



French C-ITS Deployment Coordination committee

LTE/ITS-G5 hybrid architecture – French National Central ITS Station specifications

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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
C-ITS-S	Central ITS Station
CTLM	Centralized traffic light management system
DENM	Decentralized Environmental Notification
DSMIP	Dual Stack Mobile IP
ETA	Estimated Time Arrival
ITS	Intelligent Transport System
ITS-G5	Adaptation of the IEEE 802.11p (wifi)
IVI	In Vehicle Information
MCTO	Multimodal Cargo Transport Optimization
NAP-SER	National Application Server (smartphone application)
Nfr-ITS-S	French National Central ITS Station
Nx-ITS-S	Foreign National Central ITS Station
PFro	Road operator's platform
PFcm	Car manufacturer's platform
POI	Point of Interest
R-ITS-S	Roadside ITS Station
SPaT	Signal Phase and Timing
TMS	Traffic Management System
TCC	Traffic Control Center
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
V2X	V2V or/and V2I
V-ITS-S	Vehicle ITS Station
Vro-ITS-S	Road Operator Vehicle ITS Station
Vu-ITS-S	User Vehicle ITS Station

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1 Presentation of the document

1.1 Introduction

The present document introduces the specifications of the French National Central ITS Station (Nfr-ITS-S) to be deployed for the COCSIC including the 3 projects: SCOOP@F wave 2, InterCor and C-Roads France.

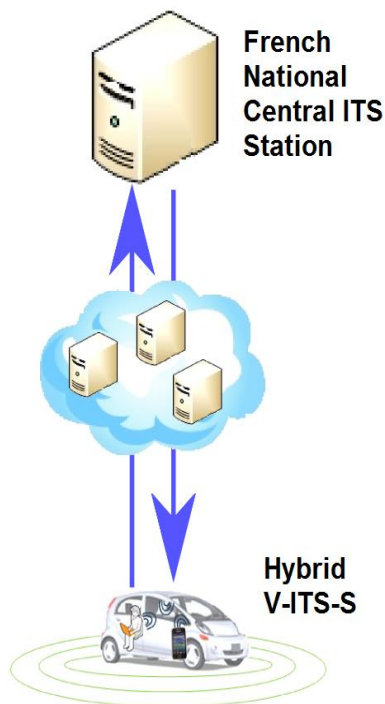


Figure 1. Connection between the French National Central ITS Station and hybrid

This deliverable describes a solution using an internet connection from vehicle (V-ITS-S) through internet. Previous projects are based on ITS-G5 communications. This communication mode will still be available. The present solution addresses the two communication modes : ITS-G5 and cellular.

The main advantage of the hybrid architecture is the wide geographical communication coverage.

The Nfr-ITS-S is the node of connection for cellular communications with V-ITS-S and with national servers and foreign countries through Internet links.

1.2 Objectives of the document and summary

The overall objective of this document is to present and describe the operating guidelines and main functions of the Nfr-ITS-S.

The document 2.4.1_H “LTE/ITS-G5 hybrid architecture - Common specifications” describes the global architecture of the COCSIC (including SCOOP) system and the specifications of the interface between each system.

Security specifications are not included in this deliverable. They are described in the deliverable [6] 2.4.4.11_H.

The Nfr-ITS-S consists of 3 main functions (cf. chapter 3):

1. receiving the message
2. processing the message
3. disseminating the message

To ensure the efficient functioning of these main functions, it is necessary to describe the associated mechanisms in the French and European architecture.

The specifications described in this document take into consideration several parallel projects, including InterCor and C-Roads France.

After a presentation of the global architecture, there is a description of the services and functions. The last part of the document concerns some examples of process.

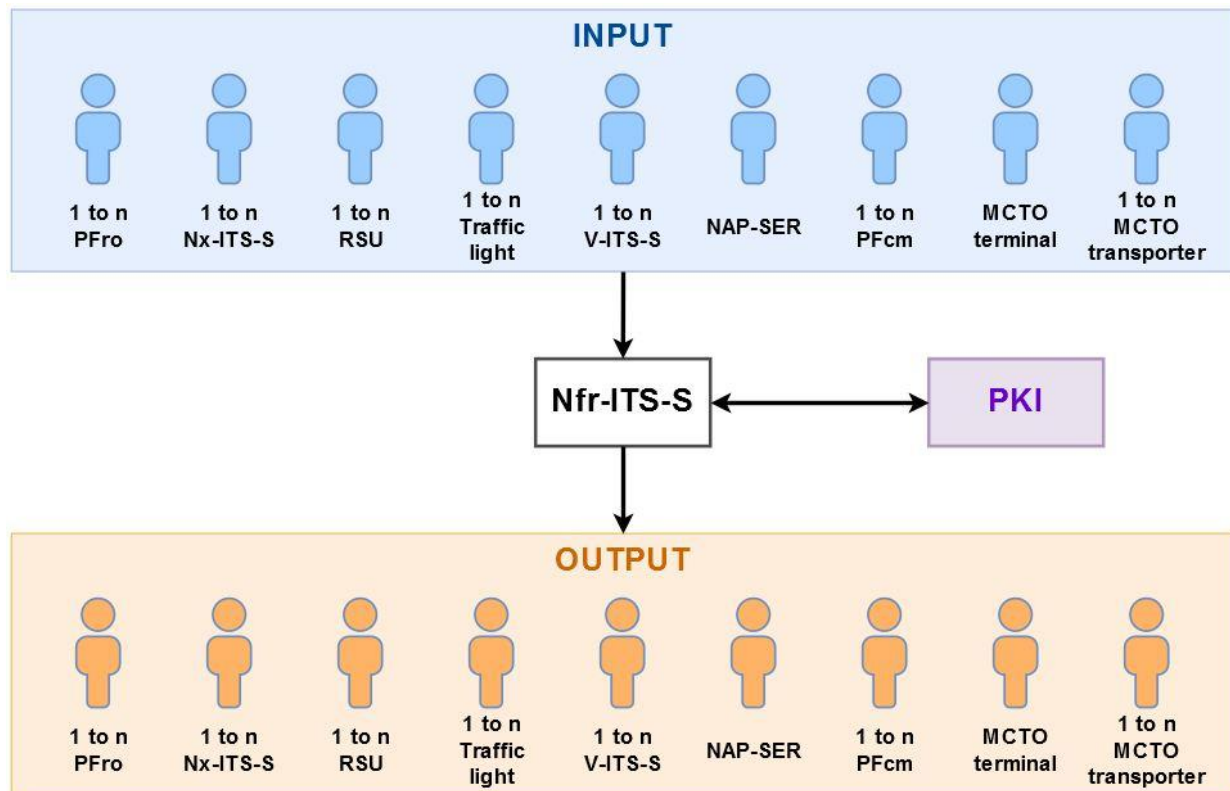


Figure 2. General presentation of the usage of the Nfr-ITS-S

2 Global architecture

The global architecture is composed of V-ITS-S, R-ITS-S, road operator's platform, car manufacturer's platform and servers (Nx-ITS-S, NAP-SER, MCTO transporter and MCTO terminal, Centralized traffic light management system(CTLM)).

The Nfr-ITS-S manages the messages exchanged between each component.

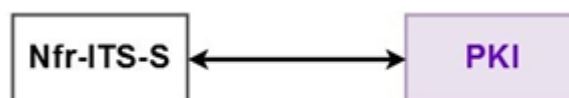


Figure 3. PKI server connection overview

A PKI server connection is implemented to ensure the security's needs of Nfr-ITS-S and it is a necessary element for the good functioning of the system.

For security concerns, the Nfr-ITS-S is part of the trust domain and it is enrolled in the ITS trust domain as all other ITS-S, perform verification of messages and sign outgoing ITS messages. It may communicate with PKI servers to request pseudonym certificates to be used to sign generated ITS messages or use pre-installed certificates and to manage certificates, CRL and TSL.

2.1 Description

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

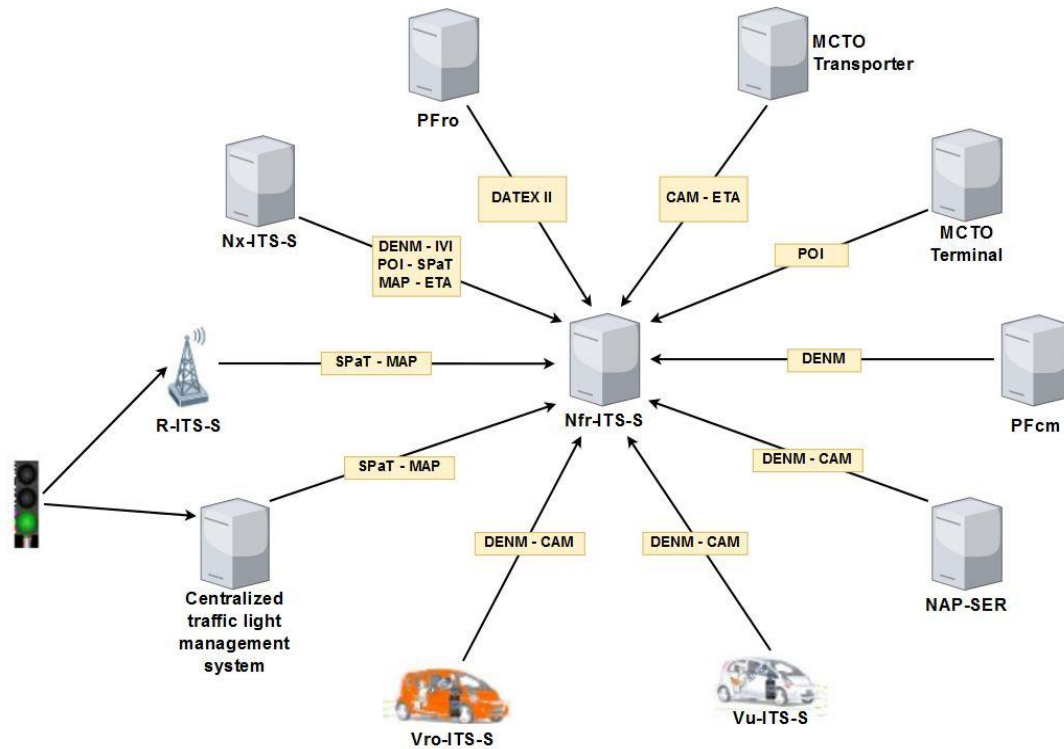


Figure 4. Messages received by the Nfr-ITS-S

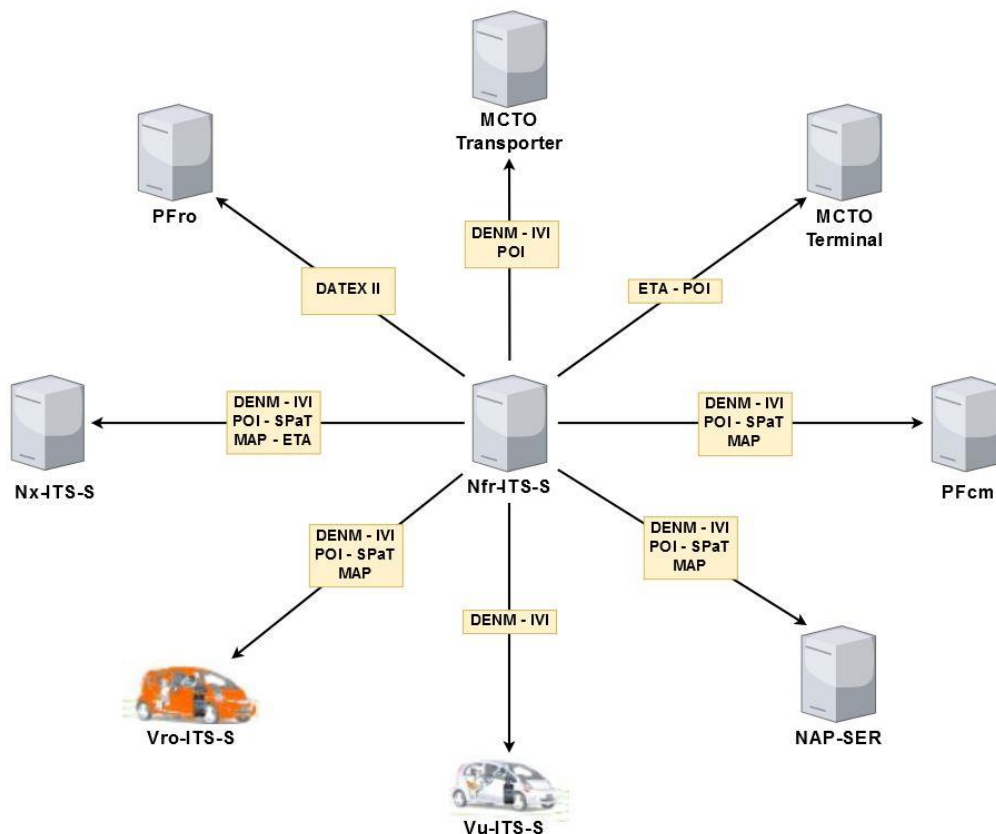


Figure 5. Messages sent by the Nfr-ITS-S

The data exchange with Nx-ITS-S is described in the chapter 3.4 . It enables interoperability at European scale.

