kennisplatform CROW

iVRI Interface RIS-FI

IDD RIS-FI version 1.2

Over deze publicatie

De internationale ontwikkeling van Smart Mobility zorgt voor flinke vernieuwingen in verkeer, vervoer en mobiliteit. Dit raakt direct ook de verkeersregelinstallaties in de Nederlandse steden en provincies en op rijkswegen. Als verkeersregelinstallaties kunnen communiceren met voertuigen en weggebruikers kunnen weggebruikers worden geïnformeerd over actuele fasewisselingen van verkeersregelinstallaties en hierop hun rijgedrag vroegtijdig aanpassen, kunnen doelgroepen als openbaar vervoer, nood- en hulpdiensten en vrachtwagens conform beleidswensen van overheden worden geprioriteerd en kan data van voertuigen zelf worden gebruikt voor betere netwerkregelingen. Dit bevordert doorstroming, bereikbaarheid, verkeersveiligheid en duurzaamheid, legt de basis voor connected en automated driving en speelt in op een digitale samenleving waarin data en connectiviteit bijdragen aan economisch aantrekkelijke en duurzame steden.

Voor het effectief, veilig en leveranciers- en overheidsonafhankelijk communiceren van intelligente verkeersregelinstallaties (iVRI's) met voertuigen en weggebruikers hebben bedrijven en overheden in het Innovatiepartnership Talking Traffic binnen internationale standaarden gezamenlijk specificaties en koppelvlakken voor iVRI's vastgelegd. Eenduidig gebruik door alle overheden en betrokken bedrijven van deze uniforme afspraken binnen internationale standaarden is noodzakelijk voor interoperabiliteit en een goede en betrouwbare werking. Deze standaarden zijn daarom vastgesteld door de landelijke publiek private Strategic Committee 'Borgen en beheren iVRI standaarden en producten'. Na vaststelling gelden deze standaarden voor alle bedrijven en overheden die in Nederland (willen gaan) werken aan iVRI's t.b.v. intelligente mobiliteit. Vanuit de rol van onafhankelijk en landelijk kennisinstituut verzamelt CROW deze landelijk vastgestelde standaarden en stelt deze transparant ter beschikking aan overheden, adviesbureaus en leveranciers.

About this publication

The international developments in Smart Mobility technology are boosting innovations for traffic, transportation and mobility. This has a direct effect on traffic control systems in Dutch cities and provinces, as well as national highways. When traffic controllers are able to communicate with vehicles and road users, the latter can be informed about real-time phase changes in traffic lights, enabling them to anticipate and adjust driving behaviour accordingly. Also, special interest groups, such as emergency services, public transport and freight carriers, can be prioritized in line with public policy guidelines. The data provided by vehicles themselves can be utilised to improve network-based traffic control programmes. This has a positive effect on flow, accessibility, traffic safety and sustainability, laying out the fundamentals for connected and automated driving and preparing for a digital society in which data and connectivity contribute to economically viable and sustainable cities.

In order to let intelligent traffic controllers (iVRI) communicate with vehicles and road users in an effective, safe and platform independent way, businesses and governments have created and recorded common specifications and interfaces for iVRI technology. These are compliant to international standards and developed within the framework of the Talking Traffic Innovation partnership. The unambiguous use of these uniform agreements, within international standards, by all governmental bodies and businesses is necessary for interoperability and a good and reliable operation. These standards are adopted by the national public-private Strategic Committee 'Ensuring and maintaining iVRI standards and products'. After adoption, these standards apply to all businesses and governmental bodies in the Netherlands that work, or plan to work, on iVRI technology for intelligent mobility purposes. Being an independent national knowledge institute, CROW collects these national standards and provides them to governments, consultants and suppliers in a transparent way.

Praktische kennis direct toepasbaar

iVRI Interface RIS-FI

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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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

Document versions:

Version	Date	Author	Comment
0.1	2016-06-08	WG2	Initial draft
0.2	2016-06-20	WG2	Use cases added
0.3	2016-06-23	WG2	Technical description and Exception use cases
0.4	2016-07-04	WG2	Added filtering
0.5	2016-07-08	WG2	Added RIS-FI object definitions
0.6	2016-07-11	WG2	
0.7	2016-07-18	WG2	Missing attributes and method examples added
0.8	2016-08-30	WG2	Added concepts as discussed in the meeting
0.9	2016-09-19	WG2	Final draft
0.91	2016-09-23	WG2	Rework after review meeting
1.0	2016-10-27	WG2	Rework after review
1.1	2017-09-01	WG2	Rework after review and Dutch Profile 1.2
1.2	2017-11-16	WG2	Added 'reason for waiting' from DP 2.0

Approval:

	Who	Date	Version
Prepared			
Reviewed			
Approved			

Publication level: Public

Version filename: iVRI2_del_1b_IDD_RIS-FI_v1.2.docx

Contents

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.

