
1 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

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2 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.

2.1 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].

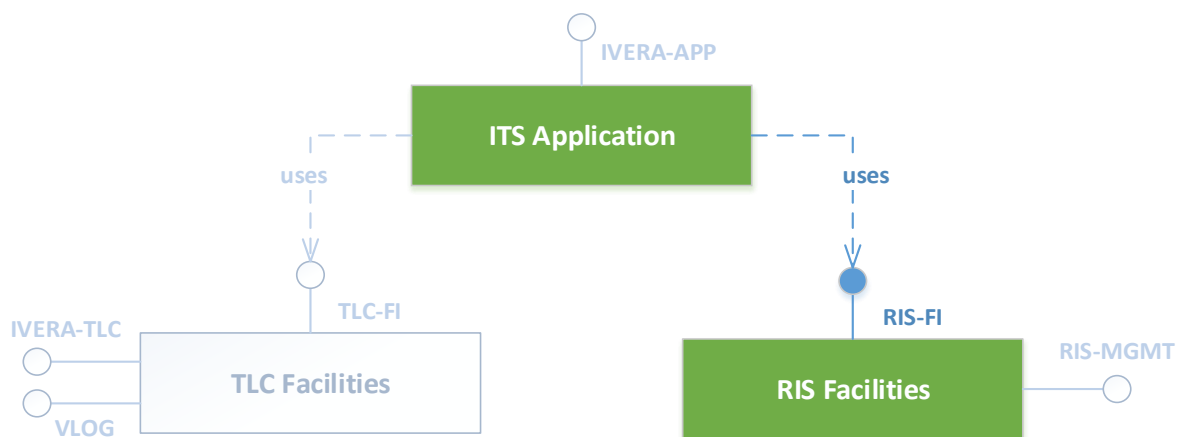


Figure 1 RIS-FI in System overview

2.2 Document overview

2.2.1 Purpose

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

2.2.2 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.

2.3 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.*

3 References

3.1 Normative

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

3.2 Informative

ID	Reference
[Ref 10]	ETSI EN 302 665, V1.1.1
[Ref 11]	ETSI TS 102 894-2, V1.2.1

4 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
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 <i>ETSI EN 302 665, V1.1.1</i>)
IVERA	Management protocol for traffic light controllers in the Netherlands
IVI	In Vehicle Information (see <i>ISO/TS 19321:2015</i>)
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.

¹ Group of traffic control specialists/engineers in the Netherlands

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: <ul style="list-style-type: none">• Access to information stored in the LDM• Services to trigger C-ITS messages

5 Requirements

5.1 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.

5.1.1 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.

5.2 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	

5.3 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	

5.4 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	

5.5 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	<i>Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	<p>With the registration request, the ITS Application provides at least the following information:</p> <ul style="list-style-type: none">• Application Identifier• Requested Role (see IRSIDD_RISFI_REG_007)• Requested maximum priority-level <p>The request is processed by the RIS Facilities by using the Security Entity which will authorize the ITS Application (assign permissions).</p> <p>The result of the request (<i>rejected</i> with reason or <i>accepted</i> with applicable permissions) is replied to requesting ITS Application.</p> <p>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.</p> <p>Used priority levels per ITS Application need to be agreed upon between suppliers of ITS Applications.</p> <p>A successful registration will start the alive-checking feature.</p>

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	<p>If the RIS Facilities detects a not responding ITS Application or a broken communication path, the following actions are taken:</p> <ul style="list-style-type: none"> • 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	<p>A 'Permission Changed Notification' can be send because of the following reasons:</p> <ol style="list-style-type: none"> 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). <p>The notification also contains the reason for change.</p>

Req-ID	IRSIDD_RISFI_REG_006
Title	Deregistration Request
Description	<p>An ITS Application can deregister itself if it will not use the RIS Facilities any further.</p> <p>Because of the deregistration, the RIS Facilities will:</p> <ul style="list-style-type: none">• 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	<p>The following groups (roles) shall be available for ITS Applications to use during registration:</p> <ul style="list-style-type: none">• Data Consumer• Data Provider• Topology Provider• TLC-Adapter <p>An ITS Application can have multiple roles at the same time (e.g. act as a Data Consumer and Data Provider).</p> <p>For each of the available groups the applicable permissions are described in [Ref 4], "<i>LDM Data Dictionary v1.1.xlsx</i>".</p>
Source	
Comment	Above list may be expanded with other groups; these are elaborated in the <i>LDM Data Dictionary v1.1.xlsx</i> .

