
            "offset" : 1.4
          }
        ]
      }
    ],
    "ticks": 64506
  },
  "id": 5,
  "jsonrpc": "2.0"
}

```

6.5 SubscribeObjects

This method is used to set a subscription for objects from the RIS.

The requesting application is provided with an initial ObjectNotification object containing the objects that match the subscription filter. Successive updates and changes matching the subscription filter will be communicated through the NotifyObjects method.

Request:

| Method: SubscribeObjects | | |
|--------------------------|--------------------|---|
| Parameter name | Type | Description |
| params | SubscriptionFilter | The subscription filter describing what type of objects to subscribe to and how to report them. |

Result:

| Parameter name | Type | Description |
|----------------|--------------------|---|
| result | ObjectNotification | Array containing the data of the object(s) matching the subscription filter. Only the attributes defined in the report are returned. |

Error:

| Parameter name | Type | Description |
|----------------|-------------------|-------------------|
| code | ProtocolErrorCode | See error codes. |
| message | String | Optional message. |

Example (subscribe to all ItsStations of type 'bus' that are map-matched)

```
{
  "method": "SubscribeObjects",
  "params": {
    "objects": {
      "type": 1,
      "selection": {
        "attribute": "stationType",
        "value": 6
      },
      "and": {
        "attribute": "matches",
        "value": null,
        "comparator": "!="
      }
    },
    "report": [ "role", "roleAttributes", "matches" ]
  },
  "id": 12,
  "jsonrpc": "2.0"
}
```

```
{
  "result": {
    "subscription": "4624",
    "objects": [],
    "ticks": 1808
  },
  "id": 12,
  "jsonrpc": "2.0"
}
```


6.6 NotifyObjects

This method is used to notify an ITS-Application when objects from the RIS changed according to a subscription that was previously placed.

Notification:

| Method: NotifyObjects | | |
|-----------------------|--------------------|---|
| Parameter name | Type | Description |
| params | ObjectNotification | Object updates. Only the attributes specified in the corresponding Report are present in the content. |

Example (notification of a map-matched ItsStation of type 'bus')

```
{
  "method": "NotifyObjects",
  "params": {
    "subscription": "4624",
    "objects": [
      {
        "id": "373552793"
        "role": 1,
        "roleAttributes": {
          "publicTransport": {
            "embarkation": false,
            "lineNr": 9,
            "serviceNr": 45,
            "journeyNr": 44,
            "companyNr": 512,
            "punctuality": -23
          }
        }
        "matches": [
          {
            "intersection": "103",
            "lane": 2,
            "signalGroup": "103_FC01",
            "distance": 73.8,
            "offset": 3.1
          },
          {
            "intersection": "103",
            "lane": 3,
            "signalGroup": "103_FC02",
            "distance": 74.3,
            "offset": 2.6
          }
        ]
      }
    ],
    "ticks": 31513
  },
  "jsonrpc": "2.0"
}
```

6.7 UnsubscribeObjects

This method is used to remove a previously set subscription at the RIS.

Request:

| Method: UnsubscribeObjects | | |
|----------------------------|--------------|--|
| Parameter name | Type | Description |
| params | Subscription | The subscription identifier that was returned with the creation of the subscription. |

Result:

| Parameter name | Type | Description |
|----------------|------|--|
| result | - | On successful removal an empty object is returned. |

Error:

| Parameter name | Type | Description |
|----------------|-------------------|-------------------|
| code | ProtocolErrorCode | See error codes. |
| message | String | Optional message. |

Example

```
{
  "method": "UnscribeObjects",
  "params": {
    "subscription": "4624"
  },
  "id": 230,
  "jsonrpc": "2.0"
}
```

```
{
  "result": {},
  "id": 230,
  "jsonrpc": "2.0"
}
```

7 Protocol error handling

7.1 Error codes

The RIS facility interface part uses error codes in the range 2001 - 3000.

| Code | Description |
|------|--|
| 2001 | Object not created |
| 2002 | ObjectID does not exist |
| 2003 | Object type inconsistent with object indicated by ObjectID |
| 2004 | Object not deleted |
| 2005 | Parameter out of range |
| 2006 | Not authorized for this object |

8 Functional use-cases

This section contains the use-cases describing the functional behaviour of the entities communicating over the interface.