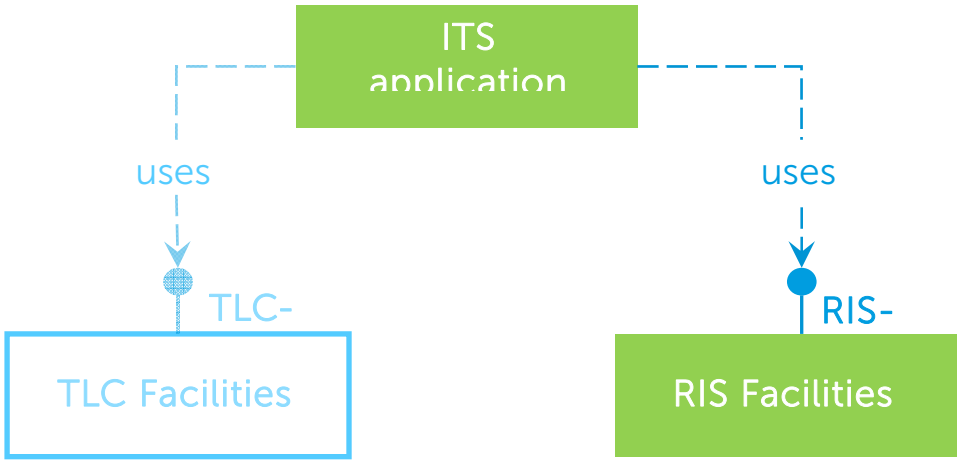

Figure 1 RIS-FI in system over view

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 1.2.0 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]	*iTLC Architecture WG3 (Deliverable F) v 1.2, jan. 2016*
[Ref 2]	*Beter Benutten Vervolg, project iVRI, Deliverable G2, IRS TLC Facilities Interface v1.2, jan 2016*
[Ref 3]	*Beter Benutten Vervolg, project iVRI, Deliverable G1, IRS RIS Facilities Interface v1.2, jan 2016*
[Ref 4]	*IDD TLC Facilities Interface v1.2, feb 2017*
[Ref 5]	*IDD Generic Facilities Interface v1.1, dec 2016*
[Ref 6]	*Dutch Profile Intersection Topology Format version 1.2*
[Ref 7]	*Dutch Profile CAM profile v1.2*
[Ref 8]	*Dutch Profile MAP profile v1.2*
[Ref 9]	*Dutch Profile SPAT profile v1.2*
[Ref 10]	*Dutch Profile SRM profile v1.2*
[Ref 11]	*Dutch Profile SSM profile v1.2*
[Ref 12]	*Dutch Profile SPAT profile v2.0*

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.
OBU	On-Board Unit
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: - 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)

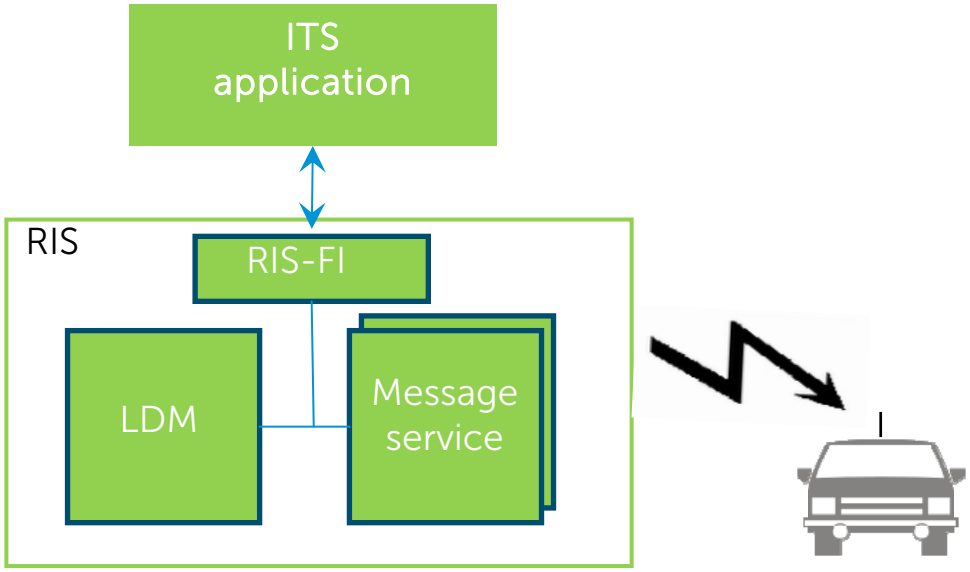

Figure 2 RIS system overview

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, which 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]. 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 v1.1, dec 2016*.

The message size produced by the RIS-FI could exceed the 32 kBytes described in [Ref 5], *IDD Generic Facilities Interface v1.1, dec 2016*. The RIS-FI does **not** provide a means to split messages in smaller parts.

Because no SessionObject is defined for the RIS-FI, no SessionEvents can be sent by the RIS Facilities when closing the connection because of a server shutdown or other RIS Facilities triggered events as prescribed by [Ref 5], *IDD Generic Facilities Interface v1.1, dec 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.

For objects that are owned by the RIS, an ITS application should get the right authorizations from the RIS to be able to modify these objects (see 4.4.5 below).

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, ITS applications can get credentials assigned during the authentication process that allow these applications to write (update) the state of configured objects, such as the signal group states, intersection states and prioritization 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. In this case all matching objects will be returned after each period.

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**.