Some V-ITS-S are directly connected to the PFcm and exchange messages with it. This link and these exchanges are not described in this deliverable.

2.2 Modules specification

The main functions of the Nfr-ITS-S are:

- Reception:
 - Authentication
 - Reception
 - validity check
- Processing:
 - Aggregation
 - Duplication check
 - translation and storage of messages
- Dissemination:
 - Forwards messages to relevant destinations
 - Add security features to DENM and IVI messages

From the road operator point of view, the Nfr-ITS-S can be considered as a national Road Side Unit for ITS-S which exchanges messages.

Each module is composed of functions as described in the following figure.

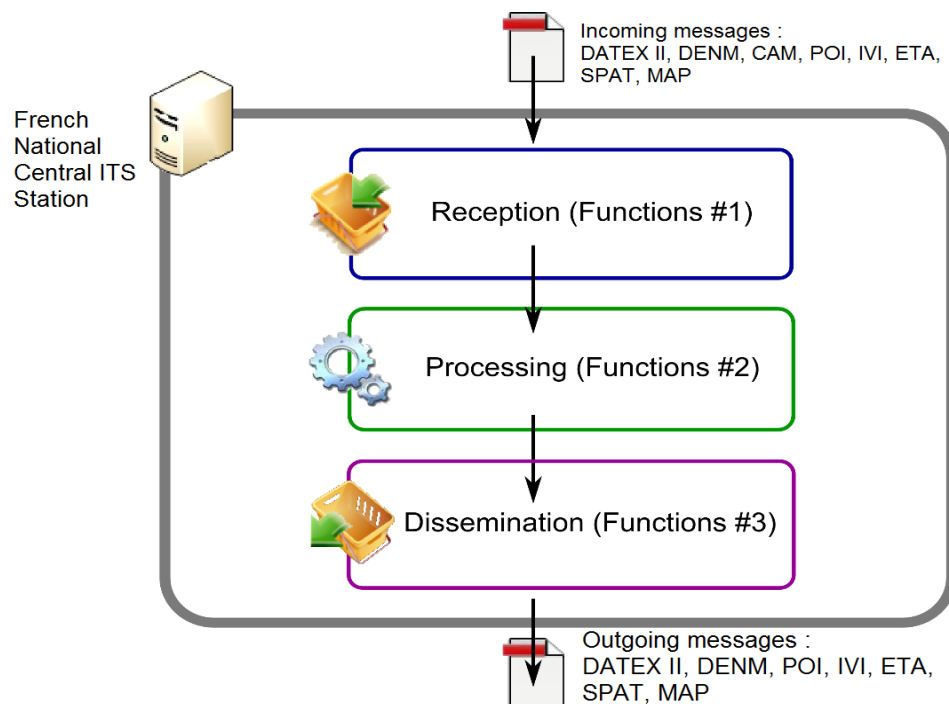


Figure 6. Main functions of the French National Central ITS Station

2.3 Services of the French National Central ITS Station

The Nfr-ITS-S plays a key role in COCSIC project to the overall SCOOP wave 2, C-Roads France and InterCor functional architecture. It is the central component that makes available to its authorized users (V-ITS-S, PFro, PFcm, NAP-SER and Nx-ITS-S), services for geo-referenced information about local Road Hazardous situations, surrounding traffic and weather conditions.

The Nfr-ITS-S is a web-based platform, able to translate and forward relevant information to the appropriate V-ITS-S. The exchanged information relies on the standardized messages, namely, CAM, DENM, DATEX, IVI, SPaT, MAP, POI, ETA and potentially other types of messages (SRM, SAM, ...).

Through the usage of cellular technology in conjunction with a central server, the Nfr-ITS-S interacts with heterogeneous road traffic entities in order to disseminate to road-users (V-ITS-S) useful and relevant information related to their local road environment. Consequently, the Nfr-ITS-S collects and centralizes the Road Environment conditions from several ITS entities, processes the information and distributes it to the appropriate V-ITS-S or other entity.

In the context of COCSIC projects with several V-ITS-S distributed over a large geographical area, the Nfr-ITS-S provides a centralized service that enhances ITS-G5 information availability (based on direct communication between ITS-S) through an additional communication vector: the cellular access technology. Thus, V-ITS-S can have access to road operators and Traffic Management Systems information even if they are not in the range of R-ITS-S.

The Nfr-ITS-S provides a set of services, which are broken down into five main blocks:

- Nfr-ITS-S Access and Authentication service (Authorization profiles definition)
- Road information services
- Nfr-ITS-S Management Service
- Traffic Efficiency Data Aggregation
- Exchange information service in France and in foreign countries

2.3.1 Nfr-ITS-S Access and Authentication Service

2.3.1.1 Authentication service

In order to prevent access to unauthorized entities, the Nfr-ITS-S provides a security service, which ensures the authentication of each communicating entity but also the authenticity of data origin. The Authentication service aims at providing the assurance that the communicating entity is the one that it claims to be. For that, it needs two levels of authentication:

- Data origin Authentication: Used to provide assurance that the source of received data is as claimed.
- Peer entity Authentication: Used to provide confidence in the identity of the entities connected.

2.3.1.2 Access and Authorization service

The Nfr-ITS-S provides an access control service, which prevents unauthorized use of the Nfr-ITS-S resources. This service controls who can have access to a specific resource or service, under what conditions access can occur, and what those accessing the service or resource are.

In the context of COCSIC projects, for each entity communicating with the Nfr-ITS-S, a security service profile is defined to ensure a high level of Access and Authorization control. Two levels of access are needed: Peer Entity Access Control and Data Authorization Control.

2 levels of Access could be identified:

- Management Service Access: It is specific access provided to the Nfr-ITS-S operators that have the responsibility to manage, monitor and maintain the services provided by the Nfr-ITS-S, see chapter 5.2 .
- Non-Restricted Service Access: This user access provides full access to the Road information services to the authorized entities without any service restriction (e.g. tile subscription).

2.3.1.3 Nfr-ITS-S Communication Confidentiality

The Nfr-ITS-S undertakes measures to ensure the confidentiality of data exchanges with the remote entities. This service prevents data to reach wrong people, while making sure that only right entities in COCSIC projects (including SCOOP wave 2) can get access to the exchanged Road Information data. The Nfr-ITS-S through the underlying communication architecture defined in 2.4.1_H might provide this service.

2.3.1.4 Nfr-ITS-S data Integrity

This service involves data integrity, from the time the ITS data has been produced by the ITS entity involved in COCSIC projects (including SCOOP wave 2) until its consumption by the authorized peer entity passing through the secured underlying communication interface. Same as in 2.3.1.3, this service might be provided through the communication interface or by the ITS messaging protocol.

2.3.2 Road Information Services

Road Information Services is the core service provided by the Nfr-ITS-S. It is the service block in charge of the collection, verification, processing, filtering and distribution of the relevant ITS Data to the identified and connected entities namely, V-ITS-S, Car manufacturer's platform, PFro, Traffic Management Center and foreign 3rd party platform.

2.3.2.1 ITS Data Collection Service

Road Information service delivery relies on the ITS Data Collection service block. The Nfr-ITS-S is in charge of ITS Data Collection.

The entities involved in the communication with the Nfr-ITS-S, exchange standardized ITS messages namely DENM, CAM, DATEX II, IVI and possibly other messages through a specific messaging protocol which is not necessarily the same for all the entities involved in COCSIC projects: SCOOP wave 2, C-Roads France and InterCor (refer to 2.4.1_H).

For some specific entities, upon reception of ITS data the Nfr-ITS-S **might** provide additional services such as data verification in order to check the message authenticity, message integrity and potentially proceed when required, with additional tasks for plausibility check.

2.3.2.2 ITS data processing

ITS data processing service could be necessary for entities involved in the projects eco-system. It may involve various processes, including ITS message translation, storage and indexing. Upon collection of ITS data, additional processing might be required.

For instance, V-ITS-S exchanging ITS data directly with the Nfr-ITS-S, geographical assignment of messages and V-ITS-S geographical localization might be required in order to ensure the correct filtering and message delivery when relevant.

2.3.2.3 ITS Data delivery

In accordance with the specificity of each entity, the Nfr-ITS-S provides ITS data delivery service based on two types of filtering criteria.

These criteria are defined either by peer entities or by the Nfr-ITS-S itself. Thus, the Nfr-ITS-S is in charge of defining and executing the filtering criteria, which are of two types: Geographical criteria or message typology criteria.

2.3.3 Nfr-ITS-S Management Service

With regard to the services provided, the Nfr-ITS-S represents the heartbeat of the hybrid architecture. Counting on its correct and efficient operation is a **shall** have. For that, the Nfr-ITS-S provides several support services:

- **Management service:** to keep the system running at the optimal level and to perform updates when needed.
- **Monitoring service:** to ensure the availability of the Nfr-ITS-S. A monitoring service is provided, if any of the Nfr-ITS-S services go down.
- **Logging service:** this service allows troubleshooting on the Nfr-ITS-S.

2.3.4 Traffic Efficiency Data Aggregation

ITS Data aggregation is a service specific to road operators. It is in charge of information compilation of CAMs with the intent to acquire traffic knowledge (average speed, average density...).

2.3.5 Exchange information service

In addition to the services described earlier, the Nfr-ITS-S provides an exchange information service. It enables national (with OEM servers) and international interoperability in the context of hybrid communication.

Details about this service are out of scope; refer to [3] for further information.

2.3.6 Performances

The Nfr-ITS-S **needs to** satisfy a set of constraints in order to provide the above services.

First of all, the Nfr-ITS-S system **should scale** with the V-ITS-S density and as a consequence with concurrent data transmission/reception. The Nfr-ITS-S **should** also correctly handle **priorities** between the different ITS messages types. The technical architecture **should** be suitable for **real-time** service provisioning. Another important aspect that the underlying architecture needs to be able to handle is the **reliability** of information and its corresponding transmission. It **should** also provide a high **availability** level and manage **multiple and concurrent access**. For that, the architecture needs to ensure among other items the integrity of data containing speed and position information in order to maintain a high-level service provisioning.

Flexibility is also an additional criterion. The Nfr-ITS-S **shall** provide options that enable the dissemination of messages for a wide range of Road Safety and traffic efficiency scenarios under a heterogeneous architecture and end-users configurations.

The Nfr-ITS-S **shall** conform to data protection and the privacy requirement defined in the deliverable 2.4.4.11_H.

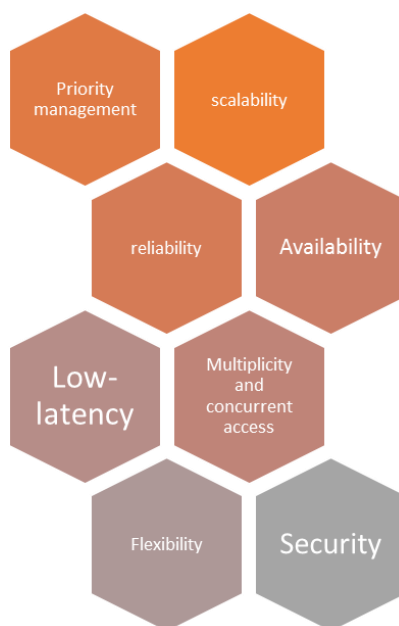


Figure 7. Main performances of the Nfr-ITS-S

The performance indicators **could** be numbered to specify the performances of the ITS-S.

3 Description of the functional requirements

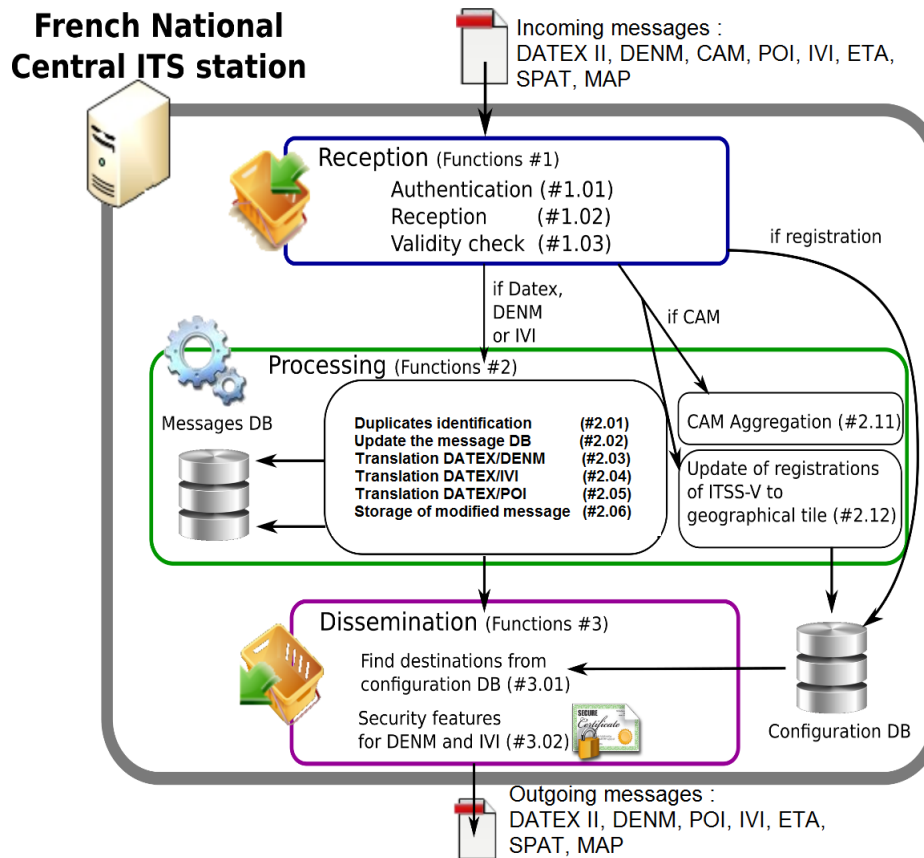


Figure 8. Functions of the Nfr-ITS-S

3.1 Message reception (Functions #1)

The reception module is composed of authentication, reception and validity check.