8.1 Monitoring of traffic

| | |
|------------------------------|---|
| Name | Monitoring of traffic |
| Description / context | <p>The RIS receives information about other ITS stations in the neighbourhood via Cooperative Awareness Messages (CAM), such as:</p> <ul style="list-style-type: none"> • Station identity • Station type (car, bus, bicycle etc.) • Current location, speed, direction <p>In case the ITS station does not exist in the Local Dynamic Map (LDM) a new ItsStation object is created in the LDM, otherwise the existing ItsStation object is updated. The ITS station may be mapped on the topology of the intersection. In this way, the LDM holds the current view of the traffic in the LDM. ITS applications can take a subscription on the LDM to be notified on changes in the LDM.</p> |
| Actor | ITS-CRA |
| Goal | To get a continuous updated view of the traffic situation on the intersection. |
| Pre-condition(s) | The ITS-CRA is registered and authenticated at the RIS. |
| Trigger | A change in the traffic situation is received by the RIS i.e. a CAM is received. |
| ITS-CRA functions | <p>The ITS-CRA executes the method “SubscribeObjects” at the RIS with object type ItsStation (1). The ITS-CRA waits for the response of the RIS.</p> <p><i>Note: The ITS-CRA may also use a filter to be notified of ItsStation objects that are map-matched for example.</i></p> <p><i>Note: The ITS-CRA could also indicate which attributes to receive in the notification.</i></p> |
| RIS functions | <p><u>When the method “SubscribeObjects” is invoked</u></p> <ul style="list-style-type: none"> - The subscription parameters are validated. - A SubscriptionID is returned to the ITS-CRA. <p><u>When a CAM is received by the RIS</u></p> <ul style="list-style-type: none"> - The location of the ITS station is mapped upon the intersection topology. - An ItsStation object is created (or updated when it already exists), that holds the information from the received CAM, in the LDM. - The method “NotifyObjects” is executed at the ITS-CRA when the ItsStation object satisfies the subscription-filter. |
| Post-conditions | - |
| Exception 1 | <p><u>The subscription parameters are invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | The LDM holds the current updated view on the traffic and subscribed ITS applications are informed on the view. |

8.2 Bus priority handling

An ITS application can use subscriptions at the RIS to get notified on approaching public transport vehicles (busses). With this information a prioritization request can be made using the TLC-FI. Prioritization can be done based on two types of ITS G5 messages; CAM and SRM. The prioritization status can also be informed by two types of ITS G5 messages; SPAT and SSM (see also section 8.7).

8.2.1 Priority handling based on CAM

| Name | Bus priority handling based on CAM |
|------------------------------|--|
| Description / context | The RIS receives information about busses in the neighbourhood via Cooperative Awareness Messages (CAM). An ITS-A can based upon this information request for priority at the TLC-FI to give way to these busses. |
| Actor | ITS-CRA |
| Goal | To give priority to busses crossing the intersection. |
| Pre-condition(s) | The ITS-CRA is registered and authenticated at the RIS. |
| Trigger | A bus is approaching the intersection broadcasting CAM. |
| ITS-CRA functions | <p>The ITS-CRA executes the method “SubscribeObjects” at the RIS with object type <code>ItsStation</code> (1) and with the filter conditions:</p> <ul style="list-style-type: none"> - “stationType” == 6 (only busses), and - “matches” != null (only with map-match results). <p><i>Note: The ITS-CRA could also indicate which attributes to receive in the notification.</i></p> <p><u>When the method “NotifyObjects” is invoked</u></p> <ul style="list-style-type: none"> - Request for priority at the TLC-FI for the signal group indicated in the map-match result. - Execute use-case “Inform on the signalling status” with (updated) information from the TLC-FI. |
| RIS functions | <p><u>When the method “SubscribeObjects” is invoked</u></p> <ul style="list-style-type: none"> - The subscription parameters are validated. - A SubscriptionID is returned to the ITS-CRA. <p><u>When a CAM from a bus is received by the RIS</u></p> <ul style="list-style-type: none"> - The location of the ITS station is mapped upon the intersection topology. - An <code>ItsStation</code> object is created (or updated when it already exists), that holds the information from the received CAM, in the LDM. - The method “NotifyObjects” is executed at the ITS-CRA when the <code>ItsStation</code> object satisfies the subscription-filter. |