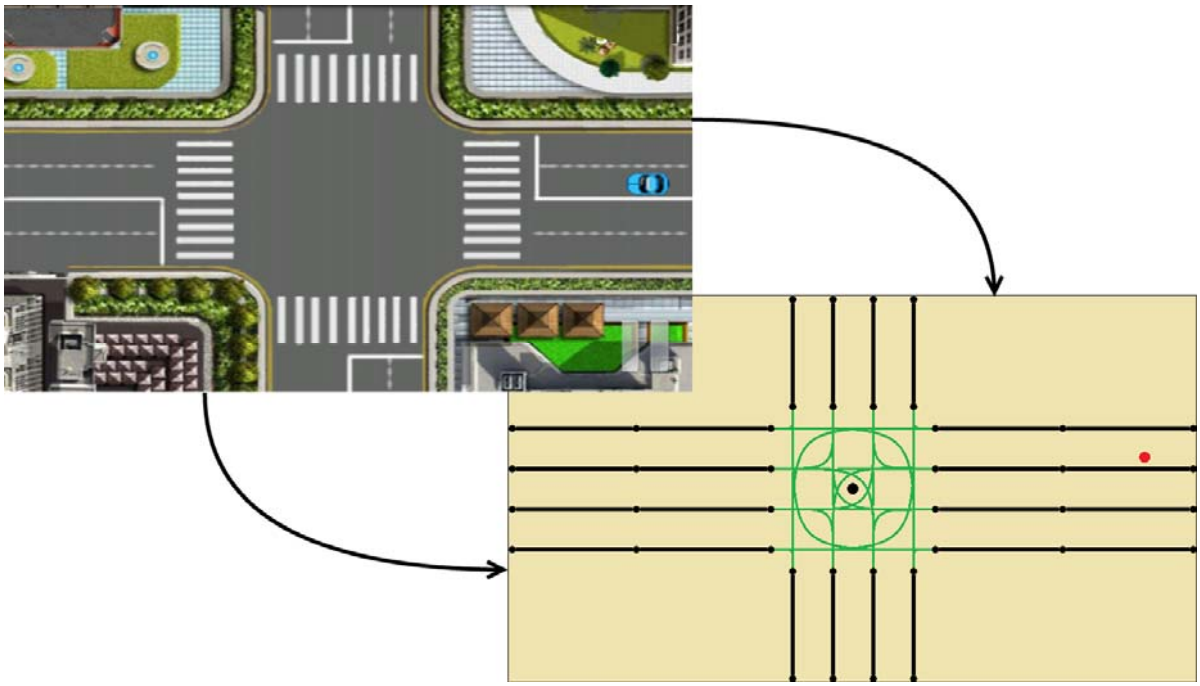

Figure 3 Projection of a vehicle onto the topology

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.

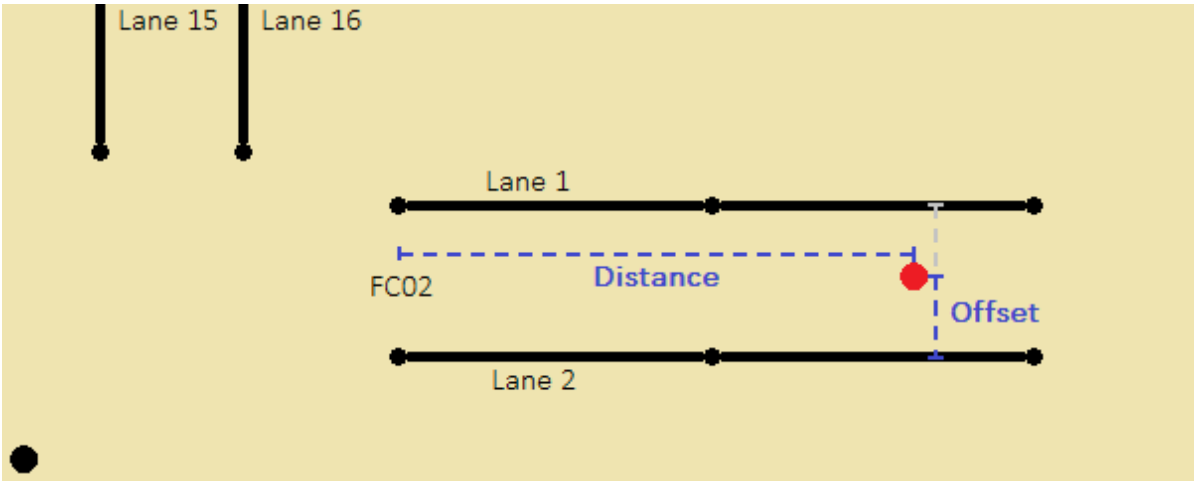

Figure 4 Path offset and distance of a Map-Match

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
Signage[1]	Describes signage information e.g. speed limits, traffic signs etc.	IVI
PrioritizationRequest	Signal priority request, received from vehicles and owned by the RIS.	SRM
ActivePrioritization	Signal priority status, set by the ITS Application and owned by the RIS.	SSM

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.

5.3 Protocol-version

The definition of RIS-FI Objects in this document is defined as version 1.2.0 of the RIS-FI.

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

It also uses generic object types from [Ref 5], *IDD Generic Facilities Interface v1.1, dec 2016* and object types from [Ref 4], *IDD TLC Facilities Interface v1.2, feb 2017* (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)
	PrioritizationRequest (6)
	ActivePrioritization (7)
	}

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

ApproachID

Descriptive name	ApproachID
Definition	Number used to group all approaching lanes of an arm into one group. This value is used to find all other lanes of an arm when driving on one of them, for example before the road fans out. Cycling and pedestrians lanes crossing an approach have the same ApproachID as the approach they cross (therefore should be excluded to find all vehicle driving lanes). A value of 0 means 'unknown'.
Representation	Integer
Range	0 to 15
Unit	-

Area

Descriptive name	Area
Definition	This object describes a geographical area, specified by a geometric shape. The MajorAxis is the distance between the centre point and the short side of the geometric shape (perpendicular bisector of the short side). The Angle is the azimuth angle of the long side of the geometric shape. For a circle the MajorAxis and MinorAxis have the same value (and Circular has the value "true"). When the attribute Circular has the value "false" the area will represent a rectangular area, instead of a circular area.

Representation	{
	Location centre
	Length majorAxis
	Length minorAxis
	Heading angle
	Boolean circular
	}

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 360.0
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

TrustState

Descriptive name	TrustState
Definition	This object defines the trust status of an object, which is based on the presence of a digital signature of the incoming object, and on the validity of the signature.
Representation	Integer

Range	ENUM {
	unsecured (0) *no digital signature present*
	untrusted (1) *the digital signature is not trusted or cannot be verified*
	trusted (2) *the digital signature is trusted*
	}

Unit	N/A

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	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)
	}	
Unit	N/A	

AccidentSubCauseCode

Descriptive name	AccidentSubCauseCode	
Definition	This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type “accident” (2).	
Representation	Integer	
Range	ENUM {	
	unavailable	(0)
	multiVehicleAccident	(1)
	heavyAccident	(2)
	accidentInvolvingLorry	(3)
	accidentInvolvingBus	(4)
	accidentInvolvingHazardousMaterials	(5)
	accidentOnOppositeLane	(6)
	unsecuredAccident	(7)
	assistanceRequested	(8)
	}	
Unit	N/A	