3.1.1 Authentication of ITS-S (V-ITS-S or servers) to initiate a connection with the Nfr-ITS-S (Function #1.01)

ID	2424H-AUTH-001(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall only process with authenticated senders. The authentication process is described in deliverable 2.4.4.11_H.
Additional information	Senders have to authenticate themselves before sending any information or to send authenticated messages. It implies that the Nfr-ITS-S have the means to check the authenticity of the sender (cf. deliverable 2.4.4.11_H). CA1: A message from an authenticated sender is processed. CA2: A message from a non-authenticated sender is dropped.

ID	2424H-AUTH-002(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall only process authentication request on data protected channel.
Additional information	The description is defined in the deliverable 2.4.4.11_H.

ID	2424H-AUTH-003(1)
Component(s)	Nfr-ITS-S
Requirement	If the authentication process fails, a record shall be done in the log files with enough precision to know the reason of the drop.
Additional information	CA1: when a non-authenticated message is received and dropped, the Nfr-ITS-S stocks it in a log file.

ID	2424H-AUTH-004(2)
Component(s)	Nfr-ITS-S, V-ITS-S, PFcm, PFro, Nx-ITS-S.
Requirement	The Nfr-ITS-S shall implement the procedure of TCP Keep Alive to check the availability of the communication link to V-ITS-S, PFcm, PFro and Nx-ITS-S.
Additional information	The socket is continually open between the V-ITS-S and the Nfr-ITS-S. The TCP is not managed on application level (except for DATEX II Keep Alive)

ID	2424H-AUTH-005(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall consider the communication as active, with a V-ITS-S, which has been authenticated, only if it receives messages (e.g. Keep Alive) from this V-ITS-S with a timer less than a configurable threshold (default value fixed to 130 seconds without communication). The Nfr-ITS-S closes its connection with the V-ITS-S after this timeout.
Additional information	The V-ITS-S is already connected to the Nfr-ITS-S. No more "Keep Alive" message is received by the Nfr-ITS-S from this station. The V-ITS-S does not notify the end of the session, in order to preserve its anonymity. Here, the behavior of the Nfr-ITS-S is similar to the one where a connection with the Nfr-ITS-S is lost.

ID	2424H-AUTH-006(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall close its connection with the V-ITS-S if it receives a message with a pseudonym different from the previous one.
Additional information	1. The V-ITS-S is already connected to the Nfr-ITS-S. 2. When a vehicle changes its identity / pseudonym, its connection parameters become invalid. The pseudonym of the V-ITS-S is sent in the message by the V-ITS-S. The vehicle does not notify the end of the session, in order to preserve its anonymity.

ID	2424H-AUTH-007(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall consider the V-ITS-S as a new V-ITS-S when new connection is successfully established and authorized. And the V-ITS-S will receive all active messages in its area. The sending process is achieved according to the chapter 3.3 .
Additional information	

3.1.2 Reception (Function #1.02)

The reception of messages is defined in the deliverable 2.4.1_H: Functional and technical hybrid architecture – Common specifications

ID	2424H-RECE-001(3)
Component(s)	Nfr-ITS-S, PFro, PFcm, R-ITS-S, Centralized traffic light management system, V-ITS-S, NAP-SER, MCTO terminal, MCTO transporter
Requirement	The Nfr-ITS-S shall receive DATEX II, DENM, CAM, IVI, POI, ETA, SPaT and MAP messages.
Additional information	The protocol used to receive data is define in the deliverable 2.4.1_H. The Nfr-ITS-S considers a message as valid if the uplink message format defined in 2.4.1_H is respected.

ID	2424H-RECE-002(2)
Component(s)	Nfr-ITS-S, PFro, PFcm, R-ITS-S, Centralized traffic light management system, V-ITS-S, NAP-SER, MCTO terminal, MCTO transporter
Requirement	The Nfr-ITS-S shall identify the type of the received message : - For V-ITS-S, DENM and CAM are received on one common TCP port and are distinguishable thanks to the BTP port. - DATEX II messages sending by the road operator's platform are received on another TCP port. - For others components, the type of message received shall be identify using the procedure of the document [3].
Additional information	If the message port is not identified, a new record is inserted in the log files and the message is dropped.

After the authentication, the Nfr-ITS-S checks the received message structure and security (Functions #1.02 to #1.03).

ID	2424H-RECE-003(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall identify the type of the message received on port thanks to the BTP port and process it as it suits. CAM: port 2001 DENM: port 2002 IVI: port 2006 POI : 2010 SPaT : 2004 MAP : 2003 ETA : 2222
Additional information	The Nfr-ITS-S receives messages encapsulated in BTP/GeoNet. If the BTP Port is not identified, a new record is inserted in the log files and the message is dropped.

ID	2424H-RECE-005(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	The Nfr-ITS-S shall extract the information of DATEX II messages taking into account the presence of a SOAP envelope.
Additional information	The Nfr-ITS-S de-encapsulates SOAP envelope. The message will then be archived without this SOAP envelope.

ID	2424H-RECE-006(2)
Component(s)	Nfr-ITS-S, PFcm, R-ITS-S, Centralized traffic light management system, V-ITS-S, NAP-SER, MCTO terminal, MCTO transporter, Nx-ITS-S
Requirement	The Nfr-ITS-S shall de-encapsulate messages CAM, DENM, IVI, POI, ETA, SPaT and MAP from Geonet/BTP (cf. procedure of the deliverable 2.4.4.11_H).
Additional information	CA, DEN, IVI, POI, SPaT, MAP and ETA messages arriving encapsulated.

ID	2424H-RECE-007(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check at the application layer that the size is not null and the size is not higher than a configurable value by message type (CA, DEN, IVI, POI, ETA, SPaT, MAP and DATEX II messages).
Additional information	TCP provides reliable, ordered, and error-checked delivery of a stream of bytes.

3.1.3 Validity check (Function #1.03)

Upon message reception, the Nfr-ITS-S **shall** check the validity of the message. This helps identifying relevant and valid messages that will be processed by the Nfr-ITS-S and other messages that will be ignored and dropped. It also guarantees the messages published by the Nfr-ITS-S.

A message is valid if it is complete and secured.

ID	2424H-VALI-001(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check at the application layer that the message is readable as one of expected format: DENM, IVI, DATEX II, CAM, POI, ETA, SPaT, MAP or registration.
Additional information	If the message format is not identified, a new record is inserted in the log files and the message is dropped.

3.1.3.1 Validity check for DATEX II messages

ID	2424H-VALI-002(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the category of DATEX II messages
Additional information	Check if it is an event message, a snapshot message or a configuration message.

ID	2424H-VALI-003(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the DATEX II messages via XSD.
Additional information	The format of the message enables the call of the next requirements. The structure : it goes through a specific XSD test to check the structure of the message (different according to the category)

ID	2424H-VALI-004(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall verify the number of events included in the DATEX II message. In case of a snapshot sent by the PFro, the Nfr-ITS-S shall create one DATEX II message for each relevant event inside the snapshot.
Additional information	PFros will send different types of DATEX II messages : <ul style="list-style-type: none"> event messages : describing one event – push from a PFro to the Nfr-ITS-S snapshot messages : regrouping different events to make sure the events in both servers (local and national ones) are synchronized – pull of PFro by the Nfr-ITS-S After this step, each DATEX II message contains only a relevant event.

ID	2424H-VALI-005(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check mandatory fields of the DATEX II messages and drop incomplete messages, cf. deliverables 2.4.1.4_H. A valid DATEX II Message shall contain a list of class and attributes in the deliverable 2.4.1.4_H (e.g <i>situationRecordCreationReference</i> , <i>SituationObservationTime</i> , <i>version</i> , ...)
Additional information	Different message fields shall be parsed to check the condition.

ID	2424H-VALI-006(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall verify valid DATEX II sender's identity and drop the message coming from unauthorized sender's identity.
Additional information	

ID	2424H-VALI-007(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	The Nfr-ITS-S shall check at the application layer that the PFro has the permission to send this type of DATEX II message.
Additional information	If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped. Example: Only DATEX II messages exchanges with PFro (see figure 3 and figure 4)

3.1.3.2 Validity check for DENM

ID	2424H-VALI-008(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the DENM via ASN1.
Additional information	The format of the message enables the call of the next requirements.

ID	2424H-VALI-040(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the validity (e.g. signature, certificate validity) of the DEN messages. This is described in deliverable 2.4.4.8_H.
Additional information	The Nfr-ITS-S processes a valid secured DEN message while an invalid secured message is dropped. In the second case, a log record is added.

ID	2424H-VALI-009(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall take into account valid secured DEN messages and drop the others.
Additional information	The Nfr-ITS-S processes a valid secured DEN message while an invalid secured message is dropped. In the second case, a log record is added.

ID	2424H-VALI-010(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check all mandatory fields defined in deliverables 2.4.1, 2.4.1.2, 2.4.1.2_H and 2.4.1_H for each of the DENM and drop incomplete messages. For example, some mandatory fields are <i>source identifier</i> , <i>action identifier</i> , <i>DetectionTime</i> , <i>message type</i> ...
Additional information	Different message fields are parsed to check the conditions. If the DENM message does not all the fields mentioned, it is dropped.

ID	2424H-VALI-011(2)
Component(s)	Nfr-ITS-S, PFcm, V-ITS-S, NAP-SER, Nx-ITS-S
Requirement	The Nfr-ITS-S shall check that the ITS Station sender has the permission for this type of DENM .
Additional information	If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped. The Service Specific Permissions (SSP) are described in the deliverable 2.4.1.2_H.

ID	2424H-VALI-020(3)
Component(s)	Nfr-ITS-S
Requirement	Before computing DEN messages, the Nfr-ITS-S shall check validity duration to know if it is still relevant. It means that "detectionTime + validityDuration" is not in the past.
Additional information	If "detectionTime + validityDuration" is in the future, see §3.2. If it is in the past, in this case the message is dropped. After checking validity, Nfr-ITS-S will check if the message was already computed by the system according to chapter 3.2.

3.1.3.3 Validity check for IVI messages

ID	2424H-VALI-021(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the IVI messages via ASN1.
Additional information	The format of the message enables the call of the next requirements.

ID	2424H-VALI-041(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the validity (e.g. signature, certificate validity) of the IVI. This is described in deliverable 2.4.4.8_H.
Additional information	The Nfr-ITS-S processes a valid secured IVI message while an invalid secured message is dropped. In the second case, a log record is added.

ID	2424H-VALI-012(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall take into account valid secured IVI messages and drop the others.
Additional information	The Nfr-ITS-S processes a valid secured IVI message while an invalid secured message is dropped. In the second case, a log record is added.

ID	2424H-VALI-013(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check all mandatory fields defined in deliverables 2.4.1.2_H for each IVI message and shall drop incomplete messages. For example, some mandatory fields are: <i>serviceProviderID</i> , <i>ivIdentificationNumber</i> , <i>timestamp</i> , <i>etc.</i>
Additional information	Different IVI message fields are parsed to check the conditions. A log record is added if the Nfr-ITS-S drops an invalid message.

ID	2424H-VALI-014(2)
Component(s)	Nfr-ITS-S, Nx-ITS-S
Requirement	The Nfr-ITS-S shall check at the application layer that the sender has the permission for this type of IVI message .
Additional information	This is described in deliverable 2.4.4.8_H. If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped.

ID	2424H-VALI-022(2)
Component(s)	Nfr-ITS-S
Requirement	Before computing IVI messages, the Nfr-ITS-S shall check <i>validTo</i> to know if it is still relevant.
Additional information	If "validTo" is in the future, see §3.2. If it is in the past, in this case the message is dropped. After cheking validity, Nfr-ITS-S will check if the message was already computed by the system according to chapter 3.2.

3.1.3.4 Validity check for CAM

ID	2424H-VALI-023(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the CAM via ASN1.
Additional information	The format of the message enables the call of the next requirements.

ID	2424H-VALI-015(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the validity (e.g. signature, certificate validity) of CAM . This is described in deliverable 2.4.4.8_H.
Additional information	A valid secured message is processed by the Nfr-ITS-S while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-016(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check mandatory fields of the CAM and drop incomplete messages.
Additional information	Different CAM fields are parsed to check the conditions. A log file is added if the message is dropped.

