

Detailed functional specifications of Road Operator Platform

Deliverable 2.4.3.2_H

Activity 2: Studies

Sub-activity 2.4 > Specifications

Version 4.00

Publication Date: 14/11/2019



Co-financed by the Connecting Europe
Facility of the European Union

The contents of this publication are the sole responsibility of the SCOOP@F project consortium, C-ROADS France project consortium and InterCor project consortium (French beneficiaries only) and do not necessarily reflect the opinion of the European Union.

Information on the document

Document: Detailed functional specifications of Road Operator Platform

Date of publication: 14/11/2019

Responsible, Entity: Vincent ROBIN, Cerema

Status: Version 4.00 – Release 4

Publication history

Date	Version	Contributor(s)	Main Updates & changes	Diffusion
11/14/2019	4.00	V. ROBIN	<ul style="list-style-type: none">Consolidated version for release 4	Release 4

Quality rules

Reference to the version administration

Version number to be composed of 3 digits > vR.XY

- **R** corresponds to the release number : it is upgraded each time SC Studies validates the diffusion of a new release,

- **X** is the major version number: it is upgraded each time SC Studies validates the deliverable,

- **Y** is the minor version number: it is upgraded each time a contributor changes anything.

Once the deliverable is approved, its version number is upgraded from vR.XY to vR.(X+1)0

Once the deliverable is release, its version number is upgraded from vR.XY to v(R+1).00

As illustration :

0.03 > Work in progress version

0.10 > Del. Approved by SC Studies but not released

2.00 > Del. approved & released (in release 2)

2.05 > Del. Updated - in progress version

Requirements identification & traceability

In this document, the following verbal forms are used to indicate requirements: **Shall / Shall not**

Recommendations shall be indicated by the verbal forms: **Should / Should not**

Permissions shall be indicated by the verbal forms: **May / May not**

Possibility and capability shall be indicated by the verbal forms: **Can / Cannot**

Inevitability used to describe behavior of systems beyond of the scope of this del. shall be indicated by: **Will / Will not**

Facts shall be indicated by the verbal forms: **Is / Is not**

In the table here below:

2.4.X.XX > is the number given to the deliverable (e.g. 2.4.4.8)

YYYY > for digit are given to identifying which component/entity the requirement is addressing (e.g. LTCA for long term certificate authority)

ZZZ > is the numeration of the requirement

ID	2.4.X.XX-YYYY-ZZZ
Component(s)	(e.g) ITSS-VU, ITSS-VRO, ITSS-R, PKI
Requirement	(e.g) An ITS station SHALL be able to request and get a Long term Certificate (LTC) from the SCOOP Public Key Infrastructure (PKI).
Acceptance	(e.g) CA1 : ITSS-VU sends a LTC request to the LTCA CA2 : ITSS-R relays the LTC request CA3 : The LTCA verifies the request and sends a response CA4 : The ITSS-R relays the response CA5 : The response is received by the ITSS-VU and is valid
Additional information	

Acronyms & abbreviations

CAM	Cooperative Aware Message
DENM	Decentralized Environmental Notification Message
ITS	Intelligent Transport System
ITS G5	Adaptation of the IEEE 802.11p (wifi)
ITS-S	Intelligent Transport System Station
IVI	In Vehicle Information
Nfr-ITS-S	French National Central ITS-S
Pfro	road operator platform
PLO	Reference point for the linear location (french reference)
R-ITS-S	roadside-ITS-S
RP	Reference point for the linear location (french reference)
TMS	Traffic Management System
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
V2X	V2V and/or V2I
V-ITS-S	Vehicle ITS-S
Vro-ITS-S	road Operator Vehicle ITS-S
Vru-ITS-S	User Vehicle ITS-S

Table of Contents

Quality rules.....	3
Acronyms & abbreviations.....	4
1 Introduction.....	8
2 Description of the road operator platform.....	8
2.1 General presentation of the road operator platform application.....	8
2.2 Architecture of French C-ITS projects.....	9
2.3 The road operator platform in its data processing environment.....	10
2.3.1 Application plan.....	10
2.3.2 Development tools.....	10
2.3.3 Developments.....	12
2.4 The road operator platform and its data processing environment.....	12
2.5 Road operator platform installation in each local sub-project.....	15
3 Road operator platform functionalities.....	15
3.1 Summary of C-ITS use cases.....	15
3.2 Interfacing from the road operator platform.....	18
3.2.1 interfacing with the R-ITS-S, Vro-ITS-S.....	18
3.2.2 Interfacing with the Nfr-ITS-S.....	18
3.2.3 Interfacing with the TMS.....	20
3.3 List of functionalities for the downlinks: from TMS to V-ITS-S.....	20
3.3.1 Operating scheme.....	20
3.3.2 List of use cases concerned: TMS > road operator platform.....	22
3.3.3 processing of incoming data.....	22
3.3.4 Data processing in the road operator platform.....	24
3.3.5 Transmitting a message.....	32
3.3.6 Event lifetime.....	34
3.4 List of functionalities for the uplinks: from V-ITS-S to TMS.....	37
3.4.1 Operating scheme.....	37
3.4.2 List of use cases: R-ITS-S > road operator platform.....	39
3.4.3 Data processing in the acquisition module.....	40
3.4.4 Data processing on the road operator platform.....	41
3.4.5 processing and calculation modules.....	50
3.5 HMI.....	50

3.6	Support functionalities.....	51
3.6.1	Authentication.....	51
3.6.2	Other internal road operator platform MODULES.....	52
3.6.3	Configuration repository.....	53
3.6.4	Geographic repository.....	54
3.6.5	Monitoring module.....	54
3.6.6	Archiving.....	54
3.6.7	Logging module.....	54
3.7	Synthesis of main functionalities of the road operator platform.....	55

List of figures

Illustration 1: General functional and communication architecture (extract from 2.4.1_H).....	9
Illustration 2: General schema of the software road operator platform operating principle.....	10
Illustration 3: DENM from TMS to V-ITS-S (extract from 2.4.1.4_H).....	19
Illustration 4: IVI from TMS to V-ITS-S (extract from 2.4.1.4_H).....	19
Illustration 5: POI from TMS to V-ITS-S (extract from 2.4.1.4_H).....	20
Illustration 6: CAM from V-ITS-S to TMS (extract from 2.4.1.4_H).....	34
Illustration 7: DENM from V-ITS-S to TMS (extract from 2.4.1.4_H).....	35
Illustration 8: DENM from Vro-ITS-S to TMS (extract from 2.4.1.4_H).....	35

1 Introduction

The general objective of the C-ITS project is to test the implementation conditions for the cooperative networked systems. The stakes of the project are as follows:

- Improve road safety
- Optimise traffic management and road information and their impacts
- Help reduce environmental pressures, especially greenhouse gas emissions
- Optimise the costs of managing the infrastructure and develop new services, including intermodal ones
- Help to prepare the vehicles of tomorrow

This deliverable presents the detailed specifications of the common road operator platform. It completes the prerequisites defined in the deliverables: 2.4.1_H, 2.4.2.4_H and 2.4.1.4_H and must be compatible with the R-ITS-S, Vro-ITS-S and Vru-ITS-S specifications.

2 Description of the road operator platform

2.1 *General presentation of the road operator platform application*

The road operator platform is an element of the C-ITS project which permits the communications between the V-ITS-S (Vro-ITS-S and Vru-ITS-S) and the TMS.

The communication from the TMS mainly concerns the messages composed of information for users, by applying a policy predefined by the road operator, and the traffic data and events on the traffic arteries defined in the repository.

The communication from the V-ITS-S concerns the messages of the conditions of circulations noticed by the user of the road and the messages send automatically

automatically by the vehicle.

In the wave 1, the C-ITS project used only the communication with the G5 network on Vru-ITS-S. The specifications were given in the deliverable 2.4.3.2.

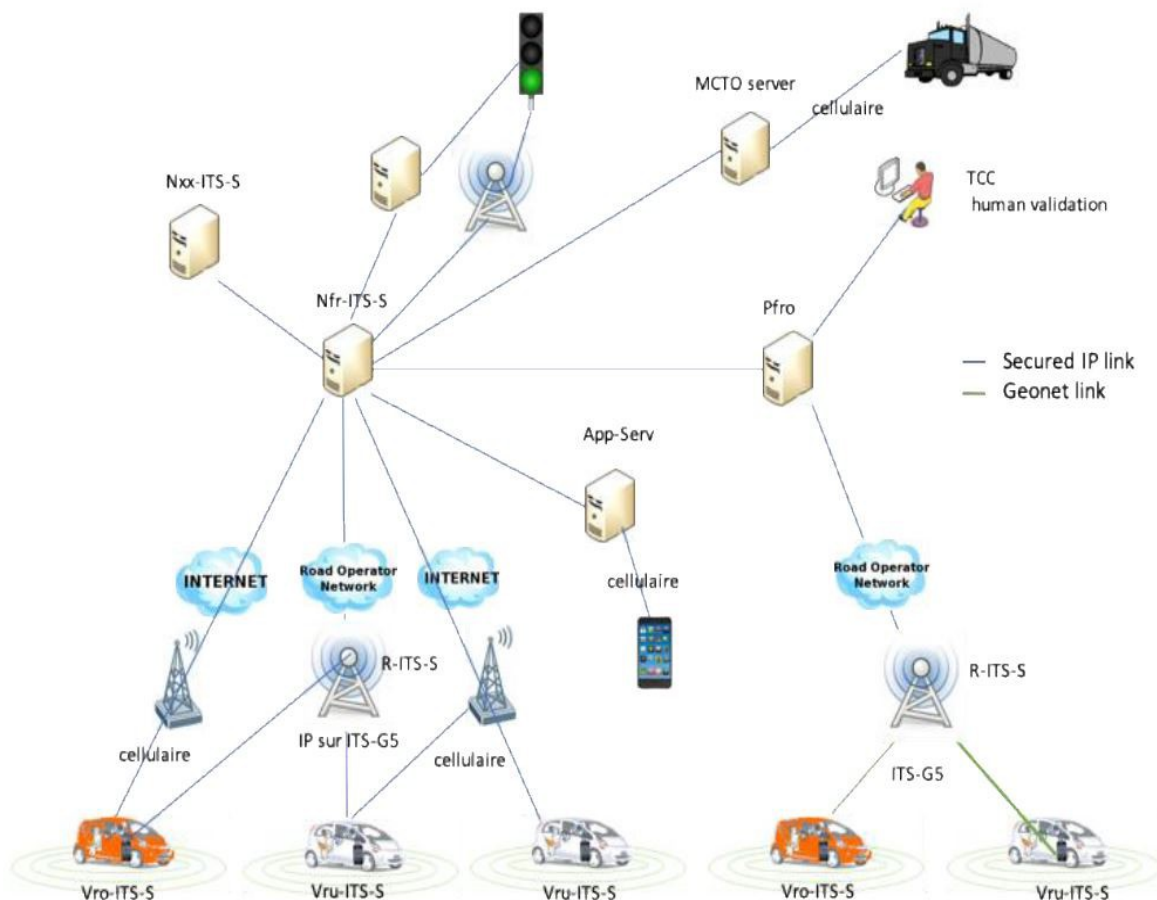
In the wave 2, hybrid communication allows extension of the area covered by G5 network.