AdverseWeatherAdhesionSubCauseCode

Descriptive name	AdverseWeatherAdhesionSubCauseCode
Definition	This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type “adverseWeatherCondition-Adhesion” (6).
Representation	Integer
Range	ENUM {
	unavailable (0)
	heavyFrostOnRoad (1)
	fuelOnRoad (2)
	mudOnRoad (3)
	snowOnRoad (4)
	iceOnRoad (5)
	blackIceOnRoad (6)
	oilOnRoad (7)
	looseChippings (8)
	instantBlackIce (9)
	roadsSalted (10)
	}
Unit	N/A

AdverseWeatherConditionVisibilitySubCauseCode

Descriptive name	AdverseWeatherConditionVisibilitySubCauseCode
Definition	This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type “adverseWeatherCondition-Visibility” (18).
Representation	Integer
Range	ENUM {
	unavailable (0)
	fog (1)
	smoke (2)
	heavySnowfall (3)
	heavyRain (4)
	heavyHail (5)
	lowSunGlare (6)
	sandstorms (7)
	swarmsOfInsects (8)
	}
Unit	N/A

AdverseWeatherConditionPrecipitationSubCauseCode

Descriptive name	AdverseWeatherConditionPrecipitationSubCauseCode
Definition	This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type “adverseWeatherCondition-Precipitation” (19).
Representation	Integer
Range	ENUM {
	unavailable (0)
	heavyRain (1)
	heavySnowfall (2)
	softHail (3)
	}
Unit	N/A

AdverseWeatherExtremeWeatherSubCauseCode

Descriptive name	AdverseWeatherExtremeWeatherSubCauseCode
Definition	This object implements the abstract object SubCauseCode and contains the sub cause codes of the event type “adverseWeatherCondition-ExtremeWeatherCondition” (17).
Representation	Integer

Range	ENUM {
	unavailable (0)
	strongWinds (1)
	damagingHail (2)
	hurricane (3)
	thunderstorm (4)
	tornado (5)
	blizzard (6)
	}

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	ENUM {	
	unavailable	(0)
	wildAnimals	(1)
	herdOfAnimals	(2)
	smallAnimals	(3)
	largeAnimals	(4)
	}	
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	ENUM {	
	Unavailable	(0)
	dangerousLeftTurnCurve	(1)
	dangerousRightTurnCurve	(2)
	multipleCurvesStartingWithUnknownTurningDirection	(3)
	multipleCurvesStartingWithLeftTurn	(4)
	multipleCurvesStartingWithRightTurn	(5)
	}	
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[2]		id
	Location		location
	FacilitiesInformation*		info
	ObjectID<Intersection>		intersections[]
	}		
Range	N/A		
Unit	N/A		

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.

[2] This type is defined in [Ref 4], *IDD TLC Facilities Interface v1.2, feb 2017*.

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. The attribute locationTime is derived from generationDeltaTime in the CAM and gives the time when the CAM was generated at the OBU at the specified location. When the vehicle role is not specified within the received CAM, the value default (0) will be set by the RIS.		
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	
	TurnIntention	turn	<OPT>
	MapMatch	matches[]	<OPT>
	TrustState	trust	<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	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)
	}	
Unit	N/A	

MapMatch

Descriptive name	MapMatch
Definition	This object describes a map-matching result of an ItsStation onto a Lane of an Intersection. 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. When the ItsStation is map-matched to one of the connecting paths that runs over the conflict area, a lane value of 0 will be returned. In this case the distance and offset have no meaning. *Note: the connection paths are defined within the ITF data, but are not made available on the RIS-FI interface.* The optional signalGroup will only be set when possible to determine.

Representation	{
	ObjectID<Intersection> intersection
	Integer lane
	ObjectID<SignalGroup> signalGroup <OPT>
	Length distance
	Length offset
	}

Range	N/A
Unit	N/A

PublicTransport

Descriptive name	PublicTransport
Definition	This object describes the additional attributes of a vehicle that is used to operate public transport service. The attributes presented here are encoded within the CAM. Refer to A – Country specific public transport encoding for more details.

Representation	{
	Boolean embarkation
	Integer lineNr
	Integer vehicleID *Unique per company*
	Integer serviceNr *Same as block number*
	Integer journeyNr
	Integer supportNr *Support journey number*
	Integer companyNr
	Integer occupancy *Number of passengers*
	}

Range	N/A
Unit	N/A

RoleAttributes

Descriptive name	RoleAttributes
Definition	This object defines the role-dependent attributes of an ItsStation. The attributes marked with "M" are mandatory and the attributes marked with "O" are optional for ItsStations with the corresponding VehicleRole value. The attributes marked with "-" are not applicable for those with the corresponding VehicleRole value.

Representation	{
	Boolean lightBarActivated
	Boolean sirenActivated
	CauseCode incidentIndication
	SubCauseCode incidentSubIndication
	PublicTransport publicTransport
	SpecialTransport specialTransport
	DangerousGoods dangerousGoods
	}

Range	N/A
Unit	N/A

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	-	-	-	-

SpecialTransport

Descriptive name	SpecialTransport
Definition	This object describes the different classifications of special transport types. 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".

Representation	{
	Boolean heavyLoad
	Boolean excessWidth
	Boolean excessLength
	Boolean excessHeight
	}

Range	N/A
Unit	N/A

TurnIntention

Descriptive name	TurnIntention
Definition	The turn an ItsStation intends to take, for example derived from the turn signals.
Representation	Integer

