Intelligente Verkeers Regel Installatie

(iVRI) – Fase 1

Deliverable G1: IRS RIS-FI

Interface Requirements Specification RIS-FI







Datum: 27 januari 2016

Versie: 1.2

# Voorwoord

In juni 2015 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 G1 van de afgesproken leverdelen in de opdrachtverstrekking, omschreven als “Interface Requirements Specificatie van de RIS Facilities Interface”.

Deze deliverable beschrijft de requirements van de interface de RIS Facilities, als zijnde een onderdeel van de iVRI.

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.*

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

Document control sheet

Document versions:

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date** | **Author** | **Comment** |
| 1.0 | 14-12-2015 | WG3 | Initial draft |
| 1.1 | 20-01-2016 | WG3 | Final draft |
| 1.2 | 27-01-2016 | WG3 | Final draft |

**Approval:**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Who** | **Date** | **Version** |
| Prepared  |  |  |  |
| Reviewed  |  |  |  |
| Approved |  |  |  |

**Publication level:** Public

**Version filename:** Del. G1 - IRS RIS-FI v1.2.docx

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# Introduction

This IRS describes the requirements of the RIS Facilities Interface (RIS-FI) of the iTLC.

In this chapter, a brief system overview will be given. See [Ref 3] for a detailed architecture description.

## System overview

The iTLC architecture defines several interfaces of the iTLC. In Figure 1 the position of the RIS-FI is shown within this architecture; not involved interfaces and functional elements are faded.

ITS Applications can use the RIS-FI to obtain information from the RIS Facilities such as LDM Data Objects, as well as to provide update-requests of LDM Data Objects. The functional description of the information and services offered by the RIS Facilities through the RIS-FI is described in the iTLC Architecture [Ref 3].



Figure 1 RIS-FI in System overview

## Document overview

### Purpose

This document provides specifications of the requirements of the RIS-FI.

### Document structure

Chapter 3 contains references to normative and informative documents

Chapter 4 explains acronyms and used definitions and concepts.

Chapter 5 contains formal requirements resulting from the use case and functional specification discussions and architecture.

## Advise for the reader

It is **important** to read and understand these documents before continuing this document:

* *ETSI EN 302895, V1.1.1*
* *CEN ISO/TS 18750:2015*

It is advised that the reader understands the iTLC Architecture as described in [Ref 3], *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture, v1.2*.

# References

## Normative

**ID Reference**

1. *ETSI EN 302895, V1.1.1*
2. *CEN ISO/TS 18750:2015*
3. *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture, v1.2*
4. *LDM Data Dictionary v1.1.xlsx*
5. *Beter Benutten Vervolg, project iVRI, Deliverable E, Uitwerking use-cases*
6. *SAE-J2735, Dedicated Short Range Communications (DSRC) Message Set Dictionary, SAE International - 2015-09*
7. *ISO/TS 19321:2015*
8. *ETSI EN 302 637-2 V1.3.2 (2014-11)*
9. *ETSI EN 302 637-3 V1.2.2 (2014-11)*

## Informative

**ID Reference**

1. *ETSI EN 302 665, V1.1.1*
2. *ETSI TS 102 894-2, V1.2.1*

# Acronyms, abbreviations and concepts

**Acronyms and abbreviations**

|  |  |
| --- | --- |
| CAM | Cooperative Awareness Message; ETSI defined service and message used for ITS-Station presence, location and status |
| CEN | European Committee for Standardization |
| 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 |
| CVN | Contactgroep Verkeersregeltechnici Nederland[[1]](#footnote-2) |
| DENM | Decentralized Environmental Notification Message; ETSI defined service and message used to defined and location notable events (e.g. Road works, accidents, stranded vehicles, congestion) |
| ETSI | European Telecommunications Standards Institute |
| IDD | Interface Design Description |
| IRS | Interface Requirements Specification |
| ISO | International Organization for Standardization |
| iTLC | Intelligent TLC performing traffic light controller functions and allowing for ITS applications |
| ITS | Intelligent Transport Systems |
| ITS Station | Functional entity specified by the ITS station reference architecture (see *ETSI EN 302 665, V1.1.1*) |
| IVERA | Management protocol for traffic light controllers in the Netherlands |
| IVI | In Vehicle Information (see *ISO/TS 19321:2015*) |
| LDM | Local Dynamic Map; Concept of data store containing a reflection of physical infrastructure and current on-street traffic and environment. LDM typically stores LDM-DO’s. |
| LDM-DO | LDM-DataObject; object is one of described LDM-DT's. A specific ‘Car’ crossing an intersection is an example of a LDM-DO. |
| LDM-DT | LDM-DataType; various types exists, for example ‘ITS-Station’, ‘Event’ and ‘DrivingLane’. |
| LDM-DD | LDM-Data Dictionary; contains all possible LDM-DT’s for a specified LDM-DD version. |
| LDM-DOID | LDM-DO Identifier; uniquely references a LDM-DO within a LDM |
| MAP | Message to convey the current road topology to road-users, often used in conjunction with SPAT |
| RIS | See R-ITS-S |
| RIS-FI | R-ITS-S Facilities Interface |
| R-ITS-S | Roadside ITS Station, responsible for a geographic area. |
| SPAT | Signal Phase And Timing message; used to convey the current status of one or more signalized intersections |
| TLC | Traffic Light Controller; controls the signal of one or more intersections |