This extension, possible with the cellular network, required changes in the C-ITS architecture. All the architecture is described in the deliverable 2.4.1.H. The main impacting the platform is the creation of a National Central ITS-S

2.2 Architecture of French C-ITS projects

French C-ITS projects components shall designate all physical components that enable users to produce or exchange the messages required to run the use cases. They are listed in the deliverable 2.4.1_H.

The core components of the cooperative systems are the ITS stations (ITS-S) as defined in the standard ETSI EN 302 665.



2.3 The road operator platform in its data processing environment

2.3.1 Application plan

The application plan below is based on a database management system (DBMS) and includes all of the possible or expected functionalities of the application as well as the interfaces with other information systems.

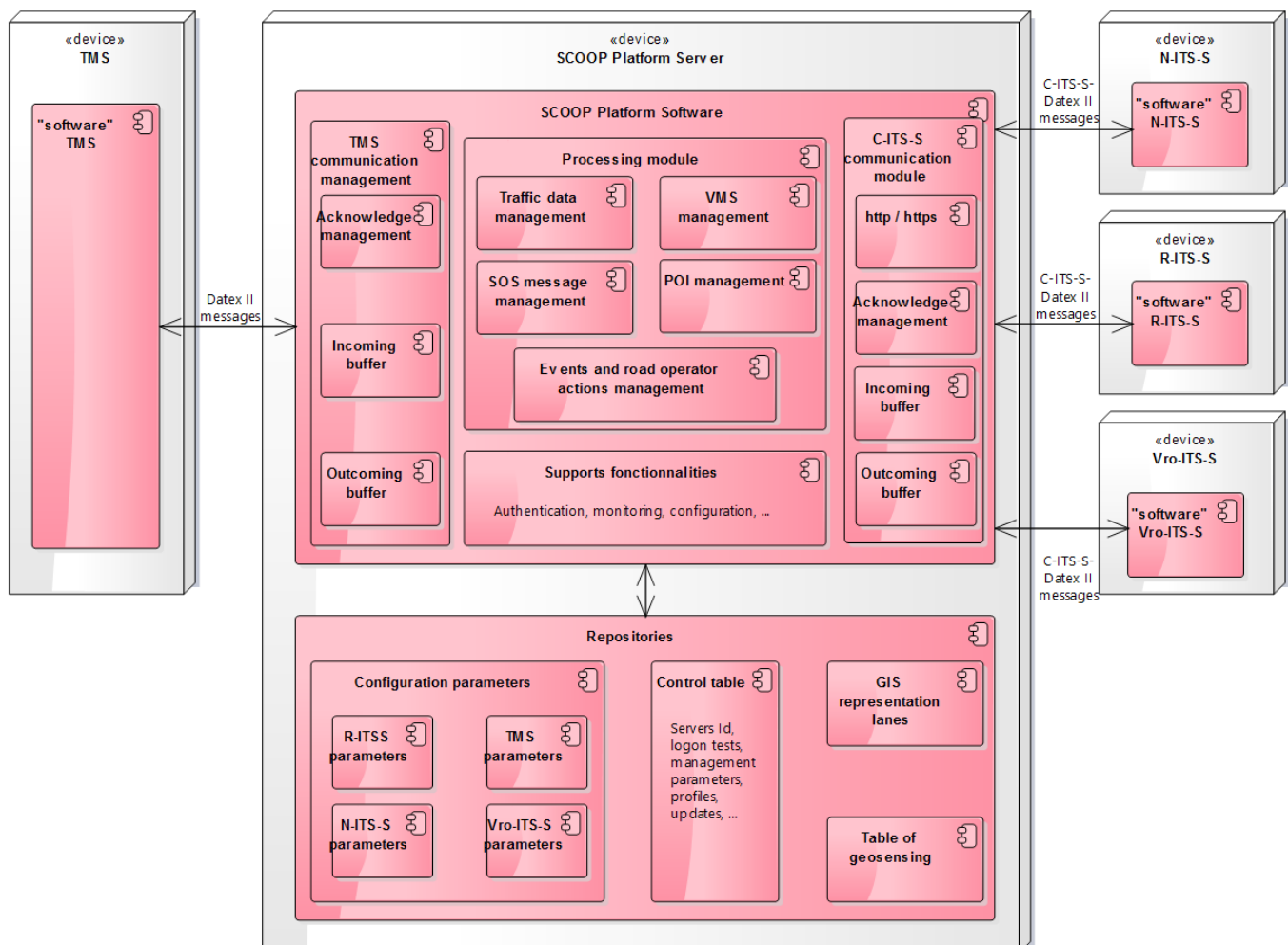


ILLUSTRATION 2: GENERAL SCHEMA OF THE SOFTWARE ROAD OPERATOR PLATFORM OPERATING PRINCIPLE

2.3.2 Development tools

ID	2432_H-DEV-001
Component(s)	road operator platform, Nfr-ITS-S, Vro-ITS-S, R-ITS-S
Requirement	The road operator platform shall comply with the ACAI coherence environment concerning the ministry applications

Extract of the terms of reference ACAI_V3 above

The target general technical architecture is that of web architectures with thin clients. This means that the clients are the browsers without a particular extension. Javascript can be used to enrich the ergonomics while respecting the accessibility principles.

Two notable exceptions are accepted:

- Visualisation and interaction with geographic data based on the non-accessible Javascript components. The accessibility to such systems can be achieved by other means.*
- The Business Object decision-making design module*

Some applications may require an operation in disconnected mode. In this case, the use of HTML5 is authorised. Synchronisation mechanisms should be developed as part of these applications.

The main objectives to comply with are:

- The Internet norms and standards (HTTP and HTTPS as the only protocols between the client station and the server)*

The inter-ministerial directives (interoperability, security, accessibility)

The road operator platform's hosting (either on the site or by a host) shall take into account the rules used in each site, especially to support GIS functionalities.

The service provider providing the road operator platform shall provide the list of the information required for the integration on each site.

Legal information and graphic charters provided for as part of the ACAI coherence are exceptional.

ID	2432_H-DEV-002
Component(s)	road operator platform, Nfr-ITS-S, Vro-ITS-S, R-ITS-S

Requirement	The environment shall be based on the stable version of the Debian operating system and composed of applications enabling to broadcast a dynamic Web service: Java, Apache, Tomcat, PostgreSQL, PostGIS, etc. By default these applications will be installed in the stable version taken from the Debian (latest stable version) operating system's default packets.
Acceptance criteria	Control that the system is on Debian 7.8 with his components: Apache, tomcat, Postgres 9,4 with postgis extension, Java 1,8

The new versions will have to follow the ministerial recommendations.

The road operator platform will use a PostgreSQL database and the stable version of PostGIS.

2.3.3 *Developments*

Any other development will be implemented on the road operator platform DIR IF (i.e., the road operator platform ordered and deployed on the benchmark site: DIR IF) and compatible with the data processing environment defined nationally. Under these conditions, all road operators will benefit from these changes.

A road operator who makes changes independently of the national project runs the risk of losing the benefit of new versions of the road operator platform or will have to ensure its changes to be adopted for the national road operator platform.

2.4 *The road operator platform and its data processing environment*

The hybrid communication architecture shall allow to send and receive message through different radio links (ITS-G5 or Cellular) from/to V-ITS-S to/From other TMS.

The road operator platform receives data from the Nfr-ITS-S

- Datex II messages

The road operator platform sends data to the Nfr-ITS-S

- Datex II messages

The main functions of the road operator platform:

- Reception:
 - receives messages from Vro-ITS-S and R-ITS-S
 - receives messages from Nfr-ITS-S

- receives messages from TMS
- processing:
 - messages aggregation (uplink flow)
 - validity check
 - duplication check
 - modifies some messages from Datex II to prepare the DENM messages
 - modifies some messages from Datex II to prepare the IVI messages
 - modifies some messages from Datex II to prepare the POI messages
 - filtering downward sense (selection of the R-ITS-S which will receive the messages according to the location, but all messages are sent to the Nfr-ITS-S)
- Distribution:
 - forwards messages to Nfr-ITS-S
 - forwards messages to R-ITS-S and Vro-ITS-S.
 - forwards messages to TMS

Concerning exchanges between R-ITS-S, Vro-ITS-S or Nfr-ITS-S and the road operator platform,

ID	2432_H-COMMUNICATION-001
Component(s)	road operator platform, Nfr-ITS-S, Vro-ITS-S, R-ITS-S
Requirement	the web-service (with a SOAP envelope) shall be used in push on occurrence with acknowledgement of receipt.
Acceptance criteria	Control that reception of the push informations is present in the log

ID	2432_H-COMMUNICATION-002
Component(s)	road operator platform, Nfr-ITS-S, Vro-ITS-S, R-ITS-S
Requirement	the web-service (with a SOAP envelope) shall be used in pull for snapshot
Acceptance criteria	Control that reception of the snapshot is present in the log.

ID	2432_H-COMMUNICATION-003
Component(s)	road operator platform, Nfr-ITS-S, Vro-ITS-S, R-ITS-S
Requirement	Regularly, the road operator platform shall emit keepalive messages (it must be configurable) to verify the connection between R-ITS-S, Nfr-ITS-S, Vro-ITS-S and the road operator platform.
Acceptance criteria	Control the acquirement of keepalive Control the periodicity in the configuration file

The model used will be the one recommended in the Datex II v2.3 technical specifications. (see 2.4.1.4_H).

A snapshot mechanism will be used, especially during communication resumptions.

The time synchronisation of all the elements is provided by a time server (using GNSS) through a NTP protocol (normal service).