Range	ENUM {
	unknown (0)
	left (1)
	straight (2)
	right (3)
	}

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	This list contains all the different vehicle roles for an ItsStation. A vehicle can be assigned a role which identifies a certain expected behaviour. This assigned role also determines the additional RoleAttributes of an ItsStation. The VehicleRole can also be used during prioritization, in that case values beyond safetyCar may not be used.		
Representation	Integer		
Range	ENUM {		*Description*
	default	(0)	*Default vehicle role as indicated by the vehicle type.*
	publicTransport	(1)	*Vehicle is used to operate public transport service.*
	specialTransport	(2)	*Indication for special transport, e.g. oversized trucks.*
	dangerousGoods	(3)	*Vehicle used for dangerous goods transportation.*
	roadwork	(4)	*Vehicle used to realize roadwork or road maintenance mission.*
	rescue	(5)	*Vehicle used for rescue purposes, e.g. as a towing service.*
	emergency	(6)	*Vehicle used for emergency mission, e.g. ambulance, fire brigade.*
	safetyCar	(7)	*Vehicle is used for public safety, e.g. patrol.* *// values below may only be used for the role of an ItsStation*
	agriculture	(8)	*Vehicle is used for agriculture, e.g. farm tractor.*
	commercial	(9)	*Vehicle is used for transportation of commercial goods.*
	military	(10)	*Vehicle is used for military purpose.*
	roadOperator	(11)	*Vehicle is used in road operator missions.*
	taxi	(12)	*Vehicle is used to provide an authorized taxi service.*
	}		
Unit	N/A		

VehicleSubRole

Descriptive name	VehicleSubRole		
Definition	This list contains all the different vehicle sub roles.		
Representation	Integer		
Range	ENUM {		*Description*
	unknown	(0)	*Default vehicle role as indicated by the vehicle type.*
	bus	(1)	
	tram	(2)	
	metro	(3)	
	train	(4)	
	emergency	(5)	*emergency vehicle with siren/lights*
	smooth	(6)	*ambulance smooth drive*
	timetable	(7)	*public transport time table service*
	interval	(8)	*public transport time interval service*
	expresstransit	(9)	
	noservice	(10)	*vehicles that are not in active service*
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	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 seperator). The detectionTime is the moment in time the event has been detected. If this moment lies in the future the behaviour of the RIS is undefined. When no DestinationArea is specified, a circle around EventPosition with a radius of RelevanceDistance will be taken. When no RepetitionInterval is specified, the corresponing DENM is broadcasted only once. Otherwise the RepetitionInterval specifies the time between between two consecutive message transmissions. The TrustState can only be available for incoming events.			
Access	Consumer	Provider		
	R	R/W		
xRepresentation	{			
	ObjectID	id		
	Timestamp	detectionTime		
	CauseCode	eventType		
	SubCauseCode	eventSubType		
	Location	eventPosition		
	Duration	validityDuration		
	Length	relevanceDistance		
	TrafficDirection	trafficDirection		
	Path	traces[]		
	Area	destinationArea	<OPT>	
	Interval	repetitionInterval	<OPT>	
	TrustState	trust	<OPT>	
	}			
Range	N/A			
Unit	N/A			

TrafficDirection

Descriptive name	TrafficDirection
Definition	This list contains all the different traffic directions that are relevant to information indicated in an ItsEvent. Upstream traffic corresponds to the incoming traffic; towards the event, and downstream traffic corresponds to the departing traffic; away from the event.
Representation	Integer

Range	ENUM {
	allTrafficDirections (0)
	upstreamTraffic (1)
	downstreamTraffic (2)
	oppositeTraffic (3)
	}

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].

Intersection

Descriptive name	Intersection			
Definition	This object describes the topology of an intersection. It also contains the (dynamic) information about the traffic light controller state. The ID of this object should be equal to the ID of the corresponding Intersection object as received from the TLC-FI. The enabledLanes is used to list the laneNrs of enabled lanes, in case dynamic lanes are available. Non-dynamic lanes may not be listed. *Note: the ID of the intersection can be retrieved from the ITF controlData section, element "name" in "controlledIntersection".* *The element name in this object is derived from the ITF controlData section, element "descriptive name" in "controlledIntersection".*			
Access	Consumer R	Provider R/W		
Representation	{			*Access*
	ObjectID	id		*R*
	String	name		*R*
	Location	referencePosition		*R*
	Speed	speedLimit	<OPT>	*R*
	Lane	lanes[]		*R*
	Integer	enabledLanes[]		*R/W*
	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	{			*Description*
		straight	(0)	*A Straight movement is allowed in this lane.*
		leftTurn	(1)	*A Left Turn movement is allowed in this lane.*
		rightTurn	(2)	*A Right Turn movement is allowed in this lane.*
		uTurn	(3)	*A U Turn movement is allowed in this lane.*
		leftTurnOnRed	(4)	*A Stop, and then proceed when safe movement is allowed in this lane.*
		rightTurnOnRed	(5)	*A Stop, and then proceed when safe movement is allowed in this lane.*
		laneChange	(6)	*A movement which changes to an outer lane on the egress side is allowed in this lane (example: left into either outbound lane).*
		noStopping	(7)	*The vehicle should not stop at the stop line (example: a flashing green arrow).*
		yieldAllways	(8)	*The allowed movements above are not protected (example: a permanent yellow condition).*
		goWithHalt	(9)	*After making a full stop, may proceed.*
		caution	(10)	*Proceed past stop line with caution.*
	}			
Unit	N/A			

Connection

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

IntersectionState

Descriptive name	IntersectionState	
Definition	This object contains the traffic controller status information that may be sent to local OBUs as part of the SPAT process. All applicable states will be set to the value “true” or "false" by the ITS application that provides this information. All other attributes must not be set. *Note: when no IntersectionState info is available, the SPAT IntersectionStatus should be set to 'noValidSPATisAvailableAtThisTime'.*	
Representation	{	*Description*
	Boolean manualControlIsEnabled	*Timing reported is per programmed values, etc. but person at cabinet can manually request that certain intervals are terminated early (e.g. green).*
	Boolean stopTimeIsActivated	*All counting/timing has stopped.*
	Boolean failureFlash	*To be used for any detected hardware failures, e.g. conflict monitor as well as for police flash.*
	Boolean preemptIsActive	
	Boolean signalPriorityIsActive	
	Boolean fixedTimeOperation	*Schedule of signals is based on time only (i.e. the state can be calculated).*
	Boolean trafficDependentOperation	*Operation is based on different levels of traffic parameters (requests, duration of gaps or more complex parameters).*
	Boolean standbyOperation	*Partially switched off or partially amber flashing.*
	Boolean failureMode	*Controller has a problem or failure in operation.*
	Boolean off	*Controller is switched off.*
	}	
Range	N/A	
Unit	N/A	