| Post-conditions | - |
| Exception 1 | <p><u>The subscription parameters are invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | A priority is handled for the approaching bus. |

8.2.2 Priority handling based on SRM

| | |
|------------------------------|---|
| Name | Bus priority handling based on SRM |
| Description / context | The RIS receives information about busses in the neighbourhood via Cooperative Awareness Messages (CAM) and Signal Request Messages (SRM). An ITS-A can based upon this information request for priority at the TLC-FI to give way to these busses. |
| Actor | ITS-CRA |
| Goal | To give priority to busses crossing the intersection. |
| Pre-condition(s) | The ITS-CRA is registered and authenticated at the RIS. |
| Trigger | A bus is approaching the intersection broadcasting CAM and SRM. |
| ITS-CRA functions | <p>The ITS-CRA executes the method “SubscribeObjects” at the RIS with object type SignalGroup (4) and with the filter condition:</p> <ul style="list-style-type: none"> - “requests” != null (only with prioritization requests). <p><i>Note: The ITS-CRA could also indicate which attributes to receive in the notification.</i></p> <p><i>Note: The ITS-CRA could also take a subscription on the ItsStation object to track the bus, or to provide extra information about position, speed, etc.</i></p> <p><u>When the method “NotifyObjects” is invoked</u></p> <ul style="list-style-type: none"> - Request for priority at the TLC-FI for the signal group indicated in the prioritization request. - Execute use-case “Inform on the signalling status” with (updated) information from the TLC-FI. |
| RIS functions | <p><u>When the method “SubscribeObjects” is invoked</u></p> <ul style="list-style-type: none"> - The subscription parameters are validated. - A SubscriptionID is returned to the ITS-CRA. <p><u>When a SRM from a bus is received by the RIS</u></p> <ul style="list-style-type: none"> - The corresponding SignalGroup object, in the LDM, is updated with the information in the request message. - The method “NotifyObjects” is executed at the ITS-CRA when the SignalGroup object satisfies the subscription-filter. |
| Post-conditions | - |
| Exception 1 | <p><u>The subscription parameters are invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | A priority is handled for the approaching bus. |

8.3 Create an ItsEvent

| | |
|------------------------------|---|
| Name | Create an ItsEvent |
| Description / context | <p>Events are used to inform ITS stations about potentially dangerous situations (e.g. Traffic jam ahead, animal on the road, bad weather condition etc.). In the case that an ITS application detects such a dangerous situation, it can request the RIS to create an ItsEvent object.</p> <p>An event contains at least the following attributes:</p> <ul style="list-style-type: none"> • The type of the event • Time of detection • Location • Validity duration of the event <p>The ItsEvent object is stored in the LDM and a Decentralized Environment Notification Message (DENM) is made which is broadcasted to other ITS stations in the neighbourhood.</p> |
| Actor | ITS-PRA |
| Goal | Inform other ITS stations of a potentially dangerous situation using DENM. |
| Pre-condition(s) | The ITS-PRA is registered and authenticated at the RIS. |
| Trigger | The ITS-PRA detects a potentially dangerous situation. |
| ITS-PRA functions | The ITS-PRA executes the method "CreateEvents" at the RIS with (at least) all the mandatory attributes present. |
| RIS functions | <p><u>When the method "CreateEvents" is invoked</u></p> <ul style="list-style-type: none"> - The request parameters are validated. - An ItsEvent object, that holds the event information, is created in the LDM. - A DENM, based upon the ItsEvent object, will be broadcasted. - The ObjectID of the created ItsEvent object is returned to the ITS-PRA for future reference. |
| Post-conditions | If configured the DENM is repeatedly transmitted until it is expired. |
| Exception 1 | <p><u>The request is invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | The newly created ItsEvent object is stored in the LDM and the associated DENM message is broadcasted. The exact moment in time the DENM is broadcasted is up to the RIS and the applicable radio conditions. |

8.4 Update an ItsEvent

| | |
|------------------------------|--|
| Name | Update an ItsEvent |