**Concepts**

|  |  |
| --- | --- |
| Traffic Control Application | Application which implements a traffic control algorithm and is able to request signal group states |
| CVN-C Application | A traffic control application which implements control through the CVN-C interface |
| ITS Control Application | A Traffic Control Application which uses TLC- and/or RIS-interfaces |
| ITS Application | An application which supports one or more ITS use-cases. Range of possible ITS Applications include an ITS Control Application |
| RIS Facilities | Component providing RIS Facilities to users (internal and/or external). Includes amongst others: * Access to information stored in the LDM
* Services to trigger C-ITS messages
 |

# Requirements

## Introduction

This chapter contains requirements of the RIS Facilities Interface (RIS-FI).
The position of the RIS-FI in the iTLC-architecture is described in [Ref 3] and depicted in Figure 1.

The RIS-FI exposes the functionality of the RIS Facilities, which can be summarized as follows:

The RIS Facilities are used by ITS Applications.

ITS Applications need to register themselves with the RIS Facilities before any further usage of the facilities is allowed. After successful registration, an ITS Application may access the RIS’s information model (LDM) to access LDM data objects, according to the applying permissions as assigned during registration.

To achieve this functionality, the RIS-FI exposes the following services:

* ITS Application Registration
* Information support (LDM)
* Station Services

The IRS as described in this document is aligned with *ETSI EN 302895, V1.1.1* and *CEN ISO/TS 18750:2015* as much as possible.

### Requirement notation format

The following format is used to define a requirement:

|  |  |
| --- | --- |
| Req-ID | IRS-x-y-zzz |
| Title |  |
| Description |  |
| Source |  |
| Comment |  |

* Req-ID: unique identification of the requirement according to the following format: ’IRS-x-y-zzz”, where x is an identifier for the interface, y is a textual tag and zzz is a number of the requirement.
* Title: a short description of the requirement
* Description: formal and detailed description of the requirement.
* Source: reference to a source document used as input for the requirement.
* Comment: optional clarification of the requirement.

## General requirements

The following requirements are applicable to the RIS-FI in general.

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_GEN\_001 |
| Title | Time referencing |
| Description | Time-references used at RIS-FI shall be UTC-based. Notation of time-references shall be according to ISO8601 |
| Source | [Ref 3] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_GEN\_002 |
| Title | Geo referencing |
| Description | References to geographical locations are described as a coordinate according to WGS84. |
| Source | [Ref 3] |
| Comment |  |

## Protocol

Below some high level requirements regarding the interface-protocol are described.

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_PROT\_001 |
| Title | IP-based |
| Description | The interface between the RIS and the ITS-Applications shall be IP-based. |
| Source | [Ref 3] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_PROT\_002 |
| Title | Request-reply |
| Description | For each request sent by an ITS Application the RIS Facilities shall send a reply. |
| Source | [Ref 3] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_PROT\_003 |
| Title | Publish-Subscribe |
| Description | ITS Applications can register subscriptions with the RIS-Facilities. Notifications shall be sent by the Facilities according to the subscription-properties (e.g. filter, periodicity). |
| Source | [Ref 3] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_PROT\_004 |
| Title | Concurrency |
| Description | Requests are handled asynchronously (non-blocking). |
| Source | [Ref 3] |
| Comment |  |

## Security

Before ITS Applications can use the RIS-FI, authentication has taken place (2-way). After an ITS-Application is authenticated, the application needs to register itself with the RIS-FI (see section 0). During registration, applicable permissions are assigned to the application. After registration, authorization takes places based on these assigned permissions.

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_SEC\_001 |
| Title | Permissions checking |
| Description | Each request sent by an ITS Application shall be validated by the RIS Facilities according to the applying permission of the specific ITS Application instance.If the permissions do not permit the execution of the request, a failure notification shall be sent to the calling ITS-Application. |
| Source | [Ref 3] |
| Comment |  |

## *ITS Application Registration*

As described in [Ref 3], registration of ITS Applications involves the following:

* registration of the ITS Application (including authentication and authorization) at the RIS-FI
* notification of ITS Application of updated/revoked roles or permissions (“Permission Changed”-event)
* deregistration of ITS Applications

Below, the requirements to support the registration of ITS-Applications are described:

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_001 |
| Title | Registration of ITS Applications (authorization) |
| Description | An ITS Application needs to register itself before it can use the RIS-FI any further. |
| Source | *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment | With the registration request, the ITS Application provides at least the following information:* Application Identifier
* Requested Role (see IRSIDD\_RISFI\_REG\_007)
* Requested maximum priority-level