ID	2432_H-SYNCHRO-001
Component(s)	road operator platform
Requirement	The time synchronisation of all the elements shall be provided by a time server (using GNSS) through a NTP protocol (normal service).
Acceptance criteria	Control the time in the system log

ID	2432_H-SYNCHRO-002
Component(s)	road operator platform
Requirement	The road operator platform shall use the Universal Time Coordinated (UTC)
Acceptance criteria	Control that the time in the Datex II message is in UTC (GMT +0)
Additional information	Datex use the Universal Time Coordinated (UTC), but DENM and CAM use the International Atomic Time (TAI). The translation shall be made in the R-ITS-S or Nfr-ITS-S.

2.5 Road operator platform installation in each local sub-project

Installation and acceptance tests of the software are made by each road operator. The necessary documents for these steps are provided to the road operator: the installation and user manuals, necessary acceptance manuals, referential, parameters files, etc.

The road operator platform is delivered with a default configuration. However each road

operator is responsible for the configuration and inputting the strategy elements and application repositories related to each site.

The full versions of the road operator platform with a default configuration shall be available online, on an identified server.

The same dispositions shall be made for the local developments.

Each road operator is responsible for preparing its site (and therefore the data processing environment) for the road operator platform's installation. The application is delivered with all of the executables necessary for its installation from scratch.

For updates, the provider will give the employed process with the necessary files and will specify in detail the evolutions.

Each road operator is responsible for developing the necessary interfaces between the road operator platform and its TMS.

The Interfaces with the TMS are developed outside the road operator platform.

3 Road operator platform functionalities

3.1 *Summary of C-ITS use cases*

The road operator platform will be used by the French Partners of the three C-ITS projects: SCOP, INTERCOR and C- Roads.

Therefore, the road operator platform must take into consideration a few use cases of the three projects, which are specified functionally in the deliverable L_2.2: "C-ITS French Use Cases Catalog – Functional descriptions V4".

For information, the following table lists the SCOP, C- Roads and InterCor uses cases and their status in terms of specifications and developments.

Use cases functionally described in the catalog	Scoop wave 1	Scoop wave 2	C- roads	InterCor
AA – Probe Vehicle Data				
A1 – Traffic data collection	X			X
A2 – Data on detected events	X			X
A3 – Data on declared events	X			X
B – road Works Warning				
B1a - Alert neutralization of part of a lane, whole lane or several lanes	X			X
B1b – Alert planned closure of a road or a carriageway		X		X
B1c – Alert planned road works – mobile	X			X
B2a&b&c - road operator’s intervention	X			X
B2d - Alert end of queue by a road operator vehicle	X			X
B3a&b&c – Winter maintenance	X			X
C – Signage Applications				
C2 – In-vehicle dynamic speed limit information			X	X
C3 – In-vehicle signage (Embedded VMS)		X		X
D – Hazardous Location Notifications				
D1 – Temporary slippery road	X			X
D2a&b – Animal or people on the road	X			X
D3 – Obstacle on the road	X			X
D4 – Alert stationary vehicle / breakdown	X			X
D5 – Alert accident area	X			X
D6 – Alert reduced visibility	X			X
D7 – Alert wrong way driving		X		X
D8 – Unmanaged blockage of a road	X			X
D10 – Alert emergency brake	X			X
D11 – Alert end of queue	X			X
D12 – Emergency vehicle approaching			X	
E – Traffic Information and Smart Routing				
E6 – Alert extreme weather conditions	X			
F – Parking, Park and Ride, Multimodality				
F1 – Information on parking lots location, availability and services			X	
G – Intersection				
G1 – GLOSA			X	X
H – Traffic management				
H2 – Dynamic traffic ban to specific vehicles				X
H4 – Dynamic lane management – reserved lane (I2V)			X	
I – Vulnerable users				
I3 – road workers in the field			X	
J – Multimodal Cargo Transport Optimization				
J1 – Truck ETA in the Terminal				X
J2 – Assigning a slot to a given vehicle for cross-channel traffic				X
J3 – Information on the site-s access conditions				X
J4 – Guide the truck in the port (Terminal or truck parking)				X

3.2 Interfacing from the road operator platform

3.2.1 interfacing with the R-ITS-S, Vro-ITS-S

- Uplink flow

ID	2432_H-INTERFACING-001
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S
Requirement	The communication to the road operator platform shall made in Datex II v2.3 format.

The Vro-ITS-S will transmit to the road operator platform their position in real time via a Datex II file (see appendix). The frequency of transmitting this file can vary (e.g., from 5 seconds to 10 minutes).

The position of these Vro-ITS-S can be made available in real time from a road operator server if it wants to process this information.

The communication from the Vro-ITS-S must be secured (http or https based on the other levels of security implemented by the road operators). In the case of white zones, no communication can be established.

When the communication is re-established, the stored information will be sent.

- Downlink flow

ID	2432_H-INTERFACING-002
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S
Requirement	The communication from the road operator platform shall made in Datex II v2.3 format.

3.2.2 Interfacing with the Nfr-ITS-S

The communication between the platform and the ITS-S-C will be made by a web service. All sent and received messages are in Datex II format.

- Downlink flow

ID	2432_H-INTERFACING-003
2Component(s)	road operator platform, Nfr-ITS-S

Requirement	Datex II messages shall sent by the road operator platform to the Nfr-ITS-S (messages going to Vru-ITS-S).
Acceptance criteria	Control that all messages destined to R-ITS-S are sent to the Nfr-ITS-S This send appears in the history files.
Additional information	The Nfr-ITS-S shall be configured as an R-ITS-S, without restriction for the location.

- Uplink flow

ID	2432_H-INTERFACING-004
2Component(s)	road operator platform, Nfr-ITS-S
Requirement	Datex II messages shall sent by the road operator platform to the Nfr-ITS-S(messages coming from Vro-ITS-S)
Acceptance criteria	This send appears in the history files.

ID	2432_H-INTERFACING-005
2Component(s)	road operator platform, Nfr-ITS-S
Requirement	Datex II messages shall sent by the Nfr-ITS-S to the road operator platform (messages coming from Vru-ITS-S)
Acceptance criteria	The road operator platform treat the Nfr-ITS-S as R-ITS-S. The message shall appear in the log files.

The specifications of the Nfr-ITS-S are defined in the 2.4.2.4_H

3.2.3 *Interfacing with the TMS*

ID	2432_H-INTERFACING-006
2Component(s)	road operator platform, TMS
Requirement	<u>Downlink flow</u> : Datex II messages shall sent by the TMS to the road operator platform.

ID	2432_H-INTERFACING-007
----	------------------------

2Component(s)	road operator platform, TMS
Requirement	<u>Uplink flow:</u> Datex II messages shall sent by the road operator platform to the TMS

3.3 *List of functionalities for the downlinks: from TMS to V-ITS-S*

3.3.1 *Operating scheme*

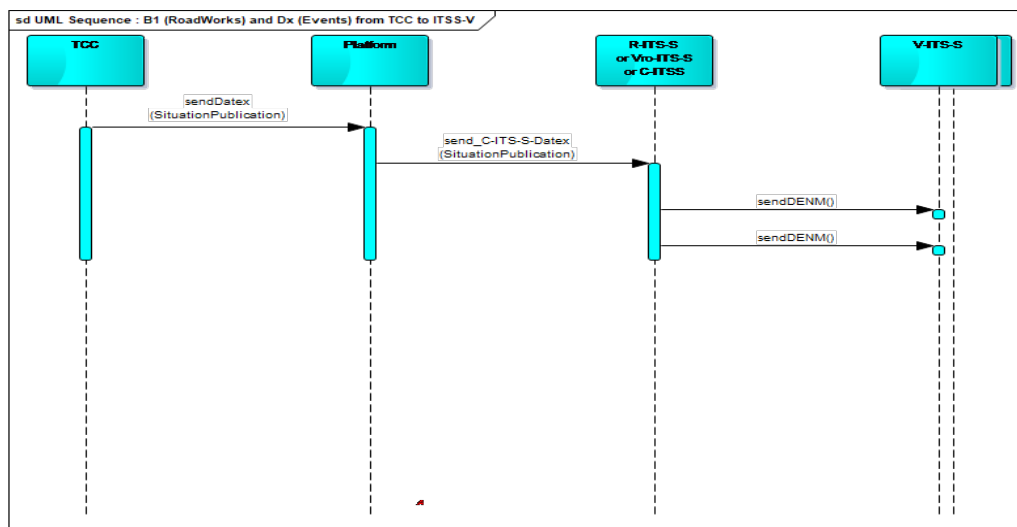
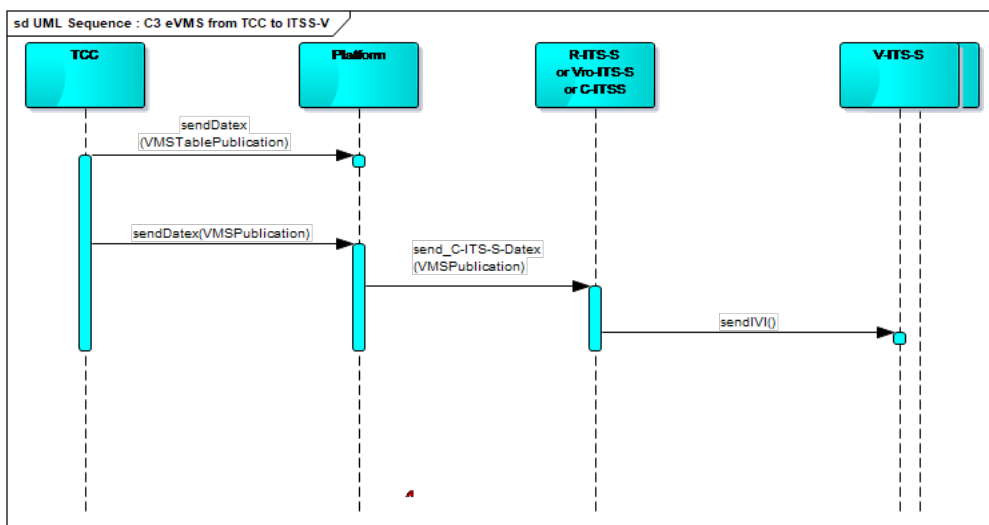
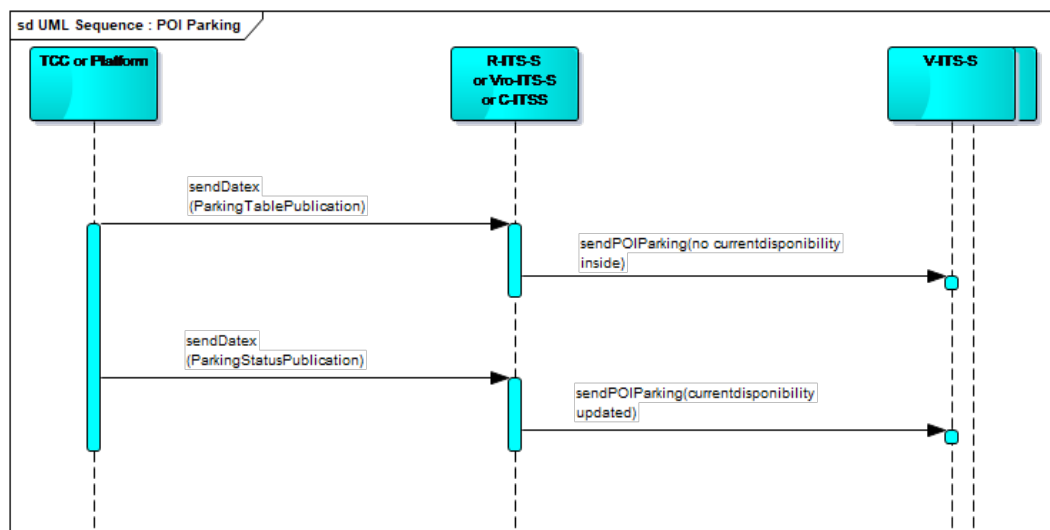