ID	2424H-VALI-017(1)
Component(s)	Nfr-ITS-S, V-ITS-S, NAP-SER, MCTO
Requirement	The Nfr-ITS-S shall check at the application layer that the sender has the permission this kind of CAM.
Additional information	This is described in deliverable 2.4.4.8_H. If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped.

3.1.3.5 Validity check for POI messages

ID	2424H-VALI-024(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the POI messages via ASN1.
Additional information	The format of the message enables the call of the next requirements.

ID	2424H-VALI-042(1)
Component(s)	Nfr-ITS-S, Foreign National Central ITS-S
Requirement	The Nfr-ITS-S shall check the validity (e.g. signature, certificate validity) of the POI message. This is described in deliverable 2.4.4.8_H.
Additional information	The Nfr-ITS-S processes a valid secured POI message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-025(3)
Component(s)	Nfr-ITS-S, Foreign National Central ITS-S
Requirement	The Nfr-ITS-S shall take into account valid secured POI messages and drop the others.
Additional information	The Nfr-ITS-S processes a valid secured POI message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-026(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check all mandatory fields define in deliverables 2.4.1.2_H for each POI message and drop incomplete messages. For example, some mandatory fields are: <i>poiHeader</i> , <i>poiType</i> , <i>timestamp</i> , <i>etc.</i>
Additional information	Different POI message fields are parsed to check the conditions. If the POI message does not contain all fields mentioned, it is dropped and a log file is added.

ID	2424H-VALI-027(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S, MCTO Terminal
Requirement	The Nfr-ITS-S shall check at the application layer that the sender has the permission for this type of POI message .
Additional information	This is described in deliverable 2.4.4.8_H. If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped.

There is no *validityDuration* of POI messages. Information should be updated regularly through C-ITS communications.

3.1.3.6 Validity check for ETA messages

ID	2424H-VALI-028(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the ETA messages via ASN1.
Additional information	The format of the message enables the call of the next requirements.

ID	2424H-VALI-043(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the validity (e.g. signature, certificate validity) of the ETA. This is described in deliverable 2.4.4.8_H.
Additional information	The Nfr-ITS-S processes a valid secured ETA message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-029(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall take into account valid secured ETA messages and drop the others.
Additional information	The Nfr-ITS-S processes a valid secured ETA message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-030(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check all mandatory fields define in deliverables 2.4.1.2_HbisMCTO for each ETA message and drop incomplete messages. For example, some mandatory fields are: <i>transporterName</i> , <i>carriageld</i> , <i>updatedETA</i> , <i>etc</i> .
Additional information	Different ETA message fields are parsed to check the conditions. If the ETA message does not contain all fields mentioned, it is dropped and a log file is added.

ID	2424H-VALI-031(1)
Component(s)	Nfr-ITS-S, MCTO Transporter, Nx-ITS-S
Requirement	The Nfr-ITS-S shall check at the application layer that the sender has the permission for this type of ETA message .
Additional information	This is described in deliverable 2.4.4.8_H. If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped.

Note: this type of message has no attribute such an end of validity, so Nfr-ITS-S does not check the temporal validity of the message.

3.1.3.7 Validity check for SPaT messages

ID	2424H-VALI-032(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the SPaT messages via ASN1.
Additional information	The format of the message enables the call of the next functions.

ID	2424H-VALI-044(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the validity (e.g. signature, certificate validity) of the SPaT messages. This is described in deliverable 2.4.4.8_H.
Additional information	The Nfr-ITS-S processes a valid secured SPaT message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-033(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall take into account valid secured SPaT messages and drop the others.
Additional information	The Nfr-ITS-S processes a valid secured SPaT message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-034(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check all mandatory fields define in deliverables 2.4.1.2_H_G1 for each SPaT message and drop incomplete messages.
Additional information	Different SPaT message fields are parsed to check the conditions. If the SPaT message does not contain all fields, it is dropped.

ID	2424H-VALI-035(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S, R-ITS-S, Centralized Traffic Light Management System
Requirement	The Nfr-ITS-S shall check at the application layer that the sender has the permission for this type of SPaT message .
Additional information	This is described in deliverable 2.4.4.8_H. If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped.

3.1.3.8 Validity check for MAP messages

ID	2424H-VALI-036(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the structure of the MAP messages via ASN1.
Additional information	The format of the message enables the call of the next functions.

ID	2424H-VALI-045(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check the validity (e.g. signature, certificate validity) of the MAP messages. This is described in deliverable 2.4.4.8_H.
Additional information	The Nfr-ITS-S processes a valid secured MAP message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-037(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall take into account valid secured MAP messages and drop the others.
Additional information	The Nfr-ITS-S processes a valid secured MAP message while an invalid message is dropped. In the second case, a log record is added.

ID	2424H-VALI-038(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall check all mandatory fields define in deliverables 2.4.1.2_H_G1 for each MAP message and drop incomplete messages.
Additional	Different MAP message fields are parsed to check the conditions.

information	If the MAP message does not contain all fields mentioned, it is dropped.
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ID	2424H-VALI-039(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S, R-ITS-S, Centralized Traffic Light Management System
Requirement	The Nfr-ITS-S shall check at the application layer that the sender has the permission for this type of MAP message .
Additional information	This is described in deliverable 2.4.4.8_H. If the authorization message type is not identified, a new record is inserted in the log files and the message is dropped.

3.1.3.9 Time validity for stored messages

ID	2424H-VALI-018(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall only manage current events: it considers a message as valid if the message time validity is not expired.
Additional information	For all messages, only current events are considered (not the scheduled event and not old events). The time system base is the <i>Nfr-ITS-S clock</i> which allows to add a validity test of the sender clock: CA1: For DENM , the value of the difference between (the <i>Nfr-ITS-S Clock</i> and the <i>DetectionTime</i>) is positive <i>and</i> is less than the sum of the <i>validity duration</i> and a configurable threshold (default value fixed to 60 sec). CA2: For IVI message, the value of the difference between (the <i>timestamp</i> and the <i>Nfr-ITS-S clock</i>) is positive and is less than the sum of <i>validTo</i> and a configurable threshold (default value fixed to 60 sec). CA3 : For POI messages, the value of the difference between (the <i>Nfr-ITS-S</i> and the <i>Timestamp</i>) is positive. (It is not a scheduled event) CA4 : For SPaT messages, the value of the difference between (the Nfr-ITS-S Clock and the <i>moy+timestamp</i>) is positive CA5: For ETA messages, the value of the difference between (the <i>Nfr-ITS-S clock</i> and the <i>updatedETA</i>) is positive. . (It is not a scheduled event) CA6 : MAP messages are used to describe the intersection geometry. The information contained is quite very static and they are set one time for all, except when intersection's description needs to evolve. There is no time validity for this type of message.

Note: The *Nfr-ITS-S clock* is described in the chapter 5.1.2 Time synchronization.

ID	2424H-VALI-019(3)
Component(s)	Nfr-ITS-S, Foreign National Central, V-ITS-S, PFro
Requirement	The Nfr-ITS-S should currently not process scheduled events.
Additional information	If scheduled messages are received, the Nfr-ITS-S does not take it into account.

3.2 Message processing (Functions #2)

This chapter specifies the steps of message processing.

The functions #2.01 to #2.06 concern the DATEX II, DENM, IVI, POI, ETA, SPaT and MAP messages.

The functions #2.11 and #2.12 concern CAM.

3.2.1 Duplicates identification (Function #2.01)

ID	2424H-DUPL-001(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall identify the duplicate messages thanks to the list of fields described below for DATEX II, DEN, IVI, MAP and SPaT message (2424H-DUPL-003, 2424H-DUPL-004, 2424H-DUPL-005, 2424H-DUPL-006 and 2424H-DUPL-007).
Additional information	Duplicated messages are identified by Table 1 below, which includes the fields that enable duplicate detection,

Duplicated messages are identified by:

Message format	Field identifying the event and its uniqueness	Fields identifying the version of the event
DATEX II with a <i>situationPublication</i>	SituationRecordCreationReference	SituationObservationTime
DATEX II with a <i>VmsPublication</i>	ivIdentificationNumber	timeLastSet
DENM	actionID	DetectionTime
IVI	serviceProviderID	Timestamp
	ivIdentificationNumber	
MAP	IntersectionReferenceID	revisionNumber
SPaT	IntersectionReferenceID	Timestamp
		moy

Table 1. Fields that enable the duplicate detection

ID	2424H-DUPL-002(3)
Component(s)	Nfr-ITS-S
Requirement	For each DATEX II message with a <i>situationpublication</i> (event message category) coming from a PFro, the Nfr-ITS-S shall identify the message as a DATEX II duplicate message if the set (<i>situationRecordCreationReference</i> AND <i>situationObservationTime</i>) has already been processed.
Additional information	A duplicate DATEX II message is identified and an info log file is generated.

ID	2424H-DUPL-006(2)
Component(s)	Nfr-ITS-S
Requirement	For each DATEX II message with a <i>VmsPublication</i> coming from a PFro, the Nfr-ITS-S shall identify the message as a DATEX II duplicate message if the field <i>ivIdentificationNumber</i> has already been processed.
Additional information	A duplicate DATEX II message is identified and an info log file is generated.

ID	2424H-DUPL-004(2)
Component(s)	Nfr-ITS-S
Requirement	For each incoming DENM, the Nfr-ITS-S shall identify the message as a duplicate DENM if the set (<i>actionID</i> AND <i>detectionTime</i>) has already been processed.
Additional	A duplicate DENM message is identified and an info log file is generated.

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ID	2424H-DUPL-005(2)
Component(s)	Nfr-ITS-S
Requirement	For each IVI message coming from a Nx-ITS-S, the Nfr-ITS-S shall identify the message as an IVI duplicate message if the set (<i>serviceProviderID</i> AND <i>ivIdentificationNumber</i> AND <i>timestamp</i>) has already been processed.
Additional information	A duplicate IVI message is identified and an info log file is generated.

ID	2424H-DUPL-007(2)
Component(s)	Nfr-ITS-S
Requirement	For each MAP message received, the Nfr-ITS-S shall identify the message as a MAP duplicate message if the set (<i>intersectionReferenceID</i> AND <i>revisionNumber</i>) has already been processed.
Additional information	A duplicate MAP message is identified and an info log file is generated.

ID	2424H-DUPL-008(2)
Component(s)	Nfr-ITS-S
Requirement	For each SPaT message coming from a Nx-ITS-S, the Nfr-ITS-S shall identify the message as a SPaT duplicate message if the set (<i>intersectionReferenceID</i> AND <i>timestamp</i> AND <i>moy</i>) has already been processed.
Additional information	An info log file is generated if a SPaT message is identified.

3.2.2 Process for duplicate messages

ID	2424H-DUPL-009(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall drop a received duplicate message if the currently sent message was received less than X minutes before (default value : 5; maximum value : 9). This concerns DENM, IVIM and MAPEM.
Additional information	A duplicate message is dropped and an info log file is generated.

ID	2424H-DUPL-010(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall replace the current message by a received duplicate message, if the currently sent message was received more than X minutes before (default value : 5; maximum value : 9). This concerns DENM, IVIM and MAPEM.
Additional information	The duplicate message is then sent to every stakeholder's.

ID	2424H-DUPL-011(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall drop the duplicate messages as soon as they are identified. This concerns DATEX II messages and SPATEM identified according to the 2424H-DUPL-002, 2424H-DUPL-006, 2424H-DUPL-008 requirements.
Additional information	An info log is generated at each drop.

3.2.3 Messages storage (Function #2.02 and Function #2.06)

This function concerns all the messages that where not dropped during the duplicate message dropping function.

ID	2424H-DUPL-003(3)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall take into account all the messages that are not duplicates ones. In other terms, The Nfr-ITS-S shall take into account all the new and updated messages.
Additional information	To take into account new and updated messages means to follow the message processing. This concerns all messages.

ID	2424H-PROC-001(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall store each message (DATEX II, DEN, IVI, POI, ETA, SPaT and MAP) completely if the message is secured and complete (cf chapter 3.1.3).
Additional information	The valid DATEX II messages are stored without their SOAP envelope.

ID	2424H-PROC-002(1)
Component(s)	Nfr-ITS-S,
Requirement	For each incoming message that passed the validity and the duplicate checks, the Nfr-ITS-S shall check if it is an update. In order to do this update check, the Nfr-ITS-S searches for the event in the database: - If the message exists, it checks if it is an update (later than the stored event). - If the message does not exist, it is stored into the database cf. requirement 2424H-PROC-003 . When a message is received and found in the table that means it is an update. If it is a newer message than the stored message, the received message replaces it, and the translation of this new message replaces the translations of older messages.
Additional information	

ID	2424H-PROC-003(3)
Component(s)	Nfr-ITS-S
Requirement	<p>The Nfr-ITS-S shall store message fields in a database to be used for dissemination until the end or update of the message.</p> <p>The database structure is defined at least by:</p> <ul style="list-style-type: none"> • The message type: DENM, IVI, DATEX II, POI, ETA, SPaT, MAP • The fields described in the Table 1 above of the chapter 3.2.1 which enable the duplication detection. • Tile reference (see chapter 3.2.3.1) • Validity date, if relevant • Boolean to know if the message is received (1) or generated (0) • Message source identifier
Additional information	

ID	2424H-PROC-004(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall store the necessary CAM information in a volatile memory.
Additional information	CAM is kept even if there is a new CAM from the same V-ITS-S as long as the computing over an aggregation period is not finished (default value 30 min).