Lane

Descriptive name	Lane		
Definition	This object describes the basic attribute information of a lane. The LaneNr is a unique number within the intersection.The nodes are defined starting closest to the centre (position) of the intersection going outwards. Connections are defined by the Lane(s) this Lane is connected to. The dynamic field determines if the lane is dynamic, i.e. it can be disabled or enabled. Enabling or disabling of a lane is done via the Intersection object.		
Representation	{		
		Integer	laneNr
		ApproachID	ingress
		ApproachID	egress
		LaneDirection	direction
		Path	nodes
		Connection	connectsTo[]
		Boolean	dynamic
	}		
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	This object describes the various information about the current or future movement state of a designated collection of one or mare lanes under a signal group. 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. *Note: the (TLC) ID of the signal group can be retrieved from the ITF controlData section, element "name" in "sg".* The Predictions should be ordered in time; first entry is the first state to be activated. The validityDuration indicates the validity duration (starting at the time of the last update) of the signalGroup information. When expired, the signal group state for the expired signal group in the SPAT will be set to "unknown". *Note; the predictions are based on the Ticks of the ITS application that writes them, therefore it makes no sense to read these values.*				
Access	Consumer	Provider			
	R	R/W			
Representation	{				*Access*
		ObjectID	id		*R*
		SignalGroupState[3]	state		*R/W*
		SignalGroupPrediction‡	predictions[]		*W*
		Duration	validityDuration		*R/W*
		SpeedProfile	speedProfiles[]	<OPT>	*R/W*
		TimeException	reason	<OPT>	*R/W*
	}				
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	

[3] This type is defined in [Ref 4], *IDD TLC Facilities Interface v1.2, feb 2017*.

SpeedProfile

Descriptive name	SpeedProfile
Definition	This object describes a recommended traveling approach speed to an intersection. 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. 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.

Representation	{
	AdvisoryType type
	Length distance
	Speed speed
	}

Range	N/A
Unit	N/A

TimeException

Descriptive name	TimeException
Definition	This list contains different reasons why a previously predicted time has changed unexpectedly.
Representation	Integer

Range	ENUM {
	unknown (0)
	publicTransportPriority (1)
	emergencyVehiclePriority (2)
	trainPriority (3)
	bridgeOpen (4)
	vehicleHeight (5)
	weather (6)
	trafficJam (7)
	tunnelClosure (8)
	meteringActive (9)
	truckPriority (10)
	bicyclePlatoonPriority (11)
	vehiclePlatoonPriority (12)
	}

Unit	N/A

5.11 PrioritizationRequest

PrioritizationRequest

Descriptive name	PrioritizationRequest			
Definition	This object describes a prioritization request as sent 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. The id is created from the StationID and the RequestID, separated with an underscore. Once a PrioritizationRequest is created by the RIS, the related ActivePrioritization is also created. The PrioritizationRequest will be removed when the eta plus the duration expires. If no duration is provided in the SRM, the PrioritizationRequest will be removed after eta plus 65 seconds.			
Access	Consumer R	Provider R		
Representation	{			
	ObjectID	id		
	Integer	sequenceNumber		
	PriorityRequestType	requestType		
	ObjectID<ItsStation>	itsStation		
	ObjectID<Intersection>	intersection		
	VehicleRole	role		
	VehicleSubRole	subrole		
	Timestamp	eta	*Estimated Time of Arrival*	
	ObjectID<SignalGroup>	signalGroup	<OPT>	
	ApproachID	approach	<OPT>	
	String	routeName	<OPT>	
	TransitStatus	transitStatus	<OPT>	
	Punctuality	punctuality	<OPT>	
	Integer	importance	<OPT>	
	TrustState	trust	<OPT>	
	}			
Range	N/A			
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		

TransitStatus

Descriptive name	TransitStatus		
Definition	This object describes the transit status.		
Representation	{		
	Boolean	loading	*parking and unable to move at this time*
	Boolean	anADAuse	*an ADA[4] access is in progress, wheelchairs, kneeling, etc.*
	Boolean	aBikeLoad	*loading of a bicycle is in progress*
	Boolean	doorOpen	*a vehicle door is open for passenger access*
	Boolean	charging	*a vehicle is connected to charging point*
	Boolean	atStopLine	*a vehicle is at the stop line for the lane it is in*
	}		
Range	N/A		
Unit	N/A		

5.12 ActivePrioritization

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 via the id and sequenceNumber, which must identify an existing PrioritizationRequest. If the related PrioritizationRequest is removed, the ActivePrioritization will be removed too by the RIS. When updating this object the sequenceNumber must be copied from the associated PrioritizationRequest.		
Access	Consumer	Provider	
	R	R/W	
Representation	{		
	ObjectID< PrioritizationRequest>		id
	Integer		sequenceNumber
	PrioritizationState		prioState
	}		
Range	N/A		
Unit	N/A		

[4] ADA Americans with Disabilities Act

PrioritizationState

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

5.13 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.

5.14 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 {		
	"=="		*Equals.*
	"<"		*Less than.*
	"<="		*Less than or equal to.*
	"!="		*Not equal to.*
	">"		*Greater than.*
	">="		*Greater than or equal to.*
	}		
Unit	N/A		

ObjectContent (abstract)

Descriptive name	ObjectContent
Definition	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. 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.
Representation	N/A
Range	N/A
Unit	N/A

ObjectFilter

Descriptive name	ObjectFilter
Definition	This object defines the selection criteria of objects. When no Selection if given, all the objects of the given Type will be present. The optional "and" attribute can be used to create a filter for two top-level object attributes.