ILLUSTRATION 3: DENM FROM TMS TO V-ITS-S (EXTRACT FROM 2.4.1.4_H)

2.4.3.2_H Detailed functional specifications of Road Operator Platform



The function of the road operator platform is to emit a Datex II message that is fully coherent with the functionalities of the R-ITS-S and the Nfr-ITS-S, especially concerning the location part.



3.3.2 List of use cases concerned: TMS > road operator platform

The use cases below are specified. New use cases will be added later.

Heading: Download C-ITS use case

- B1: Alert - scheduled roadwork (stationary and mobile)
- B1a&B1b: road Work Warning enhanced
- C3: Embedded VMS
- D1: Alert - temporarily slippery road
- D2: Alert - animal or person on the road
- D3: Alert - obstacle on the road
- D4: Alert - stationary vehicles, breakdown
- D5: Alert - unprotected accident area
- D6: Alert - low visibility
- D7: Wrong Way Driving
- D8: Alert - unmanaged obstacle on the road
- D11: Alert - end of queue
- E6 (formerly D9): Alert - exceptional weather conditions
- F1: Information on parking lots location, availability and services

3.3.3 processing of incoming data

New data is processed in 3 steps:

ID	2432_H-DOWNPROCESSINGIN-001
Component(s)	road operator platform
Requirement	the container of message shall be verified, (including xsd structure)
Acceptance criteria	Control the message compliance with Datex II
Additional information	The messages that do not comply with the Datex II v2.3 xml schema shall be rejected.

ID	2432_H-DOWNPROCESSINGIN-002
Component(s)	road operator platform
Requirement	the content shall be verified,
Acceptance criteria	Control that the mandatory and optional attributes are compliant with the deliverable L-2.4.1.4_H
Additional information	mandatory attribute of C-ITS and standard Datex II V.2.3

ID	2432_H-DOWNPROCESSINGIN-003
Component(s)	road operator platform
Requirement	the data should be recorded
Acceptance criteria	Control that the data are stored in the hard disk

The verification will concern the accepted schemas and formats (xml, Datex II v2.3) and the general characteristics of the classes, derivative classes and expected and mandatory attributes (pursuant to the C-ITS deliverables).

A consistency check is carried out on the incoming data, including in particular:

- existence of the transmitter
- structure of the message (cf. 2.4.1.4_H)

- consistency monitoring of the message (cf. 2.4.1.4_H)

Initially the rejected messages will be analysed through logs, at least during the acceptance phase or even during the operating phase. It should be possible to configure the log's level.

Next the incoming data will be entered in the road operator platform's database.

3.3.4 Data processing in the road operator platform

3.3.4.1 preparation for a translation Datex II to IVI message

The road operator platform shall prepare the translation of the Datex II messages in IVI messages for the embedded VMS (C3)

The list of correspondence between the Datex II and IVI messages is listed in the deliverable L_2.4.1.4_H and appendices.

The objective of this step is to complete the messages in Datex II v2.3 before transmitting them to the Nfr-ITS-S or R-ITS-S so they can be translated into IVI for distribution to the V-ITS-S.

ID	2432_H-IVI-001
Component(s)	road operator platform
Requirement	The message shall be completed with geographic coordinates compatible with the IVI format (ETSR89, WGS84).
Additional information	The road operator platform shall have a table to translate the VMS identifier to a XY location. (see chapter 3.3.4.5)

The road operator platform shall be respect the requirements of the document “171215-2412H-0Master-SpecUC-v0.12”, paragraph “2.2 IVI”

The road operator platform shall be respect the requirements of the document “2.4.1.4_H annexe 3_IVI Datex v0.02.ods”

3.3.4.2 preparation for a translation Datex II to DENM message

The list of correspondence between the Datex II and DENM messages is listed in the deliverable L2.4.1.4_H and appendices.

The objective of this step is to complete the event or traffic management messages in Datex II v2.3 before transmitting them to the Nfr-ITS-S or R-ITS-S so they can be translated into DENM for distribution to the V-ITS-S (DENM: Decentralized

Environmental Notification Message).

The road operator platform shall prepare translate of the Datex II messages for DENM messages for use cases

ID	2432_H-DENM-001
Component(s)	road operator platform
Requirement	The message shall completed with geographic coordinates compatible with the DENM format (ETSR89, WGS84).
Additional information	(see chapter 3.3.4.5)

The road operator platform shall be respect the requirements of the document “171215-2412H-0Master-SpecUC-v0.12”, paragraph “2.1 DENM”

The road operator platform shall be respect the requirements of the document “2.4.1.4_H annex1_RSU translation Guide Datex - DENM v0.05.ods”

3.3.4.3 *Geographic projection*

The geopositioning process is described in deliverable 2.4.1.4.

3.3.4.3.1 Location by a point

The message contains a point location defined linearly (also named RP or PLO in French language) or a point identified in ALERT-C

When a Datex II v2.3 message does not contain the location in geographic coordinates, the road operator platform will calculate the projection of the point (e.g., the marker RP or a representation of the road's geometric axis) in geographic coordinates (ETSR 89 close to WGS84).

The message contains the location in geographic coordinates

When the Datex II v2.3 message includes a location in geographic coordinates, these coordinates must be used.

3.3.4.3.2 Location by a linear

The platform will push the orientation of the event toward the R-ITS-S and Nfr-ITS-S

- with the value “aligned”, independently of the orientation given by the TMS (if TMS send aligned or opposed)

- with the value "both" if the TMS send "both"

This values allows the V-ITS-S to interpret the location as being the direction of the traffic.

(there is on the reference table of the RIU a complete direction, aligned for the increased RP and opposite for the decreased RP).

Identification of a linear event on a bi-directional road

The road operator platform will identify the receipt of a linear event on a bi-directional road.

In such case, it will create two events from the initial event with two different identifiers (one for each direction) for the R-ITS-S.

The coordinates of the initial event are not modified.

Only the traces, event history and event position (see 3.2.4.7) are modified, so the vehicles can identify more easily the events that concern them.

Conversion of the lane attribute

The road operator platform will convert the "lane" attribute transmitted by the TMS according to the specification of 2.4.1.4, with the lane number determined based on the geographic repository. The road operator platform will transfer to the R-ITS-S a Datex II message with just the numbered lanes. However, it may receive from the TMS a message using a lane description (and not the expected numbering).

For example, the road operator platform could receive, concerning the middle lane of a bidirectional road: carriageway = mainCarriageway and lane = "middleLane." In this case, it has to transform the message so the R-ITS-S can understand it. If it is a bidirectional road with three lanes, it should transmit the R-ITS-S a message with: carriageway = "mainCarriageway" and lane = "Lane2".

3.3.4.4 Decomposition of messages

ID	2432_H-DECOMPO-001
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S
Requirement	The Datex II v2.3 situations shall be broken down into simple elements.
Acceptance criteria	Control in the history files that a message received with n event is sent in n messages with one element.

In enhanced level, the road operator platform has to properly code the group of event from TMS in consecutive event linked before sending the appropriate Datex II to R-ITS-S.

ID	2432_H-DECOMPO-0002
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S

Requirement	The road operator platform shall add an attribute “relatedsituation” to link two or more linked message (road Work Warning enhanced).
Acceptance criteria	Control that the attribute “relatedsituation “is present in the sent message; Control that each message is linked with the others.

3.3.4.5 Extension Datex II

3.3.4.5.1 Roadtype

The “ roadType” information in the LocationContainer (DENM) isn’t used in generating the Datex II.

So the “roadType” will be managed from a Datex II extension (roadTypeScoopExtension class) defined in 2.4.1.4.

The road operator platform shall verify that the roadtype is properly filled in. The knowledge of network is necessary to verify the roadtype.

ID	2432_H- ROADTYPE-001
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S
Requirement	If this information of roadtype is missing, the road operator platform shall do the processing to extract the road Type information from its geographic repository
Additional information	Bear in mind, this information will then be transmitted by the Vro-ITS-S, R-ITS-S and Nfr-ITS-S in the DENM message.

The road operator platform's processing to define the roadtype will be developed from the RIU type information (repository of the ministry in charge of transportation). Any other repository must be adapted to correspond to this data formatting.

If the data in question are not present natively in each road operator's existing repositories, the road operators must first process the data to integrate the missing data in the repository, if necessary by cross-comparing files and attributes.

The possible values for roadtype are:

- 0: urban: no structural separation with opposite lane
- 1: urban: structural separation with opposite lane
- 2: non urban: no structural separation with opposite lane
- 3: non urban: structural separation with opposite lane

The inability to extract "roadtype" information from a repository will not be blocking: if the necessary information is not present, the road operator platform will not do the

processing and will transmit the Datex message to the Nfr-ITS-S or to R-ITS-S without the information, which consequently will not be transmitted to the V-ITS-S in the DENM.