| Description / context | <p>The ITS application has previously detected a potentially dangerous situation and created an ItsEvent object for this situation.</p> <p>The ITS application continues to monitor the situation and detects a change in the situation e.g. changed location, validity time.</p> <p>The ITS application updates the ItsEvent object at the RIS using the reference it received when it created the ItsEvent object.</p> |
| Actor | ITS-PRA |
| Goal | Inform other ITS stations the updated information about the situation using DENM messages. |
| Pre-condition(s) | The ITS-PRA is registered and authenticated at the RIS and has a reference to a previously created ItsEvent (by the same ITS-PRA). |
| Trigger | The ITS application detects a change in the situation. |
| ITS-PRA functions | <p>The ITS-PRA executes the method “UpdateObjects” at the RIS for object type ItsEvent (2) and the object reference to update.</p> <p><i>Note: for an update only the attributes of which the value have changed need to be provided.</i></p> |
| RIS functions | <p><u>When the method “UpdateObjects” is invoked for an ItsEvent</u></p> <ul style="list-style-type: none"> - The request parameters are validated. - The ownership of the referenced ItsEvent is validated. - The ItsEvent object, that holds the event information, in the LDM is updated. - A DENM, based upon the updated ItsEvent object, will be broadcasted. |
| Post-conditions | If configured the DENM is repeatedly transmitted until it is expired. |
| Exception 1 | <p><u>The request is invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| Exception 2 | <p><u>The ItsEvent does not exists.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| Exception 3 | <p><u>The ITS-PRA is not the owner of the ItsEvent</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | The ItsEvent object is updated in the LDM and the associated updated DENM message is broadcasted. The exact moment in time the DENM is broadcasted is up to the RIS and the applicable radio conditions. |

8.5 Delete an ItsEvent

| | |
|------------------------------|---|
| Name | Delete an ItsEvent |
| Description / context | <p>The ITS application has created an ItsEvent object for a potentially dangerous situation and the situation no longer exists.</p> <p>The ITS application wants to inform the other ITS stations that the situation no longer exists and deletes the ItsEvent object at the RIS.</p> <p>The ItsEvent is removed from the LDM and the associated DENM message with termination indication is broadcasted.</p> |
| Actor | ITS-PRA |
| Goal | Inform other ITS stations of the no longer existing situation using DENM messages. |
| Pre-condition(s) | The ITS-PRA is registered and authenticated at the RIS and has a reference to a previously created ItsEvent (by the same ITS-PRA). |
| Trigger | The ITS application detects that the situation no longer exists. |
| ITS-PRA functions | The ITS-PRA executes the method "TerminateEvents" at the RIS for object type ItsEvent (2) and the object reference to delete. |
| RIS functions | <p><u>When the method "TerminateEvents" is invoked for an ItsEvent</u></p> <ul style="list-style-type: none"> - The request parameters are validated. - The ownership of the referenced ItsEvent is validated. - The ItsEvent object, that holds the event information, in the LDM is removed. - A DENM, with the termination flag, will be broadcasted once. |
| Post-conditions | The DENM is broadcasted only once, without repetition. |
| Exception 1 | <p><u>The request is invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| Exception 2 | <p><u>The ItsEvent does not exists.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| Exception 3 | <p><u>The ITS-PRA is not the owner of the ItsEvent</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | The ItsEvent object is removed from the LDM and the associated DENM message with termination indication is broadcasted. The exact moment in time the DENM is broadcasted is up to the RIS and the applicable radio conditions. |

8.6 Monitoring of events

| | |
|------------------------------|--|
| Name | Monitoring of events |
| Description / context | In addition of creating ItsEvent objects, ITS applications can also be informed of potentially dangerous situations detected or relayed by other ITS stations. |
| Actor | ITS-CRA |
| Goal | To be informed about a potentially dangerous situation detected by other ITS stations. |
| Pre-condition(s) | The ITS-CRA is registered and authenticated at the RIS. |
| Trigger | A change in the traffic situation is received by the RIS i.e. a DENM is received. |