The request is processed by the RIS Facilities by using the Security Entity which will authorize the ITS Application (assign permissions).The result of the request (*rejected* with reason or *accepted* with applicable permissions) is replied to requesting ITS Application. If registration is accepted, the ITS Application is informed about the applicable permissions and priority-level. The ITS Application may decide to deregister if it concludes the returned priority level it too low or applicable permissions not sufficient.Used priority levels per ITS Application need to be agreed upon between suppliers of ITS Applications.A successful registration will start the alive-checking feature. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_002 |
| Title | ITS Application identification  |
| Description | Every ITS Application instance registered at RIS-FI shall be uniquely identifiable. |
| Source |  |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_003 |
| Title | Alive Checking  |
| Description | Both RIS-FI as well as registered ITS Applications shall be able to detect broken communication paths or not responding applications/interface. |
| Source | [Ref 3] |
| Comment | Detection-properties (e.g. heartbeat-frequency or time-out values) need to be agreed upon between the ITS-Application and the RIS-FI during Application-registration. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_004 |
| Title | Deregistration by Facilities  |
| Description | If the RIS Facilities detects a not responding ITS Application or a broken communication path, the following actions are taken: * ITS Application is deregistered
* Subscriptions are removed
* Session is terminated
* Entry added to system log
 |
| Source | [Ref 3] |
| Comment | The ITS Application is responsible for re-establishing the connection after a keep-alive timeout. The RIS-FI will not make any attempts to restore the connection.  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_005 |
| Title | Permissions Changed Notification |
| Description | A notification of changed permission shall be sent by the RIS-FI to the applicable ITS Application when applying permissions of this ITS Application have been changed. |
| Source | [Ref 3] |
| Comment | A ‘Permission Changed Notification’ can be send because of the following reasons:1. Maximum set of permissions changed (e.g. actual permissions of an already registered ITS Application may be revoked by e.g. the Management Entity)
2. Actual applicable set of permissions has changed; used to implement exclusive permissions (only 1 of n ITS Applications is permitted).

The notification also contains the reason for change. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_006 |
| Title | Deregistration Request |
| Description | An ITS Application can deregister itself if it will not use the RIS Facilities any further.Because of the deregistration, the RIS Facilities will:* remove subscriptions of this ITS Application
* terminate the session
* add entry to system log
 |
| Source | [Ref 3] |
| Comment | Deregistration is useful to free resources at the RIS-FI. Can also be used prior to updating an ITS Application. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_007 |
| Title | Available ITS Application groups |
| Description | The following groups (roles) shall be available for ITS Applications to use during registration:* Data Consumer
* Data Provider
* Topology Provider
* TLC-Adapter

An ITS Application can have multiple roles at the same time (e.g. act as a Data Consumer and Data Provider).For each of the available groups the applicable permissions are described in [Ref 4], “*LDM Data Dictionary v1.1.xlsx*”. |
| Source |  |
| Comment | Above list may be expanded with other groups; these are elaborated in the *LDM Data Dictionary v1.1.xlsx*. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_REG\_008 |
| Title | Available priorities |
| Description | During registration, an ITS Application requests a maximum applicable priority level used for subsequent requests. Per subsequent request a priority level can then be given, which must be lower than or equal with the maximum allowed priority level as assigned by the RIS Facilities. This priority level indicates the priority of processing the request from this ITS Application instance by the RIS Facilities. The maximum allowed priority level is returned as part of the response of a registration request of an ITS ApplicationITS Applications can request the same maximum priority level. The actual priority level is determined by the RIS Facilities, based on available processing-resources. This could mean multiple ITS Applications are assigned to the same maximum priority level.The priority level is defined as : 0 (lowest priority) … 255 (highest priority) |
| Source | *ETSI EN 302895, V1.1.1*, *CEN ISO/TS 18750:2015* |
| Comment | The registration response indicates the actual assigned priority level. |

## Information support

Information provided by RIS-FI should be easily usable by 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.

To provide for this, the LDM is defined in [Ref 3].

ITS Applications can query, add, update and delete information as LDM-DO’s by using the RIS-FI.

Also, transmission of C-ITS messages is triggered by providing the RIS Facilities with message-data as LDM-DO’s. The same applies for updating or termination of C-ITS messages.

Received C-ITS messages are used by the LDM to update corresponding LDM-DO’s.

The following topics are described:

* section 0: describe LDM Data dictionary and available LDM-DO’s
* section 0: contains requirements for Data Providers
* section 5.6.4: contains requirements for Data Consumers
* section 0: contains requirements for maintenance of the LDM
* section 5.6.6: describes storage requirements
* section 5.6.7: describes requirements related to ITS G5 messages
* section 5.6.8: topology requirements

### LDM Data Dictionary

The LDM Data Dictionary defines the LDM-Data Types (LDM-DT) as easy useable parts of information, available to ITS Applications.

The Dictionary describes for each LDM-DT the mandatory properties (object properties needed for implementation of ITS use cases) as well as optional properties (additional properties possible used by other ITS Applications).

The LDM itself contains instances of LDM-DT’s, named LDM-DataObjects (LDM-DO’s).

These LDM-DO’s can be queried and updated by ITS-Applications by using the RIS-FI.

Each LDM-DO is identifiable by the LDM-DO Identifier (LDM-DOID).