Req-ID	IRSIDD_RISFI_REG_008
Title	Available priorities
Description	<p>During registration, an ITS Application requests a maximum applicable priority level used for subsequent requests.</p> <p>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.</p> <p>The maximum allowed priority level is returned as part of the response of a registration request of an ITS Application</p> <p>ITS 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.</p> <p>The priority level is defined as : 0 (lowest priority) ... 255 (highest priority)</p>
Source	ETSI EN 302895, V1.1.1, CEN ISO/TS 18750:2015
Comment	The registration response indicates the actual assigned priority level.

5.6 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

5.6.1 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], <i>LDM Data Dictionary v1.1.xlsx</i>
Source	<i>Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
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	<i>CEN ISO/TS 18750:2015</i>
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	<i>CEN ISO/TS 18750:2015</i> ("LDM Data Record ID"), <i>ETSI EN 302895, V1.1.1</i> ("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	<i>Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	

Req-ID	IRSIDD_RISFI_LDM_DD_005
Title	LDM-DO Access Rights
Description	<p>For each LDM-DT access rights shall be defined. The following access rights shall be assigned to objects and attributes of objects:</p> <ul style="list-style-type: none"> • 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 object <p>The access rights are defined per ITS Application type.</p>
Source	<i>Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	

5.6.2 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	<p>The following LDM-DT's shall be supported:</p> <ul style="list-style-type: none"> • 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	<p>The <i>ITS-Station</i> type shall contain the following attributes:</p> <ul style="list-style-type: none"> • StationID • ReferenceTrack(s) • Type • Heading • Speed • DriveDirection • VehicleLength • VehicleWidth • LongitudinalAcceleration • Curvature • CurvatureCalculationMode • YawRate <p>Further, depending on the vehicleRole, the following information is mandatory:</p> <ul style="list-style-type: none"> • PublicTransportContainer (vehicleRole = 1) • SpecialTransportContainer (vehicleRole = 2) • DangerousGoodsContainer (vehicleRole = 3) • RoadWorksContainer (vehicleRole = 4) • SpecialVehicleContainer (vehicleRole = 5) • EmergencyContainer (vehicleRole = 6) • SafetyCarContainer (vehicleRole = 7) <p>See <i>ETSI EN 302 637-2 V1.3.2 (2014-11)</i> for details.</p>
Source	[Ref 3], [Ref 5]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DT_003
Title	Event
Description	The <i>Event</i> type shall at least contain all mandatory properties as defined in <i>ETSI EN 302 637-3 V1.2.2 (2014-11)</i> .
Source	[Ref 3], [Ref 5]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DT_004
Title	SignalgroupState
Description	The <i>SignalgroupState</i> type shall at least contain the following properties : Metadata: signalgroupID descriptive name referencetracks laneSetId actual_state: actual phase state future_states: phase state
Source	[Ref 3], [Ref 5]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DT_005
Title	PrioritizationState
Description	The <i>PrioritizationState</i> type shall at least contain the following properties : <ul style="list-style-type: none"> • StationID • signalgroupID • prioritizationState
Source	[Ref 3], [Ref 5]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DT_006
Title	In-Vehicle Information
Description	The <i>In-Vehicle Information</i> type shall at least contain all mandatory properties as defined in <i>ISO/TS 19321:2015</i> .
Source	[Ref 3], [Ref 5]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DT_007
Title	TLC-ControllerState
Description	The <i>TLC-ControllerState</i> type shall at least contain the following properties : <ul style="list-style-type: none"> • ControllerState • Per intersection: <ul style="list-style-type: none"> ○ IntersectionState ○ Road Geometry & Topology
Source	[Ref 3], [Ref 5]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DT_008
Title	DetectionArea
Description	<p>The <i>DetectionArea</i> type shall at least contain the following properties :</p> <ul style="list-style-type: none"> • Meta data • Faults <p>Further, depending on the type of sensor, one or more of the following attributes are mandatory:</p> <ul style="list-style-type: none"> • occupied • speed • intensity • vehicle type • vehicle length • direction
Source	[Ref 3], [Ref 5]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DT_009
Title	referenceTrack
Description	<p>The <i>referenceTrack</i> type shall at least contain the following properties :</p> <ul style="list-style-type: none"> • 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	<p>The <i>DrivingLane</i> type shall at least contain the following properties :</p> <ul style="list-style-type: none"> • SignalgroupState • PrioritizationState • Meta-data
Source	[Ref 3], [Ref 5]
Comment	

5.6.3 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	<p>ITS Applications can request to add a new instance of a LDM-DO in the LDM.</p> <p>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.</p>
Source	[Ref 1], [Ref 2], [Ref 3]
Comment	