Representation	{
	RISObjectType type
	SelectionCriteria selection <OPT>
	SelectionCriteria and <OPT>
	}

Range	N/A
Unit	N/A

ObjectNotification

Descriptive name	ObjectNotification
Definition	This object describes a state change of one or more RIS objects matching a subscription. The ticks attribute defines the moment at which the notification was created by the RIS. The expired attribute is used to notify the subscriber of the expired (or deleted) objects it is subscribed to. Subscribers with a notificationInterval unequal to 0 in their subscription will be notified directly on expiration/deletion of an object.

Representation	{
	SubscriptionID subscription
	ObjectContent objects[]
	ObjectID expired[] <OPT>
	Ticks ticks
	}

Range	N/A
Unit	N/A

ObjectReport

Descriptive name	ObjectReport
Definition	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. The ticks attribute defines the moment at which the report was created by the RIS.

Representation	{
	ObjectContent objects[]
	Ticks ticks
	}

Range	N/A
Unit	N/A

ObjectUpdate

Descriptive name	ObjectUpdate
Definition	This object is used to define object (state) updates. All attribute types of this object are defined in [Ref 5]. 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. The time attribute defines the reference time that corresponds to the ticks value.

Representation	{
	ObjectStateUpdate update[]
	Timestamp time
	Ticks ticks
	}

Range	N/A
Unit	N/A

RequestFilter

Descriptive name	RequestFilter
Definition	This object defines the selection and presentation criteria of a request. It determines the content of the ObjectReport. 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.

Representation	{
	ObjectFilter filter
	String report[] <OPT>
	}

Range	N/A
Unit	N/A

SelectionCriteria

Descriptive name	SelectionCriteria
Definition	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). When no Comparator is given, by default the "==" comparison is used. Optional attributes for which a selection value other than null is specified will not match when not present.

Representation	{
	String attribute
	<SimpleType> value
	Comparator comparator <OPT>
	}

Range	N/A
Unit	N/A

SubscriptionFilter

Descriptive name	SubscriptionFilter
Definition	This object defines the selection and presentation criteria of a subscription. It determines the content of the ObjectNotification. 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. When no Report is specified, all the attributes of the objects in the ObjectNotification will be present.

Representation	{
	ObjectFilter objects
	Duration notificationInterval <OPT>
	String report[] <OPT>
	}

Range	N/A
Unit	N/A

SubscriptionReference

Descriptive name	SubscriptionReference
Definition	This object contains the reference to a subscription.

Representation	{
	SubscriptionID subscription
	}

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": {
					"centre": {
						"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, ActivePrioritization 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 update 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": "TerminateEvents",
      "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: RequestObjects		
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": {
		"filter": {
			"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.

ITS applications may subscribe more than once to the same object type with different subscription filters.

Note: Objects that match the subscription filter can also be notified on updates even when none of the attributes in the report have changed.

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. *Note: Objects that match the subscription filter can also be notified on updates even when none of the attributes in the report have changed.*

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	SubscriptionReference	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": "UnsubscribeObjects",
	"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 the generic error codes as defined in [Ref 5], and the RIS-FI specific 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

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	The RIS receives information about other ITS stations in the neighbourhood via Cooperative Awareness Messages (CAM), such as: - Station identity - Station type (car, bus, bicycle etc.) - Current location, speed, direction 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.
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	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. *Note: The ITS-CRA may also use a filter to be notified of ItsStation objects that are map-matched for example.* *Note: The ITS-CRA could also indicate which attributes to receive in the notification.*
RIS functions	When the method "SubscribeObjects" is invoked - The subscription parameters are validated. - A SubscribtionID is returned to the ITS-CRA. When a CAM is received by the RIS - 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	The subscription parameters are invalid. - 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	The ITS-CRA executes the method "SubscribeObjects" at the RIS with object type ItsStation (1) and with the filter conditions: – "stationType" == 6 (only busses), and – "matches" != null (only with map-match results). *Note: The ITS-CRA could also indicate which attributes to receive in the notification.* When the method "NotifyObjects" is invoked – 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	When the method "SubscribeObjects" is invoked – The subscription parameters are validated. – A SubscribtionID is returned to the ITS-CRA. When a CAM from a bus is received by the RIS – 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	The subscription parameters are invalid. - 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). Based upon this information, an ITS-A can request for priority at the TLC-FI to give way to these busses. Also the status of currently active or pending prioritizations can be broadcasted with a Signal Status Message (SSM).
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 and has sufficient credentials to update the active prioritizations.
Trigger	A bus is approaching the intersection broadcasting CAM and SRM.
ITS-CRA functions	The ITS-CRA executes the method "SubscribeObjects" at the RIS with object type PrioritizationRequest (6) with possible filter on role (1) and subrole (1). *Note: The ITS-CRA could also indicate which attributes to receive in the notification.* *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.* When the method "NotifyObjects" is invoked - Request for priority at the TLC-FI for the signal group indicated in the prioritization request. - Report the active prioritizations by executing the "UpdateObjects" method for the object type ActivePrioritization.
RIS functions	When the method "SubscribeObjects" is invoked - The subscription parameters are validated. - A SubscribtionID is returned to the ITS-CRA. When a SRM from a bus is received by the RIS - The corresponding PrioritizationRequest object, in the LDM, is created/updated with the information in the request message. - The corresponding ActivePrioritization object is created if it does not exist. - The method "NotifyObjects" is executed at the ITS-CRA when the PrioritizationRequest object satisfies the subscription-filter. When the method "UpdateObjects" is invoked - The request parameters are validated. - The object (ActivePrioritization), which holds the status information, in the LDM is updated. - When an ActivePrioritization object is updated an SSM message is broadcasted. *Note: an ActivePrioritization is valid when the corresponding PrioritizationRequest has not expired.*
Post-conditions	-
Exception 1	The subscription parameters are invalid. - 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	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. An event contains at least the following attributes: - The type of the event - Time of detection - Location - Validity duration of the event 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.
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	When the method "CreateEvents" is invoked - 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	The request is invalid. - 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	The ITS application has previously detected a potentially dangerous situation and created an ItsEvent object for this situation. The ITS application continues to monitor the situation and detects a change in the situation e.g. changed location, validity time. The ITS application updates the ItsEvent object at the RIS using the reference it received when it created the ItsEvent object.
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	The ITS-PRA executes the method "UpdateObjects" at the RIS for object type ItsEvent (2) and the object reference to update. *Note: for an update only the attributes of which the value have changed need to be provided.*
RIS functions	When the method "UpdateObjects" is invoked for an ItsEvent - 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	The request is invalid. - An error message is returned.
Exception 2	The ItsEvent does not exist. - An error message is returned.
Exception 3	The ITS-PRA is not the owner of the ItsEvent - 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	The ITS application has created an ItsEvent object for a potentially dangerous situation and the situation no longer exists. The ITS application wants to inform the other ITS stations that the situation no longer exists and deletes the ItsEvent object at the RIS. The ItsEvent is removed from the LDM and the associated DENM message with termination indication is broadcasted.
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	When the method "TerminateEvents" is invoked for an ItsEvent - 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	The request is invalid. - An error message is returned.
Exception 2	The ItsEvent does not exists. - An error message is returned.
Exception 3	The ITS-PRA is not the owner of the ItsEvent - 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	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. *Note: The ITS-CRA may also use a filter to be notified of ItsEvent objects that have a certain direct cause for example.* *Note: The ITS-CRA could also indicate which attributes to receive in the notification.*
RIS functions	When the method "SubscribeObjects" is invoked - The subscription parameters are validated. - A SubscribtionID is returned to the ITS-CRA. When a DENM is received by the RIS - 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. - The DENM will be notified as expired (and removed from the LDM) in case a DENM with termination has been received.
Post-conditions	-
Exception 1	The subscription parameters are invalid. - 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	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.
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.
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	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). When the status of the TLC has changed - Sets *Intersection.state* to the current state of the TLC. When the state of a SignalGroup has changed - Sets *SignalGroup.state* to the current state of the signal group. - Sets *SignalGroup.predictions* to the predicted states. When the ITS-PRA has calculated advisory speeds - Sets *SignalGroup.speedProfiles* to the calculated profile.
RIS functions	When the method "UpdateObjects" is invoked - The request parameters are validated. - The object (Intersection, SignalGroup), which holds the status information, in the LDM is updated. - The SPAT and MAP, based upon the topology objects, will be periodically broadcasted.
Post-conditions	-
Exception 1	The request is invalid. - 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