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DD\_001 |
| Title | LDM Data Dictionary |
| Description | The LDM shall at least support the LDM-DT’s as described in [Ref 4], *LDM Data Dictionary v1.1.xlsx* |
| Source | *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment | Needed LDM-DTs support the implementation of ITS use cases, [Ref 5]. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DD\_002 |
| Title | LDM Data Dictionary Version |
| Description | The LDM-DD shall have a version which can be queried by the ITS Applications. |
| Source | *CEN ISO/TS 18750:2015* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DD\_003 |
| Title | Identification of LDM-DO’s |
| Description | At RIS-FI, each referenced LDM-DO shall be uniquely (within LDM-scope) identifiable by using a LDM-DOID. |
| Source | *CEN ISO/TS 18750:2015* (“LDM Data Record ID”), *ETSI EN 302895, V1.1.1* (“Data Object Identifier”) |
| Comment | Standards define this ID as Integer-value. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DD\_004 |
| Title | LDM-DT optional attributes |
| Description | For each LDM-DT and for each of its attributes it shall be identified if it is mandatory or optional. |
| Source | *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DD\_005 |
| Title | LDM-DO Access Rights |
| Description | For each LDM-DT access rights shall be defined. The following access rights shall be assigned to objects and attributes of objects: • Add : add an instance of this object type with attributes• Update : Update this object’s attributes• Read : Read the content of this object• Delete : Delete this objectThe access rights are defined per ITS Application type. |
| Source | *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

### LDM-DT’s

As described above, the LDM-DT’s are described in the LDM-DD. This is the authoritative source of the definition of the objects.

The section below provides the required types of objects from a functional level while the LDM-DD describes the details.

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_001 |
| Title | Supported LDM-DT’s |
| Description | The following LDM-DT’s shall be supported:* ITS-Station
* Event
* SignalgroupState
* PrioritizationState
* In-Vehicle Information
* iTLC-ControllerState
* DetectionArea
* referenceTrack
* DrivingLane
 |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_002 |
| Title | ITS-Station |
| Description | The *ITS-Station* type shall contain the following attributes:* StationID
* ReferenceTrack(s)
* Type
* Heading
* Speed
* DriveDirection
* VehicleLength
* VehicleWidth
* LongitudinalAcceleration
* Curvature
* CurvatureCalculationMode
* YawRate

Further, depending on the vehicleRole, the following information is mandatory:* PublicTransportContainer (vehicleRole = 1)
* SpecialTransportContainer (vehicleRole = 2)
* DangerousGoodsContainer (vehicleRole = 3)
* RoadWorksContainer (vehicleRole = 4)
* SpecialVehicleContainer (vehicleRole = 5)
* EmergencyContainer (vehicleRole = 6)
* SafetyCarContainer (vehicleRole = 7)

See *ETSI EN 302 637-2 V1.3.2 (2014-11)* for details. |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_003 |
| Title | Event |
| Description | The *Event* type shall at least contain all mandatory properties as defined in *ETSI EN 302 637-3 V1.2.2 (2014-11)*. |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_004 |
| Title | SignalgroupState |
| Description | The *SignalgroupState* type shall at least contain the following properties :Metadata: signalgroupID descriptive name referencetracks laneSetIdactual\_state: actual phase statefuture\_states: phase state |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_005 |
| Title | PrioritizationState |
| Description | The *PrioritizationState* type shall at least contain the following properties :* StationID
* signalgroupID
* prioritizationState
 |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_006 |
| Title | In-Vehicle Information |
| Description | The *In-Vehicle Information* type shall at least contain all mandatory properties as defined in *ISO/TS 19321:2015*. |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_007 |
| Title | TLC-ControllerState |
| Description | The *TLC-ControllerState* type shall at least contain the following properties :* ControllerState
* Per intersection:
	+ IntersectionState
	+ Road Geometry & Topology
 |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_008 |
| Title | DetectionArea |
| Description | The *DetectionArea* type shall at least contain the following properties :* Meta data
* Faults

Further, depending on the type of sensor, one or more of the following attributes are mandatory:* occupied
* speed
* intensity
* vehicle type
* vehicle length
* direction
 |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_009 |
| Title | referenceTrack |
| Description | The *referenceTrack* type shall at least contain the following properties :* StopBars
* Conflicting ReferenceTracks
* Meta data
* nodeList
* List of Mapped ITS-Stations
 |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DT\_010 |
| Title | DrivingLane |
| Description | The *DrivingLane* type shall at least contain the following properties :* SignalgroupState
* PrioritizationState
* Meta-data
 |
| Source | [Ref 3], [Ref 5] |
| Comment |  |

### Data Provider

The requirements in this section apply to ITS Applications with Data Provider-permissions only, to enable them to add, update and delete LDM objects (TLC-Adapter and Topology Provider are regarded as a special Data Provider-instances).