3.2.3.1 Messages tile association

ID	2424H-PROC-005(2)
Component(s)	Nfr-ITS-S
Requirement	<p>When a message (DATEX II, DENM, IVI, POI, SPaT, MAP or ETA) is received, the Nfr-ITS-S shall calculate the corresponding tile.</p> <p>The maximum zoom level is a parameter (default value: Zoom 18, corresponding approximately to 50 meters) cf. [4] specifications.</p> <p>The minimum zoom level is a parameter (default value: Zoom 11, corresponding approximately to 13 km) cf. [4] specifications.</p> <p>The process is to determine the minimal tile including the complete event.</p> <p>A complete event is defined as a point, a linear or a zone and other attributes.</p> <p>For DENM: The event is characterized by its <i>eventPosition</i>, <i>Trace(s)</i>, <i>eventHistory</i> and <i>DestinationArea</i>.</p> <p>For IVI message: The event is characterized by its <i>referencePosition</i>, <i>detectionZone(s)</i>, <i>relevanceZone(s)</i> and <i>DestinationArea</i>.</p> <p>For POI message : The event is characterized by its <i>refPoint</i> and <i>DestinationArea</i>.</p> <p>For MAP message : The event is characterized by its <i>refPoint</i> and <i>DestinationArea</i>.</p> <p>For SPaT message : the event is characterized by the <i>refPoint</i> of the associated MAP message, identified thanks to the <i>intersectionReferenceID</i> and <i>revision</i> of the SPaT and MAP messages, and <i>DestinationArea</i>.</p> <p>For DATEX II message: equivalent attributes of DEN, IVI and POI messages (cf.deliverable 2.4.1.4_H including annex).</p> <p>For ETA messages : The event is characterized by the <i>latitude</i>, <i>longitude</i> and <i>DestinationArea</i>.</p> <p>The <i>DestinationArea</i> is a configurable value for each type of message and use cases (cf. 2424H-SEND-008)</p> <p>These fields draw a geographic area and the Nfr-ITS-S determines the biggest tile contained in this entire area.</p>
Additional information	

The following figure shows an example of tile association for a DENM with a simple trace. The relevant tile is zoomed at Zoom level define in the requirement **2424H-PROC-005(1)**.

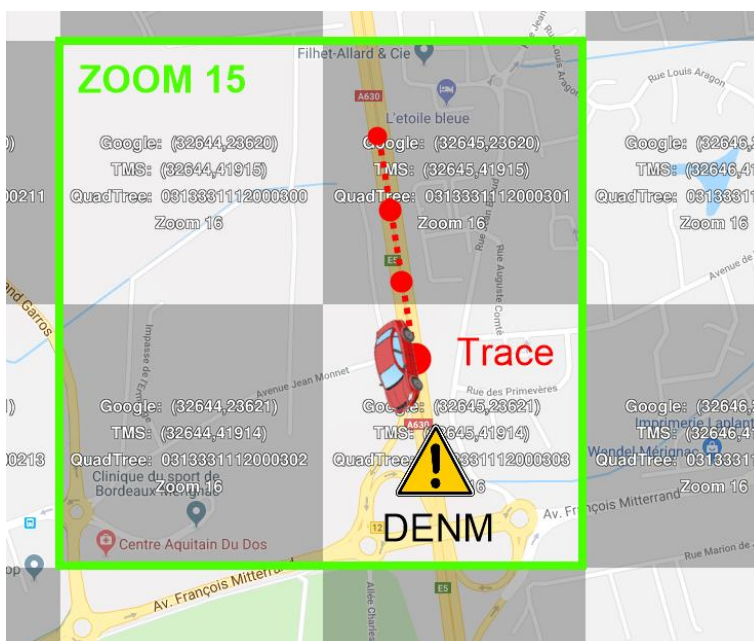


Figure 9. Tile association for a simple DENM

The following figure shows an example of tile association for a DATEX II with a circular area of interest. The relevant tile is zoomed at level define in the requirement [2424H-PROC-005\(1\)](#).

3.2.4 Translation of DATEX II messages into DENM and DENM into DATEX II (Function #2.03)

Description: Several types of Dutex II SituationPublication messages are translated into DENM.

ID	2424H-PROC-007(2)
Component(s)	Nfr-ITS-S, PFro
Requirement	When the Nfr-ITS-S receives a DATEX II message with <i>SituationPublication</i> tagged as a DENM translation in the 2.4.1.4_H, from a PFro, it shall translate it into DENM (Function #2.04) respecting the specifications of the 2.4.1.4_H deliverable and annexes. In the case of a DATEX II messages containing several events, each event will be processed individually (cf. Requirement 2424H-VALI-004).
Additional information	Reminder1: One event = one DENM = one DATEX II Situation class = one or several DATEX II Situationrecord classes. Reminder2: And one DATEX II can contain several situations. Reminder3: Different times are used in DATEX II and DENM, according to 2424H-CONF-014 . Reminder4: Example of relevant Dutex II classes: Obstruction, Accident, Conditions, ...

ID	2424H-PROC-008(3)
Component(s)	Nfr-ITS-S
Requirement	After the DATEX II messages to DENM translation, the translated message is associated to the same tile as the incoming message and included in the database.
Additional information	The new messages might be new messages, updates or terminations

ID	2424H-PROC-009(2)
Component(s)	Nfr-ITS-S
Requirement	When the Nfr-ITS-S receives a DENM message from a V-ITS-S, it shall translate it into DATEX II message respecting the specifications of the 2.4.1.4_H deliverable.
Additional information	Reminder: Different times are used in DATEX II and DENM, according to 2424H-CONF-014 .

ID	2424H-PROC-010(2)
Component(s)	Nfr-ITS-S
Requirement	After the DENM to Datex II messages translation, the Nfr-ITS-S shall associate the translated message to the same tile as the incoming message and included it in the database.

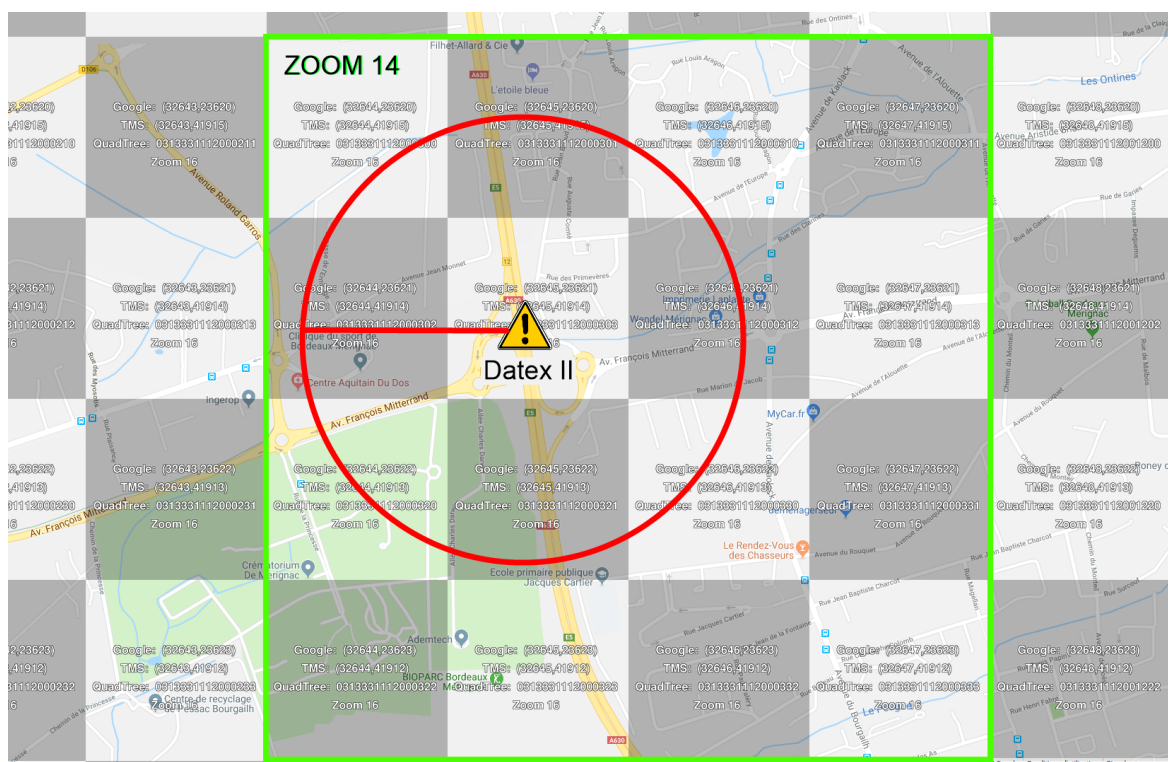


Figure 10. Tile association for a DATEX II message

Additional information	
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ID	2424H-PROC-022(1)
Component(s)	Nfr-ITS-S
Requirement	Every 9 minutes, the French National Central ITS Station shall drop DENM from DATEX II message and translate the DATEX II message into a new DENM.
Additional information	The new message is then sent to stakeholder's. This process enables to have a signature date less than 10 minutes, respecting the C2C specifications.

3.2.5 Translation of DATEX II messages into IVI and IVI into DATEX II (Function #2.04)

Description: Several types of Datex II SituationPublication messages are translated into IVI.
All the Datex II VmsPublication messages are translated in IVI

ID	2424H-PROC-028(1)
Component(s)	Nfr-ITS-S
Requirement	When the Nfr-ITS-S receives a DATEX II message with <i>SituationPublication</i> tagged as an IVI translation in the 2.4.1.4_H, from PFro, it shall translate it into IVI message (Function #2.05) respecting the specifications of the 2.4.1.4_H deliverable and annexes. In the case of a DATEX II messages containing several events, each event will be processd individually
Additional information	Reminder: Datex II and IVI messages use different times, according to 2424H-CONF-014 . Reminder: Example of relevant Datex II classes : LaneManagament, SpeedManagement, Vms...

ID	2424H-PROC-011(3)
Component(s)	Nfr-ITS-S
Requirement	When the Nfr-ITS-S receives a DATEX II message with <i>VmsPublication</i> inside from PFro, it shall translate it into IVI message (Function #2.05) respecting the specifications of the 2.4.1.4_H deliverable and annexes. In the case of a DATEX II messages containing several events, each event will be processed individually
Additional information	Reminder: Datex II and IVI messages use different times, according to 2424H-CONF-014 .

ID	2424H-PROC-012(2)
Component(s)	Nfr-ITS-S
Requirement	After the DATEX II messages to IVI translation, the translated message is associated to the same tile as the incoming message and included in the database.
Additional information	The new messages might be new messages, updates or terminations

ID	2424H-PROC-013(3)
Component(s)	Nfr-ITS-S, Nx-ITS-S
Requirement	When the Nfr-ITS-S receives an IVI message from a Nx-ITS-S it could translate it into DATEX II message respecting the specifications of the 2.4.1.4_H deliverable.
Additional information	Reminder: Different times are used in DATEX II and IVI, according to 2424H-CONF-014 Reminder: The resulting Datex II messages could be VmsPublication or SituationPublication.

ID	2424H-PROC-014(2)
Component(s)	Nfr-ITS-S
Requirement	After the IVI message to Datex II message translation, the Nfr-ITS-S should associate the translated message to the same tile as the incoming message and included it in the database.
Additional information	

ID	2424H-PROC-023(1)
Component(s)	Nfr-ITS-S
Requirement	Every 9 minutes, the French National Central ITS Station shall drop IVI message from DATEX II message and translate the DATEX II message into a new IVI.
Additional information	The new message is then sent to stakeholder's. This process enables to have a signature date less than 10 minutes, respecting the C2C specifications.

3.2.6 Translation of DATEX II messages into POI and POI into DATEX II (Function #2.05)

ID	2424H-PROC-024(2)
Component(s)	Nfr-ITS-S, PFro
Requirement	When the Nfr-ITS-S receives a DATEX II message containing a <i>ParkingStatusPublication</i> or a <i>ParkingTablePublication</i> from a PFro, it shall translate it into POI (Function #2.06) respecting the specifications of the 2.4.1.4_H deliverable and annexes. In the case of a DATEX II messages containing several events, each event will be processed individually.
Additional information	Reminder: Different times are used in DATEX II and POI messages, according to 2424H-CONF-014 .