3.3.4.5.2 Traces

“EventPosition”: Geographical position of the detected even (DENM)

“Traces”: this DF is the location referencing information of “eventPosition” (DENM) (called “zone” in IVI)

ID	2432_H-TRACES-001
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S
Requirement	The road operator platform shall create one (or more) linear of points for an event from a geographic repository to create the trace on roadworks as described in deliverable 2.4.1.4.
Acceptance criteria	Control the new marker in the history file

3.3.4.5.3 Eventhistory

“EventHistory” indicates the list of positions that a plain event has been detected prior to the eventPosition (DENM) (called “revelanceZonelds” in IVI)

ID	2432_H-EVENTHISTORY-001
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S
Requirement	The road operator platform shall create one (or more) linear of points for an event from a geographic repository to create event history on roadworks as described in deliverable 2.4.1.4.
Acceptance criteria	Control the new marker in the history file

3.3.4.5.4 Speed limits

SpeedLimits indicates the speed limitation applied to the roadwork zone (DENM)

ID	2432_H-SPEEDLIMITS-001
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S

Requirement	The road operator platform shall create one (or more) linear of points for an event from a geographic repository to create speed limits on roadworks as described in deliverable 2.4.1.4.
Acceptance criteria	Control the new marker in the history file

These straight lines are added on the road operator platform, which has a geographic repository, so the R-ITS-S can then fill in the mandatory values of the DENM file sent. The generation of these straight lines is specified in deliverable 2.4.1.4.

These straight lines are sent by a point list of X, Y, for the generating trace and the event history.

3.3.4.6 Use cases

The technical specifications will provide for each use case, the content of the Datex II v2.3 message to transmit. This dictionary, presented in the attached deliverable L_2.4.1.4_H with the associated table, can be used to identify the items to complete in the Datex II v2.3 message emitted by the TMS of the different road operators (to be defined based on the Datex II message models supplied by road operators in their use cases).

3.3.4.6.1 B1a&B - road Work Warning enhanced (I2V)

In enhanced level, the local road operator platform has to properly code the group of event from TMS in consecutive event linked before sending the C-ITS- Datex II to V-ITS-S.

ID	2432_H-UC_RWW-001
Component(s)	road operator platform,V-ITS-S
Requirement	If an events are linked, the road operator platform shall use the attributes "relatedSituation", to make the link between each events.

The events can be linked by the attribute "Relatedsituation" (Datex II), which corresponds to the attribute "referenceDenms" (DENM). These linked events, can be received in the same Datex message, or into separate Datex messages, but shall be sent into separate Datex messages

Ex: For a situation decomposed into 4 messages, the road operator platform shall add

for each message Datex II, three attributes « relatedSituation » to the situation

- add three attributes « relatedSituation » to the situation 1: id of situation 2; id of situation 3; id of situation 4
- add three attributes « relatedSituation » to the situation 2: id of situation 1; id of situation 3; id of situation 4
- add three attributes « relatedSituation » to the situation 3: id of situation 1; id of situation 2; id of situation 4
- add three attributes « relatedSituation » to the situation 4: id of situation 1; id of situation 2; id of situation 3

The other elements are the same than for the road work warning basic use case.

ID	2432_H-UC_RWW-002
Component(s)	road operator platform, V-ITS-S
Requirement	Only one event is linear, the other are punctual.

3.3.4.6.2 C3: Embedded VMS

The “VmsPublication” used between the platform and the R-ITS-S is the one from the TMS, completed with the <VmsLocationOverride> which contains the location of the VMS, the relevance zone and the detection zone.

ID	2432_H-UC_eVMS-001
Component(s)	road operator platform; R-ITS-S
Requirement	The platform shall find the location in the “VMSTablePublication”
Acceptance criteria	Control in history file associated to receipt of “VMSTablePublication”
Additional information	thanks to the linked attributes <VmsUnitReference> and <VmsUnitTableReference>.

ID	2432_H-UC_eVMS-002
Component(s)	road operator platform; R-ITS-S

Requirement	The position of the VMS on the road, either real or virtual shall given by the “referencePosition”
Acceptance criteria	The Datex II class associated is “vmsLocationOverride: LocationforDisplay”. Control if the that class exist in the message.
Additional information	Transverse position is in the middle of the carriageway.

ID	2432_H-UC_eVMS-003
Component(s)	road operator platform; R-ITS-S
Requirement	The heading direction of the carriageway concerned by the VMS shall be given by the road operator platform with the attribute “zoneHeading”.
Acceptance criteria	The Datex II class associated is “vmsLocationOverride: LocationforDisplay.bearing”. Control if the that class exist in the message.

ID	2432_H-UC_eVMS-004
Component(s)	road operator platform - R-ITS-S
Requirement	By default, the length of the relevance zone shall be 1 km. This values shall be configurable.
Acceptance criteria	Control the class “externalReferencingSystem” in the sent messages
Additional information	The attribute is “zonelId”

3.3.4.6.3 F1: Information on parking lots location, availability and services

chapter waiting from 2.4.1.2_H and 2.4.1.4_H

3.3.5 *Transmitting a message*

3.3.5.1 *Message identification*

In DENM, each message has a unique ID called “action ID”, based on a station ID and an incremental number.

ID	2432_H-IDENTIFICATION-001
Component(s)	road operator platform
Requirement	DENM message: The road operator platform shall create a unique and configurable station ID in each road operator site independently
Additional information	with a format in compliance with the deliverable L2.4.1.4: full 32-bit in hexadecimal format and completed to the left by 0s.

In IVI, each message has a unique ID

ID	2432_H-IDENTIFICATION-002
Component(s)	road operator platform
Requirement	IVI message: The road operator platform shall create a unique ID, combination of “serviceProviderId” and “IvIdentificationNumber”

This value must be establishment according to the 2.4.1.2.H, §2,2 « serviceProviderId » of IVI messages.

When the R-ITS-S emits a DENM after receiving a Datex II from the road operator platform, it emits its own station ID, but constructs its action ID from the road operator platform's ID (see: L 2.4.1.4)

3.3.5.2 *Message recipients: management of geographic repositories*

ID	2432_H-DOWNTRANSMITTING-001
Component(s)	road operator platform
Requirement	Based on a predefined traffic management policy (configuration and repository), all messages shall be transmitted to the Nfr-ITS-S and some messages shall only be transmitted to R-ITS-S, or Vro-ITS-S.
Acceptance criteria	Control in the history file that some R-ITS-S and Vro-ITS-S are no recipient of the messages
Additional information	the road operator platform knows in real time the position of the Vro-ITS-S

~~Downward, the Nfr-ITS-S, configured like an R-ITS-S, must receive all messages from~~

the platform, without restriction.

To this end, the configuration of the R-ITS-S defines among other things the notion of zone of influence by R-ITS-S. Beyond the R-ITS-S message distribution parameters contained in the message itself (zone of relevance, period of validity of the message, etc.), it is a matter of determining which R-ITS-S will transmit the message to the V-ITS-S. This could be the R-ITS-S present in a radius around the event, configurable based on the type of event, in a predefined zone, on one or more given roads or over an entire region.

ID	2432_H-DOWNTRANSMITTING-002
Component(s)	road operator platform
Requirement	All messages shall be set in XY for sending to R-ITS-S

In all exchanges, the events are located in relation to a repository in XY (ETRS89 or WGS84 specified by the road operator in its configuration), as a reference point (RP) or an Alert-C point.

3.3.5.3 *Synchronisation messages*

ID	2432_H-DOWNTRANSMITTING-003
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S
Requirement	The road operator platform shall also verify that the R-ITS-S, Vro-ITS-S and Nfr-ITS-S acknowledge the message.
Acceptance criteria	Control in history files: equipments are out of order if no acknowledge

The road operator platform acknowledge the messages sent by the TMS.

3.3.6 *Event lifetime*

3.3.6.1 *Update*

- The attribute of the situation record, (called <situationRecordCreationReference> in Datex II) is mandatory. It is created by the original supplier.
- The time of the event observation is mandatory (called <situationRecordObservationTime> in Datex II)
- These two attributes identify the update of event.

3.3.6.2 Snapshots

Beyond the specific transmission of each message, a complete transmission of all valid events will be planned, including in particular:

- when restarting the road operator platform,
- when re-establishing a connection with an R-ITS-S, Vro-ITS-S, Nfr-ITS-S,
- periodically (one to several times per day).

This is the snapshot mode broadcast by the road operator platform, periodically or on demand from the R-ITS-S, Vro-ITS-S, Nfr-ITS-S, corresponding to the Datex II operating mode 2 and 3.

ID	2432_H-EVENTLIFE-001
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S
Requirement	At their request, the R-ITS-S, Vro-ITS-S, Nfr-ITS-S, TMS shall receive snapshots that can be used to reinitialise each R-ITS-S, Vro-ITS-S, Nfr-ITS-S, TMS event tables and to make sure that the event updates are taken into account.
Acceptance criteria	Control in history files that all the events asked with the snapshot are present

ID	2432_H-EVENTLIFE-002
Component(s)	road operator platform, R-ITS-S, Vro-ITS-S, Nfr-ITS-S
Requirement	Pursuant to the Datex norm, the road operator platform shall be able request the snapshots (e.g., in case the road operator platform restarts) from both the TMS (first) and the R-ITS-S, Vro-ITS-S, Nfr-ITS-S, TMS.
Acceptance criteria	After a communication stopped, control that road operator platform send a request of snapshot in log files.

3.3.6.3 Repetition of event messages

Numerous events transmitted by the TMS contain only a state of activity and have no date of the end (e.g accident).

The dates of the beginning and the end for event messages are mandatory in DENM,

ID	2432_H-EVENTLIFE-003
Component(s)	road operator platform, R-ITS-S, Nfr-ITS-S

Requirement	The road operator platform continues to send messages with a frequency dependent of the validity of the use case and until termination of the event.(e.g. from 5 seconds to 10 minutes)
Additional information	It is calculated according to a duration of validity by default defined by case of use. At the approach of the date of the end, the message is resent with a new date of the end, calculated according to the same principle, as long as the event was not updated by the TMS (see L_2.4.1.2_H)

3.3.6.4 *Management of scheduled roadwork*

As soon as the entry of a scheduled event is done in a TMS, it is sent to the road operator platform.

This part deals with futures events cases.

ID	2432_H-EVENTLIFE-004
Component(s)	road operator platform
Requirement	Upon its receipt in the road operator platform, event shall be stored.
Acceptance criteria	Control in the log files
Additional information	These scheduled events can be stored up to 1 year (sliding) of potential scheduling.

the scheduled event lasts less than 24 hours

The event is sent as it is to the Nfr-ITS-S and R-ITS-S, when the date and time of the start of the event are reached, like any other unscheduled event except that the start time is defined in the <overallStartTime> attribute

the scheduled event lasts more than 24 hours -

ID	2432_H-EVENTLIFE-005
Component(s)	road operator platform
Requirement	The event is cut up into events of a maximum length of 24 hours

So constituted, these events are called "sub-parts of the event."