| ITS-CRA functions | <p>The ITS-CRA executes the method “SubscribeObjects” at the RIS with object type ItsEvent (2). The ITS-CRA waits for the response of the RIS.</p> <p><i>Note: The ITS-CRA may also use a filter to be notified of ItsEvent objects that have a certain direct cause for example.</i></p> <p><i>Note: The ITS-CRA could also indicate which attributes to receive in the notification.</i></p> |
| RIS functions | <p><u>When the method “SubscribeObjects” is invoked</u></p> <ul style="list-style-type: none"> - The subscription parameters are validated. - A SubscriptionID is returned to the ITS-CRA. <p><u>When a DENM is received by the RIS</u></p> <ul style="list-style-type: none"> - An ItsEvent object is created, updated when it already exists, or removed in the LDM based upon the information in the received DENM. - The method “NotifyObjects” is executed at the ITS-CRA when the ItsEvent object satisfies the subscription-filter. |
| Post-conditions | - |
| Exception 1 | <p><u>The subscription parameters are invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | The LDM holds the current valid ItsEvent(s) and subscribed ITS applications are informed on the ItsEvent(s). |

8.7 Inform on the signalling status

| | |
|------------------------------|--|
| Name | Inform on the signalling status |
| Description / context | <p>The state and predictions of signal groups of an intersection can be broadcasted to other ITS stations with the Signal Phase and Timing (SPAT) and MapData (MAP) messages.</p> <p>Also the status of currently active or pending prioritizations can be broadcasted with a Signal Status Message (SSM).</p> |
| Actor | ITS-PRA |
| Goal | To inform other ITS stations on the signalling and prioritization status of the intersection(s). |
| Pre-condition(s) | The ITS-PRA is registered and authenticated at the RIS and has sufficient credentials to update the signal group states. |
| Trigger | The ITS-PRA receives information on changes in the signalling state from the Traffic Light Controller (TLC) via the TLC-FI. |
| ITS-PRA functions | <p>The ITS-PRA writes the signal group states received from the TLC-FI by executing the “UpdateObjects” method for the object types Intersection (3) and SignalGroup (4).</p> <p><u>When the status of the TLC has changed</u></p> <ul style="list-style-type: none"> - Sets <i>Intersection.state</i> to the current state of the TLC. <p><u>When the state of a SignalGroup has changed</u></p> <ul style="list-style-type: none"> - Sets <i>SignalGroup.state</i> to the current state of the signal group. - Sets <i>SignalGroup.predictions</i> to the predicted states. <p><u>When the ITS-PRA has calculated advisory speeds</u></p> <ul style="list-style-type: none"> - Sets <i>SignalGroup.speedProfiles</i> to the calculated profile. <p><u>When the ITS-PRA receives the status of prioritization requests</u></p> <ul style="list-style-type: none"> - Sets <i>SignalGroup.prioritizations</i>. |
| RIS functions | <p><u>When the method “UpdateObjects” is invoked</u></p> <ul style="list-style-type: none"> - The request parameters are validated. - The topology object (Intersection or SignalGroup), that holds the status information, in the LDM is updated. - The SPAT and MAP, based upon the topology objects, will be periodically broadcasted. <p><u>When the prioritization status is available</u></p> <ul style="list-style-type: none"> - In addition to the SPAT and MAP, also a SSM will be periodically broadcasted. |
| Post-conditions | - |
| Exception 1 | <p><u>The request is invalid.</u></p> <ul style="list-style-type: none"> - An error message is returned. |
| End result | The signalling information on the intersection(s) is updated in the LDM and the associated SPAT, MAP and SSM message combination is broadcasted periodically. |

9 Exception handling use-cases

9.1 Invalid request

The request method is not recognized.

9.2 Invalid parameters

The input parameters in a request are not valid.

9.3 Request could not be completed

The request could not be completed due to an RIS internal error situation.

9.4 Not authorized

The request is not authorized for the user

Appendix A – Country specific public transport encoding

The CAM data provided by public transport vehicles is encoded in a country specific way.

```
PtActivation ::= SEQUENCE {
    ptActivationType PtActivationType,
    ptActivationData PtActivationData
}

PtActivationType ::= INTEGER {undefinedCodingType(0), r09-16CodingType(1), vdv-50149CodingType(2)} (0..255)

PtActivationData ::= OCTET STRING (SIZE(1..20))
```

The table below shows the fields defined in the Dutch KAR standard that are not present in any form in the ETSI message set, and thus are encoded in the PtActivationData.