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DPRV\_001 |
| Title | Add new LDM-Object to LDM |
| Description | ITS Applications can request to add a new instance of a LDM-DO in the LDM.In the response, a unique LDM-DOID is returned. This identifier can be used by the ITS Application to update or delete this instance without the need to query the LDM in advance. |
| Source | [Ref 1], [Ref 2], [Ref 3] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DPRV\_002 |
| Title | Update of a LDM object |
| Description | Any ITS Application can request to update an existing instance of a LDM-object in the LDM.Together with the updated properties, the LDM-DOID must be passed.In a reply, the RIS-FI returns the result of the update-request. If an update was not successful, a reason is also returned. |
| Source | [Ref 1], [Ref 2], [Ref 3] |
| Comment | Deviation from CEN ISO/TS 18750:2015 where updates of an LDM Data Record can only be provided by the same ITS Application process that originally generated the LDM Data Record. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DPRV\_003 |
| Title | Message protocol status of a LDM object |
| Description | If applicable, the status of transmission of ITS G5-messages according to a LDM-DO is reflected as properties of the LDM-DO. |
| Source | [Ref 3] |
| Comment | ITS Application shall be able to retrieve the status of transmission of ITS messages after a LDM Object has been added or updated. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DPRV\_004 |
| Title | Deletion of a LDM object |
| Description | ITS Applications can delete a LDM-DO.The LDM-DOID of an existing LDM-DO must be given.In the reply the RIS-FI returns the result of the delete-request. If the deletion was not successful, a reason is returned. |
| Source | [Ref 1], [Ref 2], [Ref 3] |
| Comment |  |

### Data Consumer

Data Consumers can retrieve a set of LDM-DO’s from the LDM by:

* Querying
* Subscribe and unsubscribe for updates of LDM-DO’s; when subscribed, notifications will be received by the Data Consumer.

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_001 |
| Title | First-level filtering |
| Description | RIS-FI supports a first-level filtering; filtering (as part of a query or subscription) shall be performed on:* LDM-DOID
* LDM-DT
* Area of interest
* Time of interest

Combination of these attributes is possible by logical AND and logical OR. |
| Source | *CEN ISO/TS 18750:2015* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_002 |
| Title | Second-level filtering |
| Description | RIS-FI supports second-level filtering which is applied to those LDM-DO’s resulting from first-level filtering.Second-level filtering is based on selection criteria as given as part of a query or subscription and compares attribute values of pre-selected LDM-DO’s with given reference values.Combination of these attributes is possible by logical AND and logical OR. |
| Source | *CEN ISO/TS 18750:2015* |
| Comment | Second level filtering allows for spatial queries. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_003 |
| Title | Ordering data results |
| Description | A set of returned LDM-DO’s (due to given query/subscription) may be ordered according to given order-specification.Order is specified as a LDM-DO attribute with ordering direction (ascending or descending). |
| Source | *ETSI EN 302895, V1.1.1* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_004 |
| Title | Query LDM for LDM-DO’s |
| Description | Data Consumers can query LDM-DO’s by specifying a first-level query, and optionally specify a second-level query and optionally ordering.For each query, a priority level is specified (maximum priority level is assigned during registration). |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_005 |
| Title | Result-sets contains unique LDM-DO’s |
| Description | Result-sets returned after query-request, or sent as a notification shall only contain unique LDM-DO’s (each LDM-Object in the result-set only appears exactly once in the set) |
| Source |  |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_006 |
| Title | Subscribe for notification of changed of LDM-DO’s |
| Description | ITS Applications can subscribe to updates of LDM-DO’s, specified by a first-level filter.Optionally, a second-level filter and/or ordering-specification may be added.Optionally, a notification interval may be specified (for periodically notifications).Subscription shall result in either periodic notifications of available LDM-DO’s, or event-driven notifications (with optional minimal interval), i.e. upon available updates of LDM-DO’s.For each subscription, a priority level is specified (maximum priority level is assigned during registration).Subscriptions are removed when an ITS Application is deregistered.After reboot, no subscriptions exist. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_007 |
| Title | Unsubscribe |
| Description | ITS Applications can cancel a subscription. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_008 |
| Title | Notifications of changed LDM-DO’s |
| Description | RIS Facilities shall send notifications to successfully subscribed ITS Applications and to authorized LDM-DO as requested at time of subscription.Notification can be sent periodically, or due to new or updated (changed attribute-values) LDM-DO’s. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_009 |
| Title | Prioritization of query processing |
| Description | The processing of query-requests of ITS Applications shall take place in accordance with the level priority as given with the query-request (queries with higher priority shall be processed first). |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_DCONS\_010 |
| Title | Prioritization of sending notifications |
| Description | Sending notifications to ITS Applications shall take place in accordance with the level priority as given during subscription (notifications due to subscription with higher priority shall be sent first). |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

### LDM Maintenance

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_MAINT\_001 |
| Title | Outdated information management |
| Description | Invalid and outdated information must be removed from the storage by the LDM. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment | Removal of LDM-DO’s which are out of the LDM Area of Maintenance because the position of the ITS Station has changed, is out of scope for the iTLC (fixed position). |

### Storage

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_STOR\_001 |
| Title | Persistency |
| Description | For each LDM-DT persistency is configurable. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

### ITS G5 messages

This section describes the relationships between LDM-DO’s and ITS G5-messages as can be transmitted or received by using e.g. IEEE 802.11p**.**