Confirmation of the event:

In case the initial event "initial scheduled event" is updated, the initial file is updated and an update or cancel message for the sub-part of the event underway (potentially

impacted) is sent to the Nfr-ITS-S and R-ITS-S.

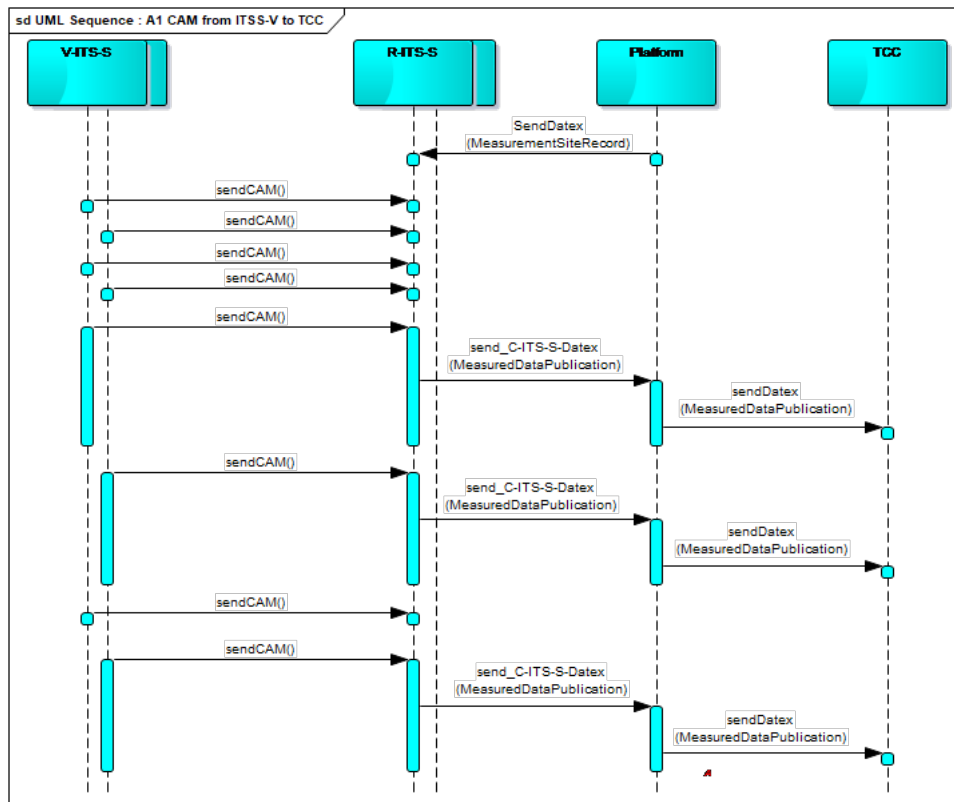
A scheduled event is likely to be confirmed by a road operator a short time before the event starts or when it starts. The confirmation of a scheduled event will make it possible to increase its quality level. Since all road operators do not have the possibility to confirm an event, the road operator will mention whether it wants to activate or not the confirmation (parameter).

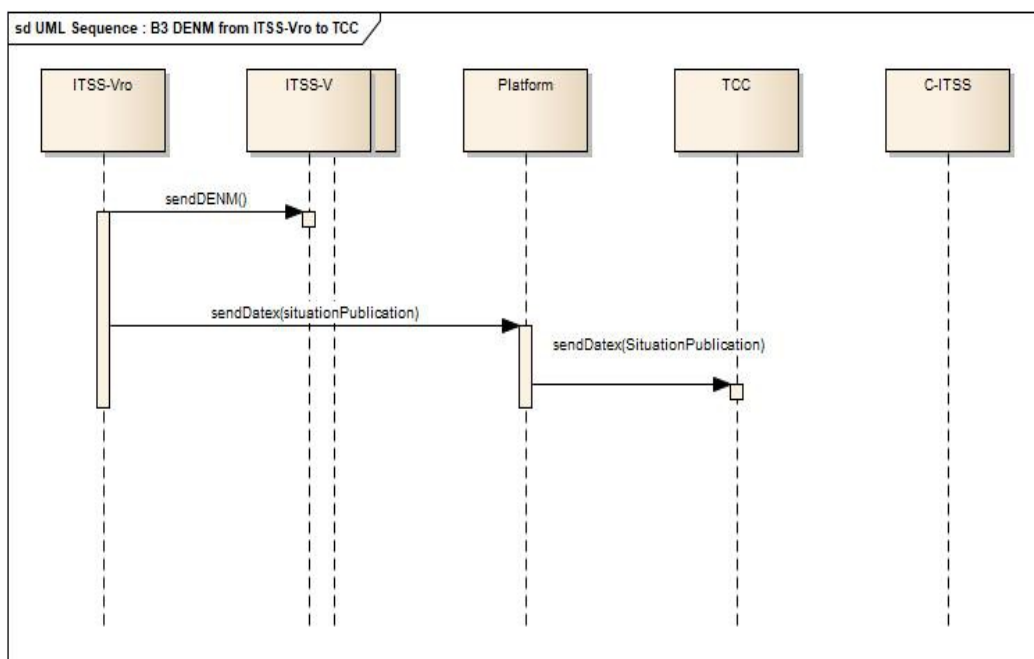
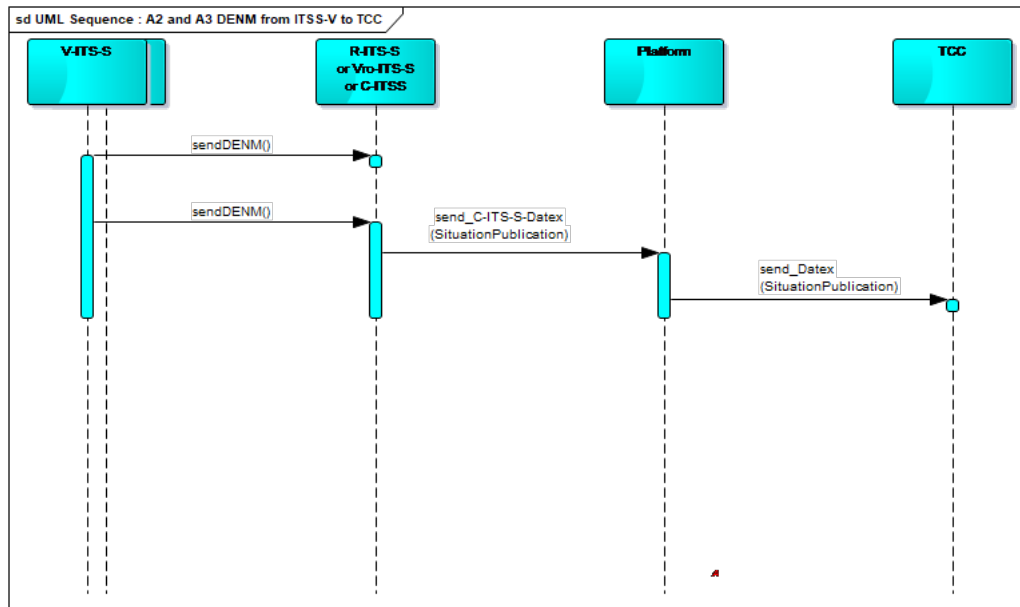
If the quality level in the message is not filled in, it shall be then calculated according to the following rule: see L-2.4.3.2 chapter 3.2.7

3.4 List of functionalities for the uplinks: from V-ITS-S to TMS

3.4.1 Operating scheme

This involves aggregating a set of Datex II events based of type, zone, duration and quality criteria. If these criteria are reached, the road operator platform will transmit a Datex II message to the TMS and to the Nfr-ITS-S.





3.4.2 List of use cases: R-ITS-S > road operator platform

The use cases below are specified. New use cases will be added later.

Uplink C-ITS use cases

A1: Traffic Data

A2-D1: road temporarily slippery

A2-D4a: Stationary vehicle

A2-D4b: Vehicle in breakdown

A2-D5: Vehicle in an accident

A2-D6: Alert low visibility

A2-D11: Alert traffic tailback

A2-E6: Alert - exceptional weather conditions

A3-D2a: Animal on the road

A3-D2b: Person on the road

A3-D3: Obstacle on the road

A3-D5: Unsecured accident zone

A3-D8: Unmanaged obstacle on the road

B2: Alert work on lane (from Vro-ITS-S)

B3: Alert - priority winter road maintenance vehicles (from Vro-ITS-S)

3.4.3 Data processing in the acquisition module

Before being transmitted to the road operator platform, the messages with vehicle data are pre-processed by the Nfr-ITS-S or R-ITS-S. The resulting data, which can be average speed type data, are then transferred by time intervals to the road operator platform in Datex II v2.3 format.

As a reminder,

- the road operator platform receives the incoming data coming from Vro-ITS-S:
 - by the R-ITS-S (communication with ITS G5 between Vro-ITS-S and R-ITS-S)
 - directly with cellular
- the road operator platform receives the incoming data coming from Vru-ITS-S:
 - by the R-ITS-S (communication with ITS G5 between Vru-ITS-S and R-ITS-S)
 - by the Nfr-ITS-S (communication with cellular between Vru-ITS-S and Nfr-ITS-S)

ID	2432_H-UPDATAPROCESS-001
Component(s)	road operator platform
Requirement	The messages received by the road operator platform shall be subject to a verification of the Action ID and the time used by the R-ITS-S to construct the “detectionTime” (data element of DENM) in order to eliminate potential duplicates.
Acceptance criteria	The road operator platform verifies that the couple “ActionID” and “detectionTime” is unique.(in Datex the “detectiontime” is in “ObservationTime” and “ActionID” “in “SituationRecordCreationReference”
Additional information	To this end, the acquisition module will keep all of the ID of messages received for a configurable time interval.

ID	2432_H-UPDATAPROCESS-002
Component(s)	road operator platform
Requirement	The road operator platform shall verify the coherence of the present various dates in the message,
Acceptance criteria	Control in the log files that: "overstarttime" <= "situationrecordfirstsupplier versiontime" <= "situationrecordversiontime"<="overallendtime"

ID	2432_H-UPDATAPROCESS-003
Component(s)	road operator platform
Requirement	The road operator platform shall verify the membership in the network of the administrator of the location of the event
Acceptance criteria	Control that event is on the network in the log files

3.4.4 Data processing on the road operator platform

The list of correspondence between the Datex II v2.3 and DENM messages is listed in the deliverable L2.4.1.4 and appendices.