| Octet # | KAR field name | size | RIS attribute |
|---------|---------------------------------------|------------------|---------------|
| 0, 1 | Line number PT | 16 bits unsigned | lineNr |
| 2, 3 | Vehicle id | 16 bits unsigned | vehicleID |
| 4, 5 | Block number | 16 bits unsigned | serviceNr |
| 6, 7 | Journey number | 16 bits unsigned | journeyNr |
| 8, 9 | Punctuality [s] | 16 bits signed | punctuality |
| 10, 11 | Activation pointnr | 16 bits unsigned | |
| 12 | Punctualityclass | 8 bits unsigned | |
| 13 | Company number | 8 bits unsigned | companyNr |
| 14 | Type of Journey or Fortify seq number | 8 bits unsigned | |

16 bit numbers are encoded in big endian format (most significant octet first).

The table below shows the mapping between the KAR fields, the RIS attributes and the related ETSI messages.

| CVN Nr | Fieldname | Size (in bytes) | Range | RIS attribute | ITS G5 message |
|--------|---|-----------------|----------------|---------------|--------------------|
| 1 | Virtual local loop number | 1 | 0..127 | lane | SRM |
| 2 | Vehicle type | 1 | 0..99 | stationType | CAM |
| 3 | Line number PT | 2 | 0 – 9999 | | CAM (PtActivation) |
| 4 | Block number | 2 | 0 – 9999 | | CAM (PtActivation) |
| 5 | Company number | 1 | 0 – 255 | | CAM (PtActivation) |
| 6 | Vehicle id | 2 | 0 – 32767 | | CAM (PtActivation) |
| 7 | Direction at intersection/signal group number | 1 | 0 – 255 | lane | SRM |
| 8 | Vehicle status | 1 | 0 – 99 | embarkation | CAM |
| 9 | Priorityclass | 1 | 0 – 99 | | SRM |
| 10 | Punctualityclass | 1 | 0 – 99 | | CAM (PtActivation) |
| 11 | Punctuality [s] | 2 | -3600 to +3600 | | CAM (PtActivation) |
| 12 | Vehicle / train length [m] | 1 | 0 – 255 | length | CAM |

| | | | | | |
|-----|--|---|-------------|------------------|--------------------|
| 13 | Actual vehicle speed [m/s] | 1 | 0 – 99 | speed | CAM |
| 14 | Distance till passage stop line [m] | 2 | -99 to 9999 | distance | CAM / MAP |
| 15 | Driving time till passage stop line | 1 | 0 – 255 | speed / distance | CAM / MAP |
| 16 | Journey number | 2 | 0 – 9999 | | CAM (PtActivation) |
| 17 | Type of Journey or Fortify seq number | 1 | 0 – 99 | | CAM (PtActivation) |
| 18 | Route Public Transport | 1 | 0 – 99 | | SRM |
| 19 | Type of command | 1 | 0 – 99 | requestType | SRM |
| 20 | Activation pointnr | 2 | 0 – 32767 | | CAM (PtActivation) |
| 21a | Location- reference Latitude [degrees] | 1 | 0 – 89 | location | CAM |
| 21b | Location-reference Latitude [minutes] | 1 | 0 – 59 | location | CAM |
| 21c | Location-reference Latitude [seconds] | 1 | 0 – 59 | location | CAM |
| 21d | Location-reference Latitude [hundreds of seconds] | 1 | 0 – 99 | location | CAM |
| 21e | Location-reference Longitude [degrees] | 1 | 0 – 179 | location | CAM |
| 21f | Location-reference Longitude [minutes] | 1 | 0 – 59 | location | CAM |
| 21g | Location-reference Longitude [seconds] | 1 | 0 – 59 | location | CAM |
| 21h | Location-reference Longitude [hundreds of seconds] | 1 | 0 – 99 | location | CAM |
| 22a | Year | 2 | 0 – 9999 | locationTime | CAM |
| 22b | Month | 1 | 1 – 12 | locationTime | CAM |
| 22c | Day | 1 | 1 – 31 | locationTime | CAM |
| 22d | Hours | 1 | 0 – 23 | locationTime | CAM |
| 22e | Minutes | 1 | 0 – 59 | locationTime | CAM |
| 22f | Seconds | 1 | 0 – 59 | locationTime | CAM |
| 23 | Reserve | 2 | | | |
| 24 | Reserve | 2 | | | |

Appendix B

TISA specification TAWG11071 (2011-11-07, drafted to potentially become ISO/TS 21219 Part 15): "Intelligent Transport Systems (ITS) - Traffic and Travel Information (TTI) via Transport Protocol Experts Group, Generation 2 (TPEG2) - Part 15: Traffic Event Compact (TPEG2-TEC-3.1/001)".