ID	2424H-PROC-025(1)
Component(s)	Nfr-ITS-S
Requirement	After the DATEX II messages to POI translation, the translated message is associated to the same tile as the incoming message and included in the database.
Additional information	

ID	2424H-PROC-026(1)
Component(s)	Nfr-ITS-S
Requirement	Every 9 minutes, the French National Central ITS Station shall drop POI message from DATEX II message and translate the DATEX II message into a new POI.
Additional information	The new message is then sent to stakeholder's. This process enables to have a signature date less than 10 minutes, respecting the C2C specifications.

3.2.7 Custom Packet for DENM, IVI and POI message

ID	2424H-PROC-015(3)
Component(s)	Nfr-ITS-S, Nx-ITS-S, PFcm, MCTO transporter, NAP-SER
Requirement	The Nfr-ITS-S should generate the custom packet from the DENM coming from DATEX II translation, before sending message to Nx-ITS-S, MCTO transporter, PFcm, and NAP-SER
Additional information	Nfr-ITS-S shall implement message format described in Table 2. Relevant information for routing and filtering of messages (source [3])

ID	2424H-PROC-016(2)
Component(s)	Nfr-ITS-S, Nx-ITS-S, PFcm, MCTO transporter, NAP-SER
Requirement	The Nfr-ITS-S should generate the custom packet from the IVI message coming from DATEX II translation, before sending message to MCTO transporter, PFcm, NAP-SER and Nx-ITS-S.
Additional information	Nfr-ITS-S shall implement message format described in Table 2. Relevant information for routing and filtering of messages (source [3])

ID	2424H-PROC-027(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S, PFcm, MCTO transporter, MCTO terminal, NAP-SER,
Requirement	The Nfr-ITS-S should generate the custom packet from the POI message coming from DATEX II translation, before sending the message to Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm and NAP-SER
Additional information	Nfr-ITS-S shall implement message format described in Table 2. Relevant information for routing and filtering of messages (source [3])

Field	Required	Description
message	Mandatory	The actual message/payload. Currently foreseen (DENM/IVI/POI/SPaT/MAP/ETA). The content of the messages should follow the profile, as defined in [1]. Messages should not be transcoded, e.g. to DATEX II messages. The same ASN.1 encoding rules should be followed as for IF1 (i.e. as used on the ITS-G5 channel)
Message type	Optional	Message type name (DENM/IVI/POI/SPaT/MAP/ETA)
Message version	Optional	Version of the message type
Originator	Optional	The source of the information, typically a (short) name of the road operator. This can be relevant for the trustworthiness of the information, and for business aspects.
Location	Optional	Relevant target location of this message. The intent is to be able to use it for filtering. The detailed location information is contained inside the message. These should be consistent
Time validity	Optional	Messages have a limited validity. “Old” messages do not have to be forwarded. The time validity can be specified based on an absolute timestamp, or on a generation timestamp and a validity time.

Table 2. Relevant information for routing and filtering of messages (source [3])

3.2.8 CAM to update of registration of V-ITS-S to geographical tile (Function#2.12)

If the CAM is authenticated (See deliverable 2.4.1.1_H), the Nfr-ITS-S parses it and registers in a database the ID of the V-ITS-S with a validity duration (30min by default).

This is done for two reasons:

1. Enable to create a list of V-ITS-S located in an area for sending future event messages (used in the push mode). The position helps the Nfr-ITS-S to store the V-ITS-S in the correct database (function #2.12). The position is erased after this operation. The database is defined by rectangular area (of variable dimension taking account of the density of the population: small area for high density region), see Figure 3.2.5

2. Use the position for road operator purpose (Computation of CAM messages - function #2.11): calculate travel time, origin/destination matrix, etc. That function already exists in Road Side Units and is described in the deliverable 2.4.4.11_H.

The Nfr-ITS-S checks if the *stationID* is not already present in the database, if another data is present, it is removed.

CAM received from V-ITS-S (using Home Agent connection) **are** the ones that are sent directly to the Nfr-ITS-S and allow two main functions:

- Identification of the position of an V-ITS-S in a tile to be able to disseminate the information to V-ITS-S: description in this chapter
- Computing of traffic related data for the road operators (generation of DATEX II messages corresponding to CAM aggregation): see next chapter 3.2.9

ID	2424H-PROC-017(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	When the Nfr-ITS-S receives a CAM from a V-ITS-S, the Nfr-ITS-S shall associate the connection to a tile by using the coordinates contained in the received CAM.
Additional information	The zoom level is a parameter (default value: Zoom 16) cf. [4] specifications. After this step, including for the dissemination function, only the tile of the V-ITS-S is used and not the vehicle position.

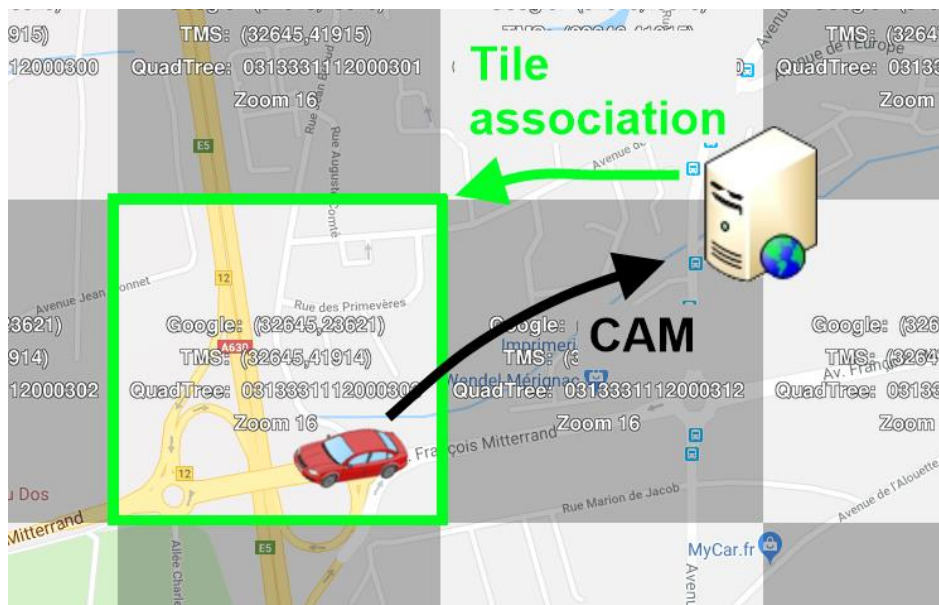


Figure 11. Tile association for a CAM

ID	2424H-PROC-018(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	<p>The Nfr-ITS-S shall consider the communication as active, with an authenticated V-ITS-S, only if it receives a signed CAM from this V-ITS-S with a timer less than a configurable threshold (default value fixed to 130 sec.)</p> <p>If this frequency is not respected, the link with the vehicle (V-ITS-S) will be considered as inactive and removed. In most cases, the frequency is higher than this default value.</p>
Additional information	<p>The strategy for sending CAM messages according to parameters (e.g. speed and time) is defined in deliverable 2.4.1_H. The lower frequency of CAM sending is for a stationary V-ITS-S, because there is no need to send back the same position.</p>

ID	2424H-PROC-019(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	If there is a new request from the same V-ITS-S after this time, Nfr-ITS-S shall consider it as a new subscription, and all messages associated with the tile will be transmitted.
Additional information	

ID	2424H-PROC-020(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	If a CAM is received from a V-ITS-S already registered in another tile, the Nfr-ITS-S shall register the connection in the newest tile and removed it from the oldest tiles.
Additional information	

ID	2424H-PROC-021(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	When a new connection is established and authorized, the Nfr-ITS-S shall send to the V-ITS-S all events registered for this tile.
Additional information	

3.2.9 CAM aggregation (Function#2.11)

This chapter describes the computing of traffic related data for the road operators: generation of DATEX II messages corresponding to CAM received from V-ITS-S aggregation.

3.2.9.1 Description of the CAM aggregation computing

Two ways of computing CAM for traffic related data **should** be developed.

ID	2424H-CAMA-001(1)
Component(s)	Nfr-ITS-S, V-ITS-S, MCTO transporter
Requirement	The Nfr-ITS-S should compute the average values of speeds and others of CAM received from V-ITS-S and MCTO transporter in the same way as a R-ITS-S.
Additional information	

ID	2424H-CAMA-002(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S should compute the travel time using the position of CAM
Additional information	

Other possible usage of Probe Vehicle Data (PDV) **could** be developed in the future.

Computing the average values of speeds and others amongst several vehicles (V-ITS-S)

ID	2424H-CAMA-003(1)
Component(s)	Nfr-ITS-S
Requirement	<p>After the configuration (see chapter 3.2.9.2) is done, the Nfr-ITS-S shall compute (cf.deliverable 2.4.2.1):</p> <ul style="list-style-type: none"> • average speed/vehicle • average speed per vehicle class • length/classified data: mean length of the vehicles <p>This computation depends on the parameter asked by the road operator using the same computing of a random R-ITS-S (harmonic mean of harmonic mean speeds of vehicles, etc.).</p>
Additional information	

ID	2424H-CAMA-004(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall generate a DATEX II message from the CAM aggregation, as described in deliverable 2.4.1.4_H. That use-case supposes that a necessary CAM information is kept (cf.requirement 2424H-PROC-004) even if there is a new CAM from the same V-ITS-S as long as the computing over an aggregation period is not finished.
Additional information	

ID	2424H-CAMA-005(1)
Component(s)	Nfr-ITS-S
Requirement	The maximum duration of an aggregation period value is 30 min. The duration of an aggregation period value shall be configurable (default value 1 min).
Additional information	For privacy reasons, the time within the CAM can be stored in a volatile memory shall be limited, that is why the aggregation period will be limited.

3.2.9.1.1 Computing the travel time using the position of vehicles (V-ITS-S)

Using the CAM messages described above, it is also possible to compute travel times between two different points.

ID	2424H-CAMA-006(1)
Component(s)	Nfr-ITS-S
Requirement	If the same vehicle passes around point A within x meters and then around point B, then the travel time should be computed directly on this itinerary from A to B by the Nfr-ITS-S.
Additional information	Basically, the computing is done when vehicles pass point B and if there is still in the database the information of the same vehicle passing point A. The travel time is then computed and updated if needed. When the time to send travel times is reached, then the DATEX II message is sent to road operators with only the last updated travel time.

3.2.9.2 Configuration of CAM aggregation

This configuration allows the configuration of the zones and the parameters of the aggregation, as mentioned in chapter 6.3.5 of deliverable 2.4.1.4_H.

ID	2424H-CAMA-007(1)
Component(s)	Nfr-ITS-S
Requirement	Before being able to compute CAM data, a configuration of the Nfr-ITS-S has to be made. This configuration shall be a dynamic configuration (no need to restart).
Additional information	

ID	2424H-CAMA-008(2)
Component(s)	Nfr-ITS-S
Requirement	An administrator shall do directly in the application the configuration for the aggregation zones and itineraries locally.
Additional information	

ID	2424H-CAMA-013(1)
Component(s)	Nfr-ITS-S
Requirement	Any PFro can send the configuration for aggregation zones and itineraries, and the Nfr-ITS-S shall integrate it.
Additional information	The configuration for the aggregation zones and itineraries could be done remotely using a DATEX II message, according to the 2.4.1.4_H specifications. This message will be sent by a PFro to the Nfr-ITS-S.

This configuration allows the configuration of the « itineraries » for the computation of the travel times.

ID	2424H-CAMA-009(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	The Nfr-ITS-S should accept the update of the CAM aggregation areas coming from an authorized PFro.
Additional information	The configuration for the aggregation zones and itineraries could be done remotely using a DATEX II message, according to the 2.4.1.4_H specifications. This message will be sent by a PFro to the Nfr-ITS-S.

The zones and Itineraries are configured in the PFro. The deliverable 2.4.3.2H gives the settings: maximum number of zones, maximum number of itineraries, etc.

ID	2424H-CAMA-012(1)
Component(s)	Nfr-ITS-S
Requirement	<p>This list of parameter shall be configurable in the Nfr-ITS-S:</p> <ul style="list-style-type: none"> aggregation period for CAMs (minimum default value : 1 min, maximum default value: 30 min) frequency of sending aggregated CAM information to PFros (minimum default value : 1 min, maximum default value: 30 min) points of zones (4 points for one zone) – XY locations (minimum space between two zones : 1 km) points of itineraries (2 points for one itineraries) (maximum default length of an itinerary : 65 km) maximum number of travel time processing area that a road operator can set
Additional information	

3.3 Dissemination (Function #3)

The dissemination process **could** be optimized on the Nfr-ITS-S.