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_G5\_001 |
| Title | DENM |
| Description | LDM-DT “Event” corresponds to a DENM. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture**ETSI EN 302 637-3 V1.2.2 (2014-11)* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_G5\_002 |
| Title | CAM |
| Description | Received CAM’s are used to update or add information of LDM-DO’s with LDM-DT “ITS-Station”. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture**ETSI EN 302 637-2 V1.3.2 (2014-11)* |
| Comment | Although CAM’s are not directly accessible from RIS-FI, this requirement is added for the sake of clarity. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_G5\_003 |
| Title | SPAT |
| Description | Updating the attribute values of LDM-DO’s “SignalgroupState”, “PrioritizationState” or “iTLC-Controller” triggers the transmission of a SPAT-message. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture**SAE-J2735, Dedicated Short Range Communications (DSRC) Message Set Dictionary, SAE International - 2015-09* |
| Comment | If a valid topology is available, the RIS Facilities will send MAP-messages periodically. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_G5\_004 |
| Title | IVI |
| Description | LDM-DT “In-vehicle Information” corresponds to an IVI-message. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture**ISO/TS 19321:2015* |
| Comment |  |

### Topology

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_TOPO\_001 |
| Title | Request current the topology  |
| Description | It shall be possible for ITS Applications to request the currently used instance of topology-description.As the topology consists of LDM-DO’s, the application may subsequently subscribe to changes of the topology and receive a notification when the topology is changed. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_LDM\_TOPO\_002 |
| Title | Request to update the topology  |
| Description | It shall be possible to request an update of the topology.A new instance of a topology-description is passed together with the request. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment | The new topology is validated and if valid, being used as a source for the transmission of MAP-messages. |

## Station Services

The RIS contains additional services, some of which are accessible by using the RIS-FI.

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_SVC\_001 |
| Title | Current time |
| Description | It shall be possible to request the current time at RIS-FI. |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment | Although the requested time is synchronized by the RIS Facilities, due to protocol- and transport-latencies the replied time is no more than an indication of the current time and not necessarily a representation of the exact current time. |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_SVC\_002 |
| Title | RIS meta data |
| Description | It shall be possible to request meta data of the RIS. The meta data contains at least the following information:* Version of RIS-FI
* Topology – meta data:
	+ Version of instance
	+ Description
	+ Version of topology-definition
* Versions of software components, e.g.:
	+ RIS Facilities
	+ LDM Dictionary ID
	+ LDM Version ID
* Supported ETSI/ISO standards / versions of used ITS-G5 message definitions
* RIS geographical position as WGS84-coordinate (See ETSI TS 102 894-2, *V1.2.1*, DF\_ReferencePosition)
* RIS manufacturer
 |
| Source | *CEN ISO/TS 18750:2015*, *Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture* |
| Comment |  |

## Quality attributes

Several quality attributes have been identified in [Ref 3]. This section provides the attributes which have an impact on the RIS-FI.

### Multiple applications - scalability

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_SCAL\_001 |
| Title | Concurrent ITS Applications |
| Description | The RIS-FI shall support at least 10 concurrent ITS Applications.  |
| Source | [Ref 3], QA\_PERF\_025 |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_SCAL\_002 |
| Title | Number of requests/replies  |
| Description | RIS-FI shall be able to process at least 20 concurrent API-requests/replies each second per ITS Application |
| Source | [Ref 3], QA\_PERF\_025 |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_SCAL\_003 |
| Title | Number of subscriptions |
| Description | RIS-FI supports at least 10 subscriptions per ITS Application.  |
| Source | [Ref 3], QA\_PERF\_025 |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_SCAL\_004 |
| Title | Notification update interval |
| Description | RIS-FI shall be able to send 25 notifications per second per ITS Application |
| Source | [Ref 3], QA\_PERF\_025 |
| Comment |  |

#### Latencies / Performance

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_PERF\_001 |
| Title | Latency of interface |
| Description | Latency max 100 msec between request at RIS-FI and resulting in response at RIS-FI.This includes checking permissions, validation of request-data, querying and updating LDM-DO’s or subscriptions, and transmission of a reply at RIS-FI. For LDM-DO’s: ‘processing’ includes updating LDM-DO’s, but excludes potential transmission of messages.Summarized: latency is specified including all actions at LDM-DO level or within RIS Facilities. |
| Source | [Ref 3], QA\_PERF\_009 |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_PERF\_002 |
| Title | Notification latency |
| Description | Maximum latency between an addition/update/delete of a LDM-DO and a transmitted notification to subscribed ITS Applications is 50 msec. for subscriptions with highest priority-level.For subscriptions with the lowest priority, a maximum latency of 500 msec. is acceptable. |
| Source | [Ref 3], QA\_PERF\_015 |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_PERF\_003 |
| Title | Process number of ITS-G5 messages |
| Description | At least, the RIS Facilities shall be able to process 250 received ITS-G5 messages per second.A received message can lead to an update or addition of a LDM-DO. |
| Source | [Ref 3], QA\_PERF\_029 |
| Comment |  |