| Cause code description | Direct cause code | Mapping with TPEG-TEC | Sub cause code | Sub cause description |
|--------------------------------------|-------------------|---|----------------|--|
| Traffic condition | 1 | Specified as traffic congestion in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 | As specified in <i>tec101</i> of clause 9.11 in TISA TAWG11071 [i.10] |
| | | | 2 | Traffic jam slowly increasing, as specified in clause 5.3.8 in ETSI TS 101 539-1 [i.4], not specified in TISA TAWG11071 [i.10] |
| | | | 3 | Traffic jam increasing, as specified in clause 5.3.8 in ETSI TS 101 539-1 [i.4], not specified in TISA TAWG11071 [i.10] |
| | | | 4 | Traffic jam strongly increasing, as specified in clause 5.3.8 in ETSI TS 101 539-1 [i.4], not specified in TISA TAWG11071 [i.10] |
| | | | 5 | Traffic stationary, as specified in clause 5.3.8 in ETSI TS 101 539-1 [i.4], not specified in TISA TAWG11071 [i.10] |
| | | | 6 | Traffic jam slightly decreasing, as specified in clause 5.3.8 in ETSI TS 101 539-1 [i.4], not specified in TISA TAWG11071 [i.10] |
| | | | 7 | Traffic jam decreasing, as specified in clause 5.3.8 in ETSI TS 101 539-1 [i.4], not specified in TISA TAWG11071 [i.10] |
| | | | 8 | Traffic jam strongly decreasing, as specified in clause 5.3.8 in ETSI TS 101 539-1 [i.4], not specified in TISA TAWG11071 [i.10] |
| Accident | 2 | Specified as accidents in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 7 | As specified in <i>tec102</i> of clause 9.12 in TISA TAWG11071 [i.10] |
| | | | 8 | Assistance requested (e-call) |
| Roadworks | 3 | Specified as road works in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 3 | As specified in <i>tec103</i> of clause 9.13 in TISA TAWG11071 [i.10] |
| | | | 4 | Short-term stationary roadworks |
| | | | 5 | Street cleaning |
| | | | 6 | Winter service |
| Adverse weather condition - adhesion | 6 | Specified as slippery road in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 10 | As specified in <i>tec106</i> of clause 9.16 in TISA TAWG11071 [i.10] |
| | 9 | | 0 | Unavailable |

| | | | | |
|---|----|---|--------|---|
| Hazardous location - Surface condition | | Specified as hazardous driving conditions in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 1 to 9 | As specified in <i>tec109</i> of clause 9.18 in TISA TAWG11071 [i.10] |
| Hazardous location - Obstacle on the road | 10 | Specified as objects on the road in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 7 | As specified in <i>tec110</i> of clause 9.19 in TISA TAWG11071 [i.10] |
| Hazardous location - Animal on the road | 11 | Specified as animals on the road in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 4 | As specified in <i>tec111</i> of clause 9.20 in TISA TAWG11071 [i.10] |
| Human presence on the road | 12 | Specified as people on roadway in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 3 | As specified in <i>tec112</i> of clause 9.21 in TISA TAWG11071 [i.10] |
| Wrong way driving | 14 | Specified as vehicle on wrong carriageway in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 | Vehicle driving in wrong lane |
| | | | 2 | Vehicle driving in wrong driving direction |
| Rescue and recovery work in progress | 15 | Specified as Rescue and recovery work in progress in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 5 | As specified in <i>tec115</i> of clause 9.23 in TISA TAWG11071 [i.10] |
| Adverse weather condition - extreme weather condition | 17 | Specified as extreme weather condition in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 6 | As specified in <i>tec117</i> of clause 9.25 in TISA TAWG11071 [i.10] |
| Adverse weather condition - visibility | 18 | Specified as visibility reduced in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 8 | As specified in <i>tec118</i> of clause 9.26 in TISA TAWG11071 [i.10] |
| Adverse weather condition -Precipitation | 19 | Precipitation as defined in TISA TAWG11071 [i.10], clause 8.3.2 | 0 | Unavailable |