ID	2424H-SEND-001(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall never send an expired message (DEN, DATEX II, IVI, POI, ETA, MAP or SPaT messages)
Additional information	

3.3.1 Selection of interested V-ITS-S and interested Servers (Function #3.01)

ID	2424H-SEND-002(3)
Component(s)	Nfr-ITS-S
Requirement	For each processed message , the Nfr-ITS-S shall request its database to have the list of interested V-ITS-S and servers to send messages (DEN, DATEX II, IVI, POI, ETA, SPaT and MAP Messages).
Additional information	<p>The selection of interested servers and V-ITS-S is based on two criteria which facilitate the dissemination of messages:</p> <ul style="list-style-type: none"> the servers' subscription to a geographic zone (static or dynamic) which correspond to a set of tile(s) the vehicles' subscription to tiles via the reception of a CAM coming by the Nfr-ITS-S. <p>The priority for sending messages is given to servers, then to V-ITS-S, depending on the tiles to which a V-ITS-S is subscribed.</p> <p>A maximal number of V-ITS-S is set as a parameter to deal with a too long list in high-density areas.</p>

ID	2424H-SEND-003(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	After the processing of CAM messages as described in chapter 3.2.9.1 , the Nfr-ITS-S shall send a DATEX II message to relevant PFro at the defined frequency parameters.
Additional information	

ID	2424H-SEND-004(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	When the sent message is a DATEX II message, the Nfr-ITS-S shall use webservice.
Additional information	Encapsulate the DATEX II message with a SOAP envelope to the corresponding PFro (cf. deliverable 2.4.1_H).

ID	2424H-SEND-005(2)
Component(s)	Nfr-ITS-S, V-ITS-S, Centralized Traffic Light Management System, Nx-ITS-S, MCTO Transporter, MCTO Terminal, PFcm, NAP-SER
Requirement	The Nfr-ITS-S shall forward DEN, IVI, POI, ETA, SPaT and MAP messages contained in a Geonet secured header as it is.
Additional information	If the message is contained in a Geonet message, the Nfr-ITS-S send the message as it is.

The car manufacturer's platform exchanges information like any other foreign Central ITS-S:

The car manufacturer's platform sends DENMs received from the V-ITS-S directly connected to it and receives, from the Nfr-ITS-S, DEN, IVI, POI, SPaT and MAP messages sent by French stations. The message exchange is done via [3].

The car manufacturer's platform subscribes to the Nfr-ITS-S for the tiles that it is interested in.

If it wants to receive messages related to the whole country, it can then subscribe to tiles covering the entire country. It will receive all new messages sent by the Nfr-ITS-S. The car manufacturer's platform is then in charge to transfer to V-ITS-S directly connector to it.

The car manufacturer's platform **should** forward the messages received from vehicle (V-ITS-S) to the Nfr-ITS-S.

3.3.2 Addition of signature for messages issued of translation of a DATEX II messages (function #3.02)

ID	2424H-SEND-006(2)
Component(s)	Nfr-ITS-S, V-ITS-S, Centralized Traffic Light Management System, Nx-ITS-S, MCTO Transporter, MCTO Terminal, PFcm, NAP-SER
Requirement	The Nfr-ITS-S shall send unchanged any received signed DEN, IVI, POI, ETA, SPaT or MAP messages . It means keep signature and signing certificate, as described in the deliverable 2.4.4.8_H.
Additional information	

ID	2424H-SEND-007(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall sign with appropriate certificate any unsigned IVI message, POI message or DENM generated locally from DATEX II message, as described in the deliverable [3] and 2.4.4.11_H.
Additional information	

ID	2424H-SEND-008(3)
Component(s)	Nfr-ITS-S
Requirement	<p>The Nfr-ITS-S shall build a Geonet header for DEN, IVI and POI messages which do not have one.</p> <p>For any messages built from a DATEX II message, the Nfr-ITS-S has to build this header using the position as destination location and distance according to deliverables 2.4.1_H and 2.4.4.11_H:</p> <ul style="list-style-type: none"> - set to 10 km by default for the radius (<i>DestinationArea</i> distance A) for the use cases corresponding to DENM - set to 10 km by default for the radius (<i>DestinationArea</i> distance A) for the use cases corresponding to IVI - set to 50 km by default for the radius (<i>DestinationArea</i> distance A) for the use cases corresponding to POI
Additional information	<p>The Nfr-ITS-S inserts the other Geonet fields (acts as an ITS-S-S). It uses its own Geonet address.</p> <p>The Nfr-ITS-S processes only of Geonet fields describes in 2.4.1_H (including the <i>DestinationArea</i>).</p>

ID	2424H-SEND-013(1)
Component(s)	Nfr-ITS-S
Requirement	The <i>DestinationArea</i> added by Nfr-ITS-S in the Geonet header shall be configurable for each use cases.
Additional information	

3.3.3 Send messages to V-ITS-S (function #3.03)

ID	2424H-SEND-009(1)
Component(s)	Nfr-ITS-S
Requirement	When the Nfr-ITS-S tries to send a message, the default values of the TCP shall be used.
Additional information	<p>If it does not receive the acknowledgment message at the TCP level, it tries again to return this message 4 times. After 5 attempts, the connection is considered interrupted. (TcpMaxDataRetransmissions parameter: value 5 per Default).</p> <p>The initial minimum duration between 2 attempts is a default value (TCPInitialRtt cf. standard RFC62986).</p> <p>If the communication with a V-ITS-S is considered as disabled.</p> <p>Other optimizations of TCP are possible during tests period. The windows seizing of TCP may be disabled as described in RFC 1323</p>

ID	2424H-SEND-010(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall keep trying to send its message(s) using TCP until the timeout is reached. Without Keep Alive messages, the Nfr-ITS-S keeps trying to transmit messages until the timeout is expired.
Additional information	

ID	2424H-SEND-011(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall sent the message on the corresponding port define in requirement 2424H-RECE-003 .
Additional information	

ID	2424H-SEND-012(1)
Component(s)	Nfr-ITS-S, V-ITS-S, NAP-SER, PFcm, MCTO terminal, MCTO transporter, PFro, Nx-ITS-S, Centralized Traffic Light Management System
Requirement	The Nfr-ITS-S shall send complete message (including Geonet, headers, security and BTP) corresponding to the 2.4.4.11_H specifications.
Additional information	The sent message are conform to the 2.4.4.11_H specifications.

3.4 Exchanges with Nx-ITS-S

This exchange link enables to exchange information between the Nfr-ITS-S and the Nx-ITS-S.

ID	2424H-LINK-001(2)
Component(s)	Nfr-ITS-S, Nx-ITS-S, MCTO Transporter, MCTO Terminal, PFcm, NAP-SER
Requirement	The Nfr-ITS-S shall implement an interface called IF2 (including AMQP protocol) according to specifications described in [3] and 2.4.1_H, to communications with Nx-ITS-S, MCTO Transporter, MCTO Terminal, PFcm and NAP-SER.
Additional information	The parameters of connections are describes in 2424H-SECU-001(1) .

ID	2424H-LINK-002(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S
Requirement	The Nfr-ITS-S shall subscribe to the Nx-ITS-S for the area of interest of French V-ITS-S located in foreign countries.
Additional information	

ID	2424H-LINK-003(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S
Requirement	The Nfr-ITS-S shall subscribe to France geographic area on the Nx-ITS-S.
Additional information	

ID	2424H-LINK-004(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S
Requirement	The Nfr-ITS-S shall publish on the interface with Nx-ITS-S only the events coming from French senders.
Additional information	The specifications of this link are those of the IF2 interface defined in [3]

ID	2424H-LINK-005(1)
Component(s)	Nfr-ITS-S, Nx-ITS-S
Requirement	The Nfr-ITS-S shall not publish on the interface with Nx-ITS-S events coming from Nx-ITS-S.
Additional information	Reminder: Tiles as the border can be considerate as French and foreign, see chapter 4.1 .

ID	2424H-LINK-006(2)
Component(s)	Nfr-ITS-S, Nx-ITS-S, MCTO Transporter, MCTO Terminal, PFcm, NAP-SER
Requirement	Via the AMQP protocol: when the connection with a server is interrupted (which means that no answer to Keep Alive are received by the Nfr-ITS-S), the Nfr-ITS-S shall try a connection to this server. If the attempt fails, the Nfr-ITS-S can try again every 10 seconds during 5 minutes. If the Nfr-ITS-S has received no answers after 5 minutes, the connection will be considered as lost, and no more connection attempts will be done.
Additional information	See [3]

Two situations will use this link (describes in chapter0):

- sending information to French V-ITS-S (vehicle) traveling outside the country,
- managing event generated by foreign V-ITS-S (vehicle).

When the Nfr-ITS-S knows that a French V-ITS-S is located in a foreign country, the Nfr-ITS-S **subscribes** to the Nx-ITS-S to be able to get all relevant information for the concerned V-ITS-S (see chapter 0).

When a foreign V-ITS-S need information on French event, the Nx-ITS-S **subscribes** to the relevant list of events of the French one (see chapter0).

4 Operating mode

This chapter describes the process in some specific cases (for example change of vehicle identity, loss of cellular connection, etc.)

Requirement about this part: The vehicle is authenticated on the Nfr-ITS-S.

4.1 Operations for a French vehicle crossing the border to

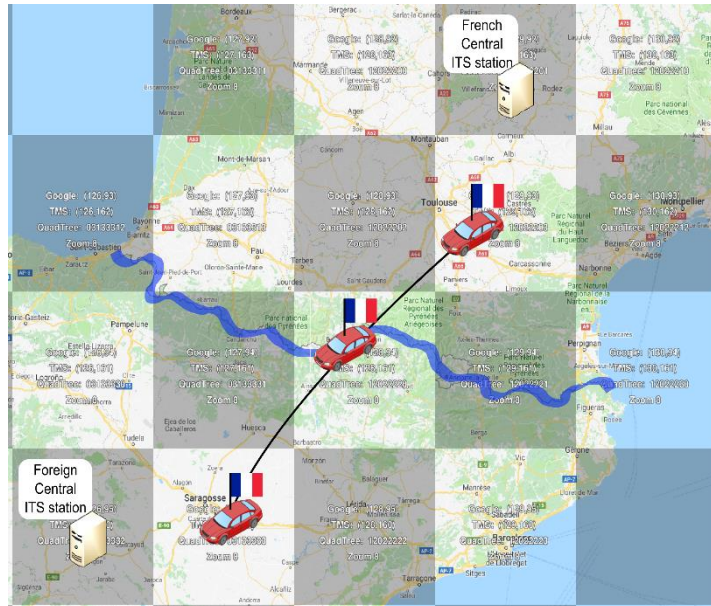


Figure 12. Vehicle (V-ITS-S) crossing a border

another country equipped with a Nx-ITS-S

4.1.1 French vehicle at the French border with another country

In the beginning, the French V-ITS-S is in France. The Nfr-ITS-S achieves the authentication of the vehicle (see chapter 3.1.1).

The Nfr-ITS-S receive a CAM of a French V-ITS-S corresponding to a French Border Tile between France and an other Country.

ID	2424H-OPMO-001(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall have a dictionary associating border tiles to the countries to which they belong. All border tiles are associated to all countries present in the tile. For France borders: all French border tiles located between France and another country will be collected and for each one we mention the country who shares with France this tile.
Additional information	

ID	2424H-OPMO-002(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall send messages located in France (on the shared tile) to the vehicle (see chapter 3.3.3)
Additional information	The Nfr-ITS-S sends to the V-ITS-S all relevant messages. (see chapter 3.3)

ID	2424H-OPMO-003(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall subscribe to all border's tiles of Nx-ITS-S of bordering country(ies).
Additional information	Subscribe on IF2 interface [3]

ID	2424H-OPMO-004(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall send to the V-ITS-S messages received on IF2 interface from country(ies) which are present on the border tile.
Additional information	The Nfr-ITS-S sends to the V-ITS-S all relevant messages. (see chapter 3.3.3)

ID	2424H-OPMO-005(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall link between each tile and the corresponding country.
Additional information	

If the V-ITS-S continue its trajectory, it will be in a Tile corresponding to another country, cf.next chapter.

4.1.2 French vehicle in a foreign country

This chapter concerns French vehicles that are directly connected to the Nfr-ITS-S.

The Nfr-ITS-S achieves the authentication of the vehicle (see chapter 3.1.1).

The Nfr-ITS-S receive a CAM of a French V-ITS-S corresponding to another country.

ID	2424H-OPMO-006(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall subscribe to the Nx-ITS-S where the vehicle is located.
Additional information	Subscribe on IF2 interface

ID	2424H-OPMO-007(1)
Component(s)	Nfr-ITS-S, V-ITS-S
Requirement	The Nfr-ITS-S shall send to the vehicle messages received on IF2 interface from the Nx-ITS-S.
Additional information	

ID	2424H-OPMO-008(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall publish on IF2 interface all valid messages from French V-ITS-S which are located outside France.
Additional information	Only valid messages are sent to Foreign national Central ITS-S. The Nx-ITS-S will receive the events about an area if it has subscribed to this area. A log file is generated and the message is stored.

4.2 Data exchange with Nx-ITS-S for foreign vehicles in France

This chapter does not concern the vehicle connected through a PFcm.

ID	2424H-OPMO-009(1)
Component(s)	Nfr-ITS-S
Requirement	Nfr-ITS-S shall subscribe to every Nx-ITS-S IF2 interface on the France area in order to get all messages located in France, cf. Chapter 3.4 .
Additional information	For the interaction between both National Central ITS-S, the IF2 interface is used.