### Availability

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_AVAIL\_001 |
| Title | Resilience against temporary network disruption |
| Description | It shall be possible for a RIS-FI to withstand temporary network disruption without major loss of function.  |
| Source | [Ref 3] |
| Comment |  |

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_AVAIL\_002 |
| Title | QoS |
| Description | ITS Applications can request a certain Quality of service level. The RIS-Facilities decides if it can support this QoS level. RIS-Facilities can decide to apply certain QoS measures when it detects congestion or performance problems |
| Source | [Ref 3], QA\_PERF\_029 |
| Comment |  |

### Evolution

|  |  |
| --- | --- |
| Req-ID | IRSIDD\_RISFI\_QA\_EVO\_001 |
| Title | RIS-FI protocol backwards compatibility  |
| Description | It shall be possible for an ITS application to use an older LDM-DD definition than the version used at the RIS-FI.  |
| Source | [Ref 3], QA\_EVO\_004 |
| Comment |  |

# APPENDIX 1: Requirements overview

As a reference, below all requirements are listed.

|  |  |
| --- | --- |
| [IRSIDD\_RISFI\_GEN\_001](#_Toc441736221)[IRSIDD\_RISFI\_GEN\_002](#_Toc441736222)[IRSIDD\_RISFI\_PROT\_001](#_Toc441736223)[IRSIDD\_RISFI\_PROT\_002](#_Toc441736224)[IRSIDD\_RISFI\_PROT\_003](#_Toc441736225)[IRSIDD\_RISFI\_PROT\_004](#_Toc441736226)[IRSIDD\_RISFI\_SEC\_001](#_Toc441736227)[IRSIDD\_RISFI\_REG\_001](#_Toc441736228)[IRSIDD\_RISFI\_REG\_002](#_Toc441736229)[IRSIDD\_RISFI\_REG\_003](#_Toc441736230)[IRSIDD\_RISFI\_REG\_004](#_Toc441736231)[IRSIDD\_RISFI\_REG\_005](#_Toc441736232)[IRSIDD\_RISFI\_REG\_006](#_Toc441736233)[IRSIDD\_RISFI\_REG\_007](#_Toc441736234)[IRSIDD\_RISFI\_REG\_008](#_Toc441736235)[IRSIDD\_RISFI\_LDM\_DD\_001](#_Toc441736236)[IRSIDD\_RISFI\_LDM\_DD\_002](#_Toc441736237)[IRSIDD\_RISFI\_LDM\_DD\_003](#_Toc441736238)[IRSIDD\_RISFI\_LDM\_DD\_004](#_Toc441736239)[IRSIDD\_RISFI\_LDM\_DD\_005](#_Toc441736240)[IRSIDD\_RISFI\_LDM\_DT\_001](#_Toc441736241)[IRSIDD\_RISFI\_LDM\_DT\_002](#_Toc441736242)[IRSIDD\_RISFI\_LDM\_DT\_003](#_Toc441736243)[IRSIDD\_RISFI\_LDM\_DT\_004](#_Toc441736244)[IRSIDD\_RISFI\_LDM\_DT\_005](#_Toc441736245)[IRSIDD\_RISFI\_LDM\_DT\_006](#_Toc441736246)[IRSIDD\_RISFI\_LDM\_DT\_007](#_Toc441736247)[IRSIDD\_RISFI\_LDM\_DT\_008](#_Toc441736248)[IRSIDD\_RISFI\_LDM\_DT\_009](#_Toc441736249)[IRSIDD\_RISFI\_LDM\_DT\_010](#_Toc441736250)[IRSIDD\_RISFI\_LDM\_DPRV\_001](#_Toc441736251)[IRSIDD\_RISFI\_LDM\_DPRV\_002](#_Toc441736252)[IRSIDD\_RISFI\_LDM\_DPRV\_003](#_Toc441736253)[IRSIDD\_RISFI\_LDM\_DPRV\_004](#_Toc441736254)[IRSIDD\_RISFI\_LDM\_DCONS\_001](#_Toc441736255)[IRSIDD\_RISFI\_LDM\_DCONS\_002](#_Toc441736256)[IRSIDD\_RISFI\_LDM\_DCONS\_003](#_Toc441736257)[IRSIDD\_RISFI\_LDM\_DCONS\_004](#_Toc441736258)[IRSIDD\_RISFI\_LDM\_DCONS\_005](#_Toc441736259)[IRSIDD\_RISFI\_LDM\_DCONS\_006](#_Toc441736260)[IRSIDD\_RISFI\_LDM\_DCONS\_007](#_Toc441736261)[IRSIDD\_RISFI\_LDM\_DCONS\_008](#_Toc441736262)[IRSIDD\_RISFI\_LDM\_DCONS\_009](#_Toc441736263)[IRSIDD\_RISFI\_LDM\_DCONS\_010](#_Toc441736264)[IRSIDD\_RISFI\_LDM\_MAINT\_001](#_Toc441736265)[IRSIDD\_RISFI\_LDM\_STOR\_001](#_Toc441736266)[IRSIDD\_RISFI\_LDM\_G5\_001](#_Toc441736267)[IRSIDD\_RISFI\_LDM\_G5\_002](#_Toc441736268)[IRSIDD\_RISFI\_LDM\_G5\_003](#_Toc441736269)[IRSIDD\_RISFI\_LDM\_G5\_004](#_Toc441736270)[IRSIDD\_RISFI\_LDM\_TOPO\_001](#_Toc441736271)[IRSIDD\