3.4.4.1 Vehicle data message

ID	2432_H-UPDATAPROCESS-004
Component(s)	road operator platform
Requirement	Speeds may be subject to a statistical treatment, like average, or sampling. The possible treatments for these data will be configurable on the road operator platform.
Acceptance criteria	Control the incoming values with the values calculated.
Additional information	The data will be associated with predefined measurement zones (predefined repository and unique identifier per zone).

ID	2432_H-UPDATAPROCESS-005
Component(s)	road operator platform
Requirement	Based on a configurable time interval, the road operator platform shall transmit a Datex II "MeasuredDataPublication" type publication cumulating all of the measurement zones.
Acceptance criteria	Check that the calculation is done and sent in the log files.
Additional information	see deliverable L_2.4.1.4

The running count will be done on the last data uploaded by the R-ITS-S, Vro-ITS-S or Nfr-ITS-S, excluding the data located outside a configurable time interval (by default 10 minutes) from the instant the road operator platform publishes.

3.4.4.2 *processing of the Datex II event: general provisions*

A message from an uplink Datex II v2.3 is processed in three steps:

Step 1: make sure that the messages are processed corresponding to the same event.

Step 2: locate the aggregated event (associate a position and a direction with it).

Step 3: associate a reliability with it.

For each of them, different parameters will be taken into account.

All Datex II events received by the road operator platform shall not be systematically uploaded to the TMS or to the Nfr-ITS-S. The conditions for uploading to the TMS will be configured based on the types of event.

All events from the R-ITS-S, Nfr-ITS-S or Vro-ITS-S received by the road operator platform are positioned in X,Y and azimuth. They have a level of confidence, determined when the DENM is translated into Datex II using the "ProbabilityOfOccurrence" attribute.

The layout of each road operator network is integrated in the road operator platform's GIS in vectorial form along with its reference points (RP and PLO). This network is geo-referenced.

ID	2432_H-LOG-001
Component(s)	road operator platform
Requirement	The log files shall be used to monitor the operation of the algorithm, aggregations and uploads to the TMS and the Nfr-ITS-S.
Acceptance criteria	Control the presence of the log file
Additional information	A log file will record all movements and all processes carried out.

ID	2432_H-LOG-002
Component(s)	road operator platform
Requirement	Each day and for each equipment, a log file shall be created.
Acceptance criteria	Control the presence of the log file
Additional information	This file will be cut and renamed with the date of the day.

ID	2432_H-LOG-003
Component(s)	road operator platform
Requirement	The events outside the road network manager shall be systematically logged with a specific message.
Acceptance criteria	Control the log files.

3.4.4.3 *Creating and transmitting an event*

- Each Datex II message received by the road operator platform will be stored in a database.
- The road operator platform will verify whether the event is on the road operator's road network (see Locating an event)
- The road operator platform will search whether one or more events of the same type exist already in the database with which it could be aggregated (see Aggregation).

Event activated by Vru-ITS-S

ID	2432_H-UPTRANSMITTING-001
Component(s)	road operator platform
Requirement	If x identical events (from R-ITS-S, Vro-ITS-S or Nfr-ITS-S) are located in a defined zone and in a defined time interval, an aggregation makes it a unique event (called Pfro event in this deliverable) transmitted to the TMS and the Nfr-ITS-S as soon as the transmission conditions are satisfied (type, duration, zone, quality)
Additional information	See chapters 3.3.4.4, 3.3.4.5, 3.3.4.6 of 2.4.3.2

The road operator platform continues to process the events received as long as the aggregation continues, even if a Pfro event was already created from this aggregation. This makes it possible to update the Pfro event resulting from the processing

Systematically, the road operator platform will verify in the pending related events (type, timestamp and geoposition) whether the aggregation lead-time T (type) has not expired for some of them. In this case, the road operator platform will no longer take into account the expired R-ITS-S event(s).

ID	2432_H-UPDATAPROCESS-006
Component(s)	road operator platform
Requirement	If the road operator platform receives a cancellation of an event, the event is noted cancelled and shall no longer taken into account in the aggregation.
Acceptance criteria	Control in the HMI that the event is not taken into account

Event activated by Vro-ITS-S

ID	2432_H-UPTRANSMITTING-002
Component(s)	road operator platform
Requirement	the event shall be uploaded to the TMS and the Nfr-ITS-S at the first occurrence with its quality level (normally Q3).
Acceptance criteria	Control in the log files that all messages received from the Vro-ITS-S are transmitted
Additional information	See chapter 3.3.4.4, 3.3.4.5, 3.3.4.6 of 2.4.3.2

An update of the initial event (the road operator vehicle will transmit the updates of its ~~location or the event's location~~) will result in an update being uploaded to the TMS and

the Nfr-ITS-S(case provided for in Datex II format). The cancellation or end of the event by the Vro-ITS-S will result in the transmission to the TMS and the Nfr-ITS-S of a cancellation or end of event message.

If a second road operator vehicle transmits the same event nearby, since there is no aggregation, they will be managed as two separate events and will be regularly updated to the TMS and the Nfr-ITS-S.

ID	2432_H-UPTRANSMITTING-003
Component(s)	road operator platform
Requirement	In the case of "SOS" messages sent directly from the Vro-ITS-S to the road operator platform, it should be possible to transfer a Datex2 message, depending on the TMS.
Additional information	This upload will be configurable.

3.4.4.4 Updating event previously uploaded to TMS and Nfr-ITS-S

- In the case of a new version related to a type A2 or A3 pending event already uploaded by a Pfro event, the new version is only uploaded if the following conditions are satisfied:
 - the new quality level is greater than the level already uploaded to the TMS (Q2 for Q1 previously uploaded, Q3 for Q2 or Q1 previously uploaded): a new version of the event is then recorded.
 - If the quality level was Q3, the event is not updated.

ID	2432_H-UPDATAPROCESS-008
Component(s)	road operator platform
Requirement	New version of A2 or A3 event: the new version shall be only taken into account if the new quality level is greater than the level already uploaded to the TMS
Additional information	There is no update transmitted to the TMS where only the location has changed. This is true for use cases A2 and A3, except if the message is send by an Vro-ITS-S.

3.4.4.5 Location of an event

Location in RP+abscissa

The algorithm seeks all segments or parts of the network located less than a distance Dr from the event and whose azimuth (or the tangent) is compatible with the event (i.e., the same orientation, or opposite orientation if the event is not oriented) in a range of

compatibility Alpha (defined in degrees and configurable).

- If there is only one segment or one compatible axis, the location on the network is deduced in X_r , Y_r , Axis, Direction (Right or Left or Indefinite) and $RP+Abscissa$ (curvilinear abscissa) by orthogonal projection
- If several segment or axis candidates are possible, the location and XY aggregation must be used.(see 3.3.4.6)
- If no portion of the network is found, the event is not kept.

If the event is localised by X,Y , the procedure of location in XY is applied.

Location in X,Y (on vectorial map)

The algorithm seeks all segments or parts of the network located less than a distance D_r from the event and whose azimuth or the tangent is compatible with the event (i.e., the same orientation, or opposite orientation if the event is not oriented) in a range of compatibility Alpha (defined in degrees).

- Only the closest is kept and the position on the segment is calculated by projection of the X,Y point. The location is deduced on the network in X_r , Y_r and Axis.
- If no portion of the network is found, the event is not kept.

ID	2432_H-LOCATION-001
Component(s)	road operator platform
Requirement	Each localizable event shall be located according to the algorithm above.

3.4.4.6 *Aggregation by locator*

To check whether the events should be aggregated, the algorithm checks whether the Axis and Direction are identical. Then it compares the location of the new event in the current "situation."

Control by RP

An aggregation is related to x incoming events positioned as $RP+abscissa$. The algorithm checks that the same axes and directions are used. If this is not the case, X,Y control is used. Then the algorithm checks the RP position of the new event vis-a-vis other events (compared to the minimum and maximum of events' RP).

- If it is included between the minimum RP and maximum RP of events, the new event is aggregated with the others.
- Otherwise, the algorithm looks at the minimum variance between the position of the new event and the most remote event.
- ~~If this distance is less than twice the aggregation distance $D_a(\text{type})$, then the~~

event is aggregated. Since this distance is considered as a radius, 2 events located at the outside of the diameter are aggregated, hence the comparison to $2D_a$.

- Otherwise, we consider that it is a new event.

Control by X,Y (the sections with just a road name and the network layout. We use the algorithm of the minimum rectangle).

A new incoming event of X,Y coordinates of the same type is compared with an aggregation located in X_o, Y_o (provisional centre of the minimum rectangle of related events).

Initially, the algorithm checks whether the distance to a pending event is less than 2 times the aggregation distance of the type:

distance of (X,Y) to $(X_o, Y_o) \leq 2 \times D_a(\text{type})$

- If not, it is a new event.
- If yes, we calculate the new provisional centre of the minimum rectangle:
 - $X'o = 1/2 [\min (X_o, X) , \max (X_o, X)]$
 - $Y'o = 1/2 [\min (Y_o, Y) , \max (Y_o, Y)]$

then we check that all the points are in the circle of the $X'o, Y'o$ circle and the $D_a(\text{type})$ radius.

If this is the case, then the new event is associated with the current situation.

When the aggregation conditions are satisfied (especially when the aggregation threshold is reached), the event should be located (see 3.3.4.7)

ID	2432_H-AGGREGATION-001
Component(s)	road operator platform
Requirement	Each event that can be aggregated shall be aggregated according to the algorithm above.

3.4.4.7 Locating aggregated events

Location in RP

An aggregation is related to x incoming events positioned as RP+abscissa.

The algorithm will use a location mode configured by use case and thus by type of event to define which point will be kept among the 4 possibilities:

- 1 the earliest point (if the use case is oriented)

- 2 the latest point (if the use case is oriented)
- 3 the average point
- 4 the median point

An incoming event is positioned in X,Y and Azimuth. Depending on the type of event, we can distinguish the direction of traffic flow (i.e., 2 close declarations but made in 2 distinct directions are considered as 2 distinct events, provided that the associated road network is a carriageway with separated lanes (CSL).

Example 1: A2-D5 Vehicle in an accident is an oriented event. It is the vehicle itself that is in an accident and its orientation gives us the direction of traffic flow (provided that the network in this place is CSL type).

Example 2: A3-D5 Accident is not oriented. The manual declaration could concern the opposite direction of traffic flow (even on CSL). In this case, 2 close declarations are considered as the same event.

An "oriented event" parameter will be defined for each type of event and make it possible to take into account (or not) the orientation in the location and aggregation algorithm.