Req-ID	IRSIDD_RISFI_LDM_DPRV_002
Title	Update of a LDM object
Description	<p>Any ITS Application can request to update an existing instance of a LDM-object in the LDM.</p> <p>Together with the updated properties, the LDM-DOID must be passed.</p> <p>In a reply, the RIS-FI returns the result of the update-request. If an update was not successful, a reason is also returned.</p>
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	<p>ITS Applications can delete a LDM-DO.</p> <p>The LDM-DOID of an existing LDM-DO must be given.</p> <p>In the reply the RIS-FI returns the result of the delete-request. If the deletion was not successful, a reason is returned.</p>
Source	[Ref 1], [Ref 2], [Ref 3]
Comment	

5.6.4 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	<p>RIS-FI supports a first-level filtering; filtering (as part of a query or subscription) shall be performed on:</p> <ul style="list-style-type: none"> • LDM-DOID • LDM-DT • Area of interest • Time of interest <p>Combination of these attributes is possible by logical AND and logical OR.</p>
Source	<i>CEN ISO/TS 18750:2015</i>
Comment	

Req-ID	IRSIDD_RISFI_LDM_DCONS_002
Title	Second-level filtering
Description	<p>RIS-FI supports second-level filtering which is applied to those LDM-DO's resulting from first-level filtering.</p> <p>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.</p>
Source	<i>CEN ISO/TS 18750:2015</i>
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	<i>ETSI EN 302895, V1.1.1</i>
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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
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	<p>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).</p> <p>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).</p> <p>Subscriptions are removed when an ITS Application is deregistered. After reboot, no subscriptions exist.</p>
Source	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	

Req-ID	IRSIDD_RISFI_LDM_DCONS_007
Title	Unsubscribe
Description	ITS Applications can cancel a subscription.
Source	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	

Req-ID	IRSIDD_RISFI_LDM_DCONS_008
Title	Notifications of changed LDM-DO's
Description	<p>RIS Facilities shall send notifications to successfully subscribed ITS Applications and to authorized LDM-DO as requested at time of subscription.</p> <p>Notification can be sent periodically, or due to new or updated (changed attribute-values) LDM-DO's.</p>
Source	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	

5.6.5 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).

5.6.6 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	

5.6.7 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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i> <i>SAE-J2735, Dedicated Short Range Communications (DSRC) Message Set Dictionary, SAE International - 2015-09</i>
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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i> <i>ISO/TS 19321:2015</i>
Comment	

5.6.8 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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	The new topology is validated and if valid, being used as a source for the transmission of MAP-messages.

5.7 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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
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	<p>It shall be possible to request meta data of the RIS. The meta data contains at least the following information:</p> <ul style="list-style-type: none">• Version of RIS-FI• Topology – meta data:<ul style="list-style-type: none">◦ Version of instance◦ Description◦ Version of topology-definition• Versions of software components, e.g.:<ul style="list-style-type: none">◦ 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	<i>CEN ISO/TS 18750:2015, Beter Benutten Vervolg, project iVRI, Deliverable F, iTLC Architecture</i>
Comment	

5.8 Quality attributes

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

5.8.1 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	

5.8.1.1 Latencies / Performance

Req-ID	IRSIDD_RISFI_QA_PERF_001
Title	Latency of interface
Description	<p>Latency max 100 msec between request at RIS-FI and resulting in response at RIS-FI.</p> <p><i>This includes checking permissions, validation of request-data, querying and updating LDM-DO's or subscriptions, and transmission of a reply at RIS-FI.</i></p> <p><i>For LDM-DO's: 'processing' includes updating LDM-DO's, but excludes potential transmission of messages.</i></p> <p>Summarized: latency is specified including all actions at LDM-DO level or within RIS Facilities.</p>
Source	[Ref 3], QA_PERF_009
Comment	

Req-ID	IRSIDD_RISFI_QA_PERF_002
Title	Notification latency
Description	<p>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.</p> <p>For subscriptions with the lowest priority, a maximum latency of 500 msec. is acceptable.</p>
Source	[Ref 3], QA_PERF_015
Comment	

Req-ID	IRSIDD_RISFI_QA_PERF_003
Title	Process number of ITS-G5 messages
Description	<p>At least, the RIS Facilities shall be able to process 250 received ITS-G5 messages per second.</p> <p>A received message can lead to an update or addition of a LDM-DO.</p>
Source	[Ref 3], QA_PERF_029
Comment	

5.8.2 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	<p>ITS Applications can request a certain Quality of service level. The RIS-Facilities decides if it can support this QoS level.</p> <p>RIS-Facilities can decide to apply certain QoS measures when it detects congestion or performance problems</p>
Source	[Ref 3], QA_PERF_029
Comment	

5.8.3 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	Time referencing	10
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