_RISFI\_LDM\_TOPO\_002](#_Toc441736272)[IRSIDD\_RISFI\_SVC\_001](#_Toc441736273)[IRSIDD\_RISFI\_SVC\_002](#_Toc441736274)[IRSIDD\_RISFI\_QA\_SCAL\_001](#_Toc441736275)[IRSIDD\_RISFI\_QA\_SCAL\_002](#_Toc441736276)[IRSIDD\_RISFI\_QA\_SCAL\_003](#_Toc441736277)[IRSIDD\_RISFI\_QA\_SCAL\_004](#_Toc441736278)[IRSIDD\_RISFI\_QA\_PERF\_001](#_Toc441736279)[IRSIDD\_RISFI\_QA\_PERF\_002](#_Toc441736280)[IRSIDD\_RISFI\_QA\_PERF\_003](#_Toc441736281)[IRSIDD\_RISFI\_QA\_AVAIL\_001](#_Toc441736282)[IRSIDD\_RISFI\_QA\_AVAIL\_002](#_Toc441736283)[IRSIDD\_RISFI\_QA\_EVO\_001](#_Toc441736284) | [Time referencing 10](#_Toc441736285)[Geo referencing 10](#_Toc441736286)[IP-based 10](#_Toc441736287)[Request-reply 10](#_Toc441736288)[Publish-Subscribe 10](#_Toc441736289)[Concurrency 11](#_Toc441736290)[Permissions checking 11](#_Toc441736291)[Registration of ITS Applications (authorization) 12](#_Toc441736292)[ITS Application identification 12](#_Toc441736293)[Alive Checking 13](#_Toc441736294)[Deregistration by Facilities 13](#_Toc441736295)[Permissions Changed Notification 13](#_Toc441736296)[Deregistration Request 14](#_Toc441736297)[Available ITS Application groups 14](#_Toc441736298)[Available priorities 15](#_Toc441736299)[LDM Data Dictionary 16](#_Toc441736300)[LDM Data Dictionary Version 16](#_Toc441736301)[Identification of LDM-DO’s 16](#_Toc441736302)[LDM-DT optional attributes 16](#_Toc441736303)[LDM-DO Access Rights 17](#_Toc441736304)[Supported LDM-DT’s 17](#_Toc441736305)[ITS-Station 18](#_Toc441736306)[Event 18](#_Toc441736307)[SignalgroupState 19](#_Toc441736308)[PrioritizationState 19](#_Toc441736309)[In-Vehicle Information 19](#_Toc441736310)[TLC-ControllerState 19](#_Toc441736311)[DetectionArea 20](#_Toc441736312)[referenceTrack 20](#_Toc441736313)[DrivingLane 20](#_Toc441736314)[Add new LDM-Object to LDM 21](#_Toc441736315)[Update of a LDM object 21](#_Toc441736316)[Message protocol status of a LDM object 21](#_Toc441736317)[Deletion of a LDM object 22](#_Toc441736318)[First-level filtering 22](#_Toc441736319)[Second-level filtering 22](#_Toc441736320)[Ordering data results 23](#_Toc441736321)[Query LDM for LDM-DO’s 23](#_Toc441736322)[Result-sets contains unique LDM-DO’s 23](#_Toc441736323)[Subscribe for notification of changed of LDM-DO’s 23](#_Toc441736324)[Unsubscribe 24](#_Toc441736325)[Notifications of changed LDM-DO’s 24](#_Toc441736326)[Prioritization of query processing 24](#_Toc441736327)[Prioritization of sending notifications 24](#_Toc441736328)[Outdated information management 25](#_Toc441736329)[Persistency 25](#_Toc441736330)[DENM 25](#_Toc441736331)[CAM 25](#_Toc441736332)[SPAT 26](#_Toc441736333)[IVI 26](#_Toc441736334)[Request current the topology 26](#_Toc441736335)[Request to update the topology 26](#_Toc441736336)[Current time 27](#_Toc441736337)[RIS meta data 27](#_Toc441736338)[Concurrent ITS Applications 27](#_Toc441736339)[Number of requests/replies 28](#_Toc441736340)[Number of subscriptions 28](#_Toc441736341)[Notification update interval 28](#_Toc441736342)[Latency of interface 28](#_Toc441736343)[Notification latency 29](#_Toc441736344)[Process number of ITS-G5 messages 29](#_Toc441736345)[Resilience against temporary network disruption 29](#_Toc441736346)[QoS 29](#_Toc441736347)[RIS-FI protocol backwards compatibility 29](#_Toc441736348) |

1. Group of traffic control specialists/engineers in the Netherlands [↑](#footnote-ref-2)