9.5 Invalid Object reference

For Objects than can expire, or are dynamically created and removed by the RIS, the connection must not be closed; only an error may be returned. This deviates from the Generic-FI ([Ref 5]).

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.

The PtActivationData contents for the Netherlands have been defined in [Ref 7].

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	Support journey number	16 bits unsigned	supportNr
10	Company number	8 bits unsigned	companyNr
11, 12	Occupancy	16 bits unsigned	Occupancy

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	approach/signalGroup	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	approach/signalGroup	SRM
8	Vehicle status	1	0 – 99	Embarkation	CAM
9	Priorityclass	1	0 – 99		SRM
10	Punctualityclass	1	0 – 99		
11	Punctuality [s]	2	-3600 to +3600		SRM
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		
18	Route Public Transport	1	0 – 99		SRM
19	Type of command	1	0 – 99	requestType	SRM
20	Activation pointnr	2	0 – 32767		
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	1	0 – 99	location	CAM

	[hundreds of seconds]				
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 *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1	As specified in *tec101* 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 *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 7	As specified in *tec102* of clause 9.12 in TISA TAWG11071 [i.10]
			8	Assistance requested (e-call)
Roadworks	3	Specified as road works in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 3	As specified in *tec103* 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 *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 10	As specified in *tec106* of clause 9.16 in TISA TAWG11071 [i.10]
Hazardous location - Surface condition	9	Specified as hazardous driving conditions in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 9	As specified in *tec109* of clause 9.18 in TISA TAWG11071 [i.10]

Hazardous location - Obstacle on the road	10	Specified as objects on the road in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 7	As specified in *tec110* of clause 9.19 in TISA TAWG11071 [i.10]
Hazardous location - Animal on the road	11	Specified as animals on the road in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 4	As specified in *tec111* of clause 9.20 in TISA TAWG11071 [i.10]
Human presence on the road	12	Specified as people on roadway in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 3	As specified in *tec112* of clause 9.21 in TISA TAWG11071 [i.10]
Wrong way driving	14	Specified as vehicle on wrong carriageway in *tec002* 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 *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 5	As specified in *tec115* of clause 9.23 in TISA TAWG11071 [i.10]
Adverse weather condition - extreme weather condition	17	Specified as extreme weather condition in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 6	As specified in *tec117* of clause 9.25 in TISA TAWG11071 [i.10]
Adverse weather condition - visibility	18	Specified as visibility reduced in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 8	As specified in *tec118* 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 *tec119* of clause 9.27 in TISA TAWG11071 [i.10]
Slow vehicle	26	Specified as slow moving vehicles in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 8	As defined in *tec126* of clause 9.32 in TISA TAWG11071 [i.10]
Dangerous end of queue	27	Specified as dangerous end of Queue in *tec002* of clause 9.2 in TISA TAWG11071 [i.10]	0	Unavailable
			1 to 4	As defined in tec127 of clause 9.33 in TISA TAWG11071 [i.10]
Vehicle breakdown	91	Values are assigned referring to ETSI TS 101 539-1 [i.4], clause 6.3.3	0	Unavailable
			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 101 539-1 [i.4], clause 6.3.7	0	Unavailable
			1	Dangerous left turn curve
			2	Dangerous right turn curve
			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

Colophon

iVRI Interface RIS-FI

Published by
Talking Traffic

Date
1 December 2017

Status
Final

Version number
1.2

CROW number
D3047-4