Location in X,Y

The position of the event is the projection of the centre of the smallest rectangle that contains all the points on the segments of the network:

$$X_o = 1/2 [\min (X_1, \dots, X_n) , \max (X_1, \dots, X_n)]$$

$$Y_o = 1/2 [\min (Y_1, \dots, Y_n) , \max (Y_1, \dots, Y_n)]$$

Point X_r, Y_r is obtained by projection of the X_o, Y_o point on the segments of the network.

ID	2432_H-LOCAGGREGATION-001
Component(s)	road operator platform
Requirement	Each aggregated event shall be located according to the algorithm above.

3.4.4.8 Condition of generating the aggregated message

The variables of the event included in the message are associated with the type of event (each type has its set of parameters).

Thus we have 2 types of producer: User or Road operator (in principle the user cannot upload the B cases or the AxB cases mentioned).

Level of confidence condition

We attribute a weight to each level of quality: $Q1 \rightarrow k1$, $Q2 \rightarrow k2$, $Q3 \rightarrow k3$ and we set a minimum confidence level Sq (for each type of event).

We calculate the weighted level of confidence:

$$Qp = k1 \cdot N_{messagesQ1} + k2 \cdot N_{messagesQ2} + k3 \cdot N_{messagesQ3}$$

The upload condition is reached if the threshold is reached ($Qp \geq Sq$).

To define the weighting values and the threshold of confidence, we can reason based on the number of events received.

The algorithm used the two conditions separately (equivalent to an "OR"):

- If the message is emitted by a road operator vehicle, the event is uploaded,
- If the level of confidence condition is satisfied, the event is uploaded.

If several points are to be aggregated, the aggregated event is the point with the highest quality and the aggregated position is the one of the event with the highest quality

3.4.4.9 Recap of the parameters taken into account in the algorithm

Type of network repository: $RP+abs$ or geographical coordinates

By type of event:

Type A algorithm (road operator without aggregation)

Oriented event (Y/N)

If yes: Type of location aggregated = Upstream, Downstream, Middle, Median

Dr = maximum acceptable distance of an event on the road network

α = maximum angle between the azimuth of the event and the network segment

Da = maximum radius for the aggregation of events

T = lead-time taken into account for the aggregation of events

$K1$ = relative weight of the $Q1$ level

$K2$ = relative weight of the $Q2$ level

$K3$ = relative weight of the $Q3$ level

Sq = minimum threshold of the weighted level of confidence

Dr , α , Da and Sq depend on the type of event and the type of network.

3.4.5 processing and calculation modules

The functions common to several modules (calculation of coordinates, processing, etc.) will be developed as independent modules, which will be used by the different modules corresponding to the use cases.

3.5 HMI

ID	2432_H-HMI-001
Component(s)	road operator platform
Requirement	The road operator platform shall include a set of information from the TMS, R-ITS-S, the Nfr-ITS-S, Vru-ITS-S and Vro-ITS-S. These informations shall be able filtered.
Acceptance criteria	Check on display HMI
Additional information	<ul style="list-style-type: none"> the events received (excluding duplicates), the situations that are in preparation to transmit potential events to the TMS, when the upload conditions are satisfactory. At this level an event can be an aggregation of several events of the same type. the events transmitted to the TMS or the Nfr-ITS-S.

ID	2432_H-HMI-002
Component(s)	road operator platform,
Requirement	The road operator platform shall display in real time <ul style="list-style-type: none"> web pages the information (event, R-ITS-S position) it has collected the operating status of the Vro-ITS-S, the TMS, and R-ITS-S
Acceptance criteria	Check on display HMI

In no case should the application allow Vro-ITS-S to be located.

This way the user can have access to the road operator platform's known ongoing events, traffic data, the status of operation of the R-ITS-S, Vro-ITS-S, etc.

These different data can be subject to differentiated displays via filters (transmitter, ID, date of creation, validity, number of version, type, source, status, RP + abs, etc.). The information will be presented in a list (browser type) or graphical form using the road network's repository on a map background.

A specific web page will make it possible to replay and display in browser mode (and mapping mode if possible) former situations that will be loaded from the archive database with these same filters.

3.6 Support functionalities

3.6.1 Authentication

ID	2432_H-AUTHENTICATION-001
Component(s)	road operator platform
Requirement	The road operator platform's configuration, management and monitoring shall be managed by a web interface and configuration files.

Access to the road operator platform and web services will be authenticated.

ID	2432_H-AUTHENTICATION-002
Component(s)	road operator platform
Requirement	The transports ministry authentication tool called “Cerbère” (which is a personal secure authentication for one use session) shall be usable for this authentication.
Additional information	“Cerbère” offers a standardised procedure that ensures secured and controlled accesses to data and programs on the RIE Intranet, ADER inter-ministerial and Internet networks. This generic system makes it possible to manage the authentication of users (internal or external) accessing an application site and the access rights to the different modules of an application. This standard procedure can be used to ensure the homogeneity and reduce the costs of security developments in the applications. See Cerbere guide

For the non-ministry sites, other solutions will be implemented: It can be possible to use “Cerbère” in dongle mode (with a local management of rights and RPofiles).

ID	2432-AUTHENTICATION-003
Component(s)	road operator platform

Requirement	the road operator platform shall be able to work with an authentication tool chosen by the site manager, which will interface with the road operator platform (e.g., LDAP authentication server).
-------------	---

ID	2432-AUTHENTICATION-004
Component(s)	road operator platform
Requirement	Access to the road operator platform through the HMI (web pages) shall be differentiated according to several profiles (administrators, road operators, etc.), where each profile can be configured by the site administrator via the administrator profile.

3.6.2 Other internal road operator platform MODULES

In administration mode, the application should provide monitoring modules specific to the road operator platform as well as backup, restoration, purge and automatic and manual archiving modules for the database. The road operator platform's logs will also be archived.

ID	2432_H-ADDMODULES-001
Component(s)	road operator platform
Requirement	The backup procedure shall differentiate the repository and monitoring parts from the events and messages part. An automatic backup procedure with different time intervals will be developed.
Acceptance criteria	The configuration shall be saved automatically
Additional information	The partial or total restoration will be done manually from the backups.

ID	2432_H-ADDMODULES-002
Component(s)	road operator platform
Requirement	The archiving module shall integrate a configured purge system, which will clean the database of elements past the retention time defined for archiving.

ID	2432_H-ADDMODULES-003
Component(s)	road operator platform

Requirement	The archiving database and the logs should make it possible to replay prior situations and to diagnose the problems encountered.
-------------	--

3.6.3 Configuration repository

ID	2432_H-ADDMODULES-004
Component(s)	road operator platform
Requirement	The parametrizable values of all functionalities shall do on the HMI.

A specific module shall be used to define in a database the different distribution and archiving parameters predefined by the road operator: priority, zone of influence, zone of distribution and length of validity.

This module will also be able to define the types of processes implemented: sampling, aggregation, average, etc.

The road operator platform will be delivered with default parameters.

3.6.4 Geographic repository

The objective of the repository is to describe cartographically and alphanumerically certain functional characteristics of the road network and the R-ITS-S equipment on it.

This repository shall be used in particular to calculate all of the necessary coordinates for the content of messages as well as to define the R-ITS-S' zones of influence.

A vectorial cartographic repository will be integrated in the road operator platform, including the network and reference points (PLO, RP) in a shape format.

It may also be possible to export the road operator platform's vectorial repository in a standard GIS format (e.g., SHP), in ETRS89 or WGS84 at the road operator's choice, to modify it with an external GIS tool, then to reimport it in the road operator platform with the modifications.

3.6.5 Monitoring module

All of the items used to monitor the system (servers, R-ITS-S status, Vro-ITS-S status, connections) shall be put in a database and accessible via the monitoring module.

The status of the R-ITS-S and Vro-ITS-S equipment shall be displayed on the cartographic HMI and browser via a colour code (green, orange, red and grey), function of the equipment status (nominal, minor error or major error or disconnected) and function of the returns on keepalive and data from the R-ITS-S servers.

~~For the Vro-ITS-S, the on-screen location must be configurable and independent of the~~

actual location.

A warning message should exist when the communication with the Nfr-ITS-S is cut off.

3.6.6 Archiving

The purpose of these archived data is to be processed in batch mode to evaluate a project independently of the road operator platform.

3.6.7 Logging module

ID	2432_H-ADDMODULES-005
Component(s)	road operator platform
Requirement	It shall be possible to independently log each process based on 4 trail levels (error, warning, info and debugging).
Acceptance criteria	It shall be possible to set log levels on the HMI

3.7 Synthesis of main functionalities of the road operator platform

<u>Main functionalities</u>	<u>precision</u>
Visualize R-ITS-S	
Visualize event	
Management of R-ITS-S	
Management of TMS	
Management of users	
Management of logs	Configurable levels
Management of geographical reference table	
Initialisation road operator platform	
Receive a Datex II message	Acquittal of a received message
Oversee equipments	Sending or reception keepalive
Equipments status	Sending or reception snapshot
Message from TMS:preparation for a	

translation Datex II to IVI message	
Message from TMS: preparation for a translation Datex II to DENM message	
Treat a message coming from R-ITS-S or Nfr-ITS-S or Vro-ITS-S	<ol style="list-style-type: none"> 1. Store received message 2. Verify SOAP 3. delete envelope SOAP 4. Verify XSD 5. Verify event 6. Verify if A1 message or event message 7. Cut the message on unique event 8. Verify the consistency of the Datex II format 9. Verify double 10. Decode message 11. Record event 12. Control of the dates 13. Convert location 14. Verify location on the network 15. Update status 16. Save event after treatment 17. Aggregating events in message 18. Integrate contents A1 19. Send messages to the TMS
Treat a message coming from TMS	<ol style="list-style-type: none"> 1. Store received message 2. Verify SOAP 3. delete envelope SOAP 4. Verify XSD 5. Verify event 6. Cut the message on unique event 7. Verify the coherence of the Datex II format 8. Verify if event is bidirectional 9. Duplicate event, one by direction

	<ul style="list-style-type: none"> 10. Verify double 11. Decode message 12. Record event 13. Control of the dates 14. Add situationRecordCreationReference 15. Convert location (XY) 16. Verify location on the network 17. Modify nature 18. Create a unique ID 18. Generate traces and eventhistory 19. Update status 20. Save event after treatment 21. Choice the R-ITSS for sending 22. Send messages to the R-ITS-S, Vro-ITS-S and Nfr-ITS-S •
Send a message	

3.8