| | | | 1 to 3 | As defined in <i>tec119</i> of clause 9.27 in TISA TAWG11071 [i.10] |
| Slow vehicle | 26 | Specified as slow moving vehicles in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 8 | As defined in <i>tec126</i> of clause 9.32 in TISA TAWG11071 [i.10] |
| Dangerous end of queue | 27 | Specified as dangerous end of Queue in <i>tec002</i> of clause 9.2 in TISA TAWG11071 [i.10] | 0 | Unavailable |
| | | | 1 to 4 | As defined in <i>tec127</i> of clause 9.33 in TISA TAWG11071 [i.10] |
| Vehicle breakdown | 91 | Values are assigned referring to ETSI TS 101 539-1 [i.4], | 0 | Unavailable |

| | | | | |
|---|--------------------------|--|-----------------------|---|
| | | clause 6.3.3 | 1 | Lack of fuel |
| | | | 2 | Lack of battery |
| | | | 3 | Engine problem |
| | | | 4 | Transmission problem |
| | | | 5 | Engine cooling problem |
| | | | 6 | Braking system problem |
| | | | 7 | Steering problem |
| | | | 8 | Tyre puncture |
| Post-crash | 92 | Values are assigned referring to ETSI TS 101 539-1 [i.4], clause 6.3.3 | 0 | Unavailable |
| | | | 1 | Accident without e-Call triggered |
| | | | 2 | Accident with e-Call manually triggered |
| | | | 3 | Accident with e-Call automatically triggered |
| | | | 4 | Accident with e-Call triggered without a possible access to a cell network. |
| Human problem | 93 | Values are assigned referring to ETSI TS 101 539-1 [i.4], clause 6.3.3 | 0 | Unavailable |
| | | | 1 | Glycaemia problem |
| | | | 2 | Heart problem |
| Stationary vehicle | 94 | Not specified in TISA TAWG11071 [i.10] Values are assigned referring to ETSI TS 101 539-1 [i.4], clause 6.3.3 | 0 | Unavailable |
| | | | 1 | Human Problem |
| | | | 2 | Vehicle breakdown |
| | | | 3 | Post-crash |
| | | | 4 | Public transport stop |
| | | | 5 | Carrying dangerous goods |
| Cause code description | Direct cause code | Mapping with TPEG-TEC | Sub cause code | Sub cause description |
| Emergency vehicle approaching | 95 | Not specified in TISA TAWG11071 [i.10] Values are assigned referring to ETSI TS 101 539-1 [i.4], clause 6.3.1 | 0 | Unavailable |
| | | | 1 | Emergency vehicle approaching |
| | | | 2 | Prioritized vehicle approaching |
| Hazardous location indication - Dangerous Curve | 96 | Not specified in TISA TAWG11071 [i.10]. Values are assigned referring to ETSI TS | 0 | Unavailable |
| | | | 1 | Dangerous left turn curve |
| | | | 2 | Dangerous right turn curve |

| | | | | | | | |
|---------------------|----|---|------------------|---|------------------------|---|---------------------|
| | | 101 539-1 [i.4], clause 6.3.7 | 3 | Multiple curves starting with unknown turning direction | | | |
| | | | 4 | Multiple curves starting with left turn, | | | |
| | | | 5 | Multiple curves starting with right turn | | | |
| Collision risk | 97 | Intersection collision Not specified in TISA TAWG11071 [i.10] Values are assigned referring to ETSI TS 101 539-2 [i.5] | 0 | Unavailable | | | |
| | | | 1 | Longitudinal collision risk | | | |
| | | | 2 | Crossing collision risk | | | |
| | | | 3 | lateral collision risk | | | |
| | | | 4 | Collision risk involving vulnerable road user | | | |
| | | | Signal violation | 98 | Intersection violation | 0 | Unavailable |
| | | | | | | 1 | Stop sign violation |
| | | | 2 | Traffic light violation | | | |
| | | | 3 | Turning regulation violation | | | |
| Dangerous situation | 99 | Not specified in TISA TAWG11071 [i.10] Values are assigned referring to ETSI TS 101 539-1 [i.4], clause 6.3.4 | 0 | Unavailable | | | |
| | | | 1 | Emergency electronic brake lights | | | |
| | | | 2 | Pre-crash system activated | | | |
| | | | 3 | ESP(Electronic Stability Program) activated | | | |
| | | | 4 | ABS (Anti-lock braking system) activated | | | |
| | | | 5 | AEB (Automatic Emergency Braking) activated | | | |
| | | | 6 | Brake warning activated | | | |
| | | | 7 | Collision risk warning activated | | | |