Cf.requirement 2424H-OPMO-007(1)

ID	2424H-OPMO-010(1)
Component(s)	Nfr-ITS-S
Requirement	Nfr-ITS-S shall publish messages located in France on IF2 Interface.
Additional information	Nx-ITS-S are able to subscribe to Nfr-ITS-S on IF2 Interface to obtains messages located in France

5 Support modules

5.1 Configuration

Tiles configurations

ID	2424H-CONF-001(1)
Component(s)	Nfr-ITS-S
Requirement	The referential of tiles used shall be used by the Nfr-ITS-S defined in [3].
Additional information	The referential chosen is display on [4].

ID	2424H-CONF-002(1)
Component(s)	Nfr-ITS-S
Requirement	<p>Several variables are configured with default values in a configuration file, for example:</p> <ul style="list-style-type: none"> - Time before considering the connection with an V-ITS-SU as interrupted cf. requirement 2424-AUTH-003(1) - Zoom levels (maximum and minimum) (cf.3.2.2.1); - Aggregation period for CAMs (maximum and minimum values) (cf.3.2.4.2.3); - Maximum length of an itinerary (cf.3.2.4.2.3); - Sending frequency of aggregated CAM to PFros (maximum and minimum) (cf.3.2.5); - Sending frequency of acceptance of signed CAMs as a Keep Alive; - Number of attempts before considering the connection as interrupted during the sending of a message. (TcpMaxDataRetransmissions parameter) (cf.requirement 2424H-SEND-001(1)); - The initial minimum duration between 2 attempts (TCPInitialRtt) (cf.requirement 2424H-SEND-001(1)); - Synchronization frequency with the NTP server (cf.4.1); - Time before considering the connection with a PFro as interrupted (cf.4.1); - Sending frequency of DATEX II Keep Alives to PFros (cf.4.2); - DENM and IVI validity (cf. chapter 3.1.3) - Validity duration of CAM, fixed by the Nfr-ITS-S when registering it in a database (cf.5.3.2).
Additional information	The default values of these variables are disseminated in this document.

5.1.1 Connection

ID	2424H-CONF-003(1)
Component(s)	Nfr-ITS-S
Requirement	The URL of the Nfr-ITS-S shall be configurable.
Additional information	The Web hosting service constraints are described in chapter 5.4

ID	2424H-CONF-004(1)
Component(s)	Nfr-ITS-S, Centralized Traffic Light Management System, Nx-ITS-S, MCTO terminal, MCTO transporter, PFCM, NAP-SER
Requirement	The Nfr-ITS-S shall exchange information with other servers in a secured way: The communication to the servers is secured. To that extent, an authentication is needed. The Nfr-ITS-S stores the certificates and/or the login associated to these connections. Cf. requirement 2424H-LINK-004(1) and deliverables 2.4.4.11_H and 2.4.1_H.
Additional information	After the connection is secured, the Nfr-ITS-S can exchange information.

5.1.1.1 With a PFro

ID	2424H-CONF-005(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	The Nfr-ITS-S shall accept ask request of authorized PFro.
Additional information	So a PFro can receive all new messages sent by the Nfr-ITS-S corresponding on the area defined by the requirement 2424H-CONF-006(1) .

ID	2424H-CONF-006(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	The Nfr-ITS-S shall associate the tiles (from zoom min level 10 by default) containing the network of each road operator. This geographic area definition is static for every road operator. The tiles of higher zoom level (Zoom 11 to Zoom Max, default value define in the requirement 2424H-PROC-005) are concerned if they are in the Zoom define in the requirement 2424H-PROC-005 in the previous list of tiles. The subscription to the corresponding tiles is static and permanent. (However, the tiles associated to each road operator can be re-compute after each manual reception of a shape file).
Additional information	Every road operator sends, when needed, the shape file of the road network he is interested in. As a reminder, one tile can be associated to different road operators. Possible optimization: the Nfr-ITS-S could define, for every zoom level, the set of tiles concerning each road operator.

ID	2424H-CONF-007(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	The Nfr-ITS-S shall send DATEX II Keep Alive and check the reception of DATEX II Keep Alive periodically for the exchanges with the PFro.
Additional information	The connection between the Nfr-ITS-S and each PFro is considered as broken if there are no answers to keep alive (sent to PFros every 10 sec by default) during a configurable duration (fixed at 6 min by default).

ID	2424H-CONF-008(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	The Nfr-ITS-S accept the DATEX II Keep Alive Messages coming from a PFro.
Additional information	

ID	2424H-CONF-009(2)
Component(s)	Nfr-ITS-S, PFro
Requirement	At each new connection to a PFro or after a long disconnection, the Nfr-ITS-S shall request a DATEX II snapshot to this particular PFro.
Additional information	In case of error, ask again the DATEX II snapshot after a time define by default to X seconds.

ID	2424H-CONF-010(1)
Component(s)	Nfr-ITS-S, PFro
Requirement	At every connection to a PFro, the Nfr-ITS-S shall send snapshot if there is a request a DATEX II snapshot from a PFro.
Additional information	

5.1.1.2 With a V-ITS-S

Cf.requirement [2424-AUTH-003\(1\)](#)

5.1.1.3 With servers using IF2 link

Cf.chapter 3.4 .

ID	2424H-CONF-011(3)
Component(s)	Nfr-ITS-S, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER
Requirement	Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm and NAP-SER shall subscribe to the Nfr-ITS-S, so they can receive all relevant messages sent by the Nfr-ITS-S.
Additional information	Cf.deliverable 2.4.1_H

5.1.2 Time synchronization

ID	2424H-CONF-012(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall embed a NTP client to be time synchronized with a NTP server, which will broadcast the temporal synchronization in client/server mode to the NTP client installed in the Nfr-ITS-S.
Additional information	Cf.deliverable 2.4.1_H

ID	2424H-CONF-013(2)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall do time synchronization regularly (once per hour by default).
Additional information	Cf. deliverable 2.4.1_H If the connection is lost between the Nfr-ITS-S and the NTP server, an error message is generated.

ID	2424H-CONF-014(2)																										
Component(s)	Nfr-ITS-S																										
Requirement	<p>The Nfr-ITS-S shall manage two types of time reference. This two types are used for the conversion between the different time formats, considering the different types of messages:</p> <table><tr><td>Message type</td><td>IVI</td><td>CA</td><td>DEN</td><td>DATEX</td><td>POI</td><td>SPaT</td><td>MAP</td><td>ETA</td></tr><tr><td>Time format</td><td>TAI</td><td>TAI</td><td>TAI</td><td>UTC</td><td>TAI</td><td>UTC</td><td>UTC</td><td>TAI</td></tr></table>									Message type	IVI	CA	DEN	DATEX	POI	SPaT	MAP	ETA	Time format	TAI	TAI	TAI	UTC	TAI	UTC	UTC	TAI
Message type	IVI	CA	DEN	DATEX	POI	SPaT	MAP	ETA																			
Time format	TAI	TAI	TAI	UTC	TAI	UTC	UTC	TAI																			
Additional information	<p>The Nfr-ITS-S communicates in the time TAI for CA, DEN, IVI, POI and ETA messages, because it is the one used in the exchanges (V2V or I2V/ or V2I).</p> <p>The following algorithm shall be used: TAI = UTC(system) - UTC(01/01/2004) + (intercalary seconds since 01/01/2004)</p>																										

5.1.3 Archiving

ID	2424H-CONF-015(1)
Component(s)	Nfr-ITS-S
Requirement	The application shall provide monitoring modules specific to the Nfr-ITS-S as well as backup, restoration, purge and automatic and manual archiving modules for the database.
Additional	

information	
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ID	2424H-CONF-016(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall also archive all received messages (DATEX II, IVI, DENM).
Additional information	If messages are not conform, they are archived before been dropped. Reminder: the CAM are not archived.

ID	2424H-CONF-017(1)
Component(s)	Nfr-ITS-S
Requirement	The archiving module shall integrate a configured purge system, which will clean the database of elements past the retention time defined for archiving and archived the logs.
Additional information	Cf.chapter 5.1.3

ID	2424H-CONF-018(1)
Component(s)	Nfr-ITS-S
Requirement	An automatic backup procedure with different time intervals shall be developed.
Additional information	

ID	2424H-CONF-019(1)
Component(s)	Nfr-ITS-S
Requirement	The partial or total restoration should be made possible. It will be done manually from the backups.
Additional information	

5.1.4 Databases cleaning

For CAM, the Station ID will periodically change. Thus, all old records will be automatically removed from the database.

ID	2424H-CONF-020(2)
Component(s)	Nfr-ITS-S
Requirement	Once every 24 hours (configurable value), the Nfr-ITS-S shall erase from the database every message that are no longer valid. The message is previously archived before being deleted. The fields to test if the message is expired are: - DENM: <i>validityDuration</i> - IVI: <i>validTo</i> - DATEX II: <i>overallEndTime</i> cf.deliverable 2.4.1.4_H
Additional information	The messages are normally deleted progressively when they expire; this is only an additional deletion check.

ID	2424H-CONF-036(2)
Component(s)	Nfr-ITS-S
Requirement	POI and MAP messages do not have validity duration. The Nfr-ITS-S shall only erase these messages from its database when there is an update of these messages.
Additional information	

ID	2424H-CONF-037(3)
Component(s)	Nfr-ITS-S
Requirement	SPaT and ETA messages shall be erased from the Nfr-ITS-S database at the same frequency as CAMs.
Additional information	The messages are normally deleted progressively when there is an update; this is only an additional deletion check.

5.1.5 Supervision

ID	2424H-CONF-021(1)
Component(s)	Nfr-ITS-S
Requirement	Nfr-ITS-S shall permit to manage different type of users with restricted permissions.
Additional information	

ID	2424H-CONF-022(1)
Component(s)	Nfr-ITS-S, PFro, Centralized Traffic Light Management System, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER
Requirement	Nfr-ITS-S shall supervise the connection status with the connected servers
Additional information	

ID	2424H-CONF-023(1)
Component(s)	Nfr-ITS-S
Requirement	Nfr-ITS-S shall generate at the minimum 4 levels of logs (debug, info, warning, error).
Additional information	

5.2 Human–Machine Interface (HMI)

ID	2424H-CONF-024(1)
Component(s)	Nfr-ITS-S, PFro, Centralized Traffic Light Management System, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display the connection status with the connected servers: Nfr-ITS-S, PFro, Centralized Traffic Light Management System, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER. A color code will be used: green (Ok), orange (not perfect), Red (problems) and gray (no answer).
Additional information	

ID	2424H-CONF-025(1)
Component(s)	Nfr-ITS-S, PFro, Centralized Traffic Light Management System, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display the geographic area request of each server, as a list and on specific html page.
Additional information	

ID	2424H-CONF-026(1)
Component(s)	Nfr-ITS-S
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display the logs files, with possibility of filtering per log type.
Additional information	The archiving and the purge should be access only by administrator.

ID	2424H-CONF-027(1)
Component(s)	Nfr-ITS-S
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall permit to filter each previous HMI pages, in function of criteria: <ul style="list-style-type: none"> - ITS Stations type, - Sender - country - Message Type - Event Type (cf. uses cases)
Additional information	

ID	2424H-CONF-028(1)
Component(s)	Nfr-ITS-S
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display the time TAI and the time UTC.
Additional information	

ID	2424H-CONF-029(1)
Component(s)	Nfr-ITS-S
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display a readable map of the current events.
Additional information	If two events are geographically close, they should be displayed separately. Configurable time of refresh (10 seconds by default)

ID	2424H-CONF-030(1)
Component(s)	Nfr-ITS-S
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display the maps on a geographical area with a zoom defined by default according to the previous connection.
Additional information	A scrolling list of defined geographic areas could be added in the future.

ID	2424H-CONF-031(1)
Component(s)	Nfr-ITS-S
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display a table the events with at minimum this list of fields: <ul style="list-style-type: none"> - ITS Stations type, - Sender - country - Message Type - Event Type (cf.uses cases)
Additional information	Configurable time of refresh (10 seconds by default)

ID	2424H-CONF-032(1)
Component(s)	Nfr-ITS-S
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall permit to configure the the time value between two refresh of the page and associated process. The configurable time of refresh is define at 10 seconds by default.
Additional information	

ID	2424H-CONF-034(1)
Component(s)	Nfr-ITS-S, PFro, Centralized Traffic Light Management System, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display a table with at minimum this list of columns: <ul style="list-style-type: none"> - ITS station pseudonym, - the timestamp humanly readable of the previous connection, - the timestamp humanly readable of the last revived message, - the timestamp humanly readable of the last emitted message, - the timestamp humanly readable of the last Keep Alive received - the timestamp humanly readable of the last Keep Alive emitted with acknowledge - a value corresponding to the color code will be used: green (Ok), orange (not perfect), Red (problems) and gray (no answer).
Additional information	Without the possibility to display their location.

ID	2424H-CONF-035(1)
Component(s)	Nfr-ITS-S, PFro, Centralized Traffic Light Management System, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER
Requirement	The Human–Machine Interface of the Nfr-ITS-S shall display the remaining validity time of ITS certificates.
Additional information	Cf.deliverable 2.4.4.11_H.

5.3 Security configuration

ID	2424H-SECU-001(1)
Component(s)	Nfr-ITS-S
Requirement	The Nfr-ITS-S shall manage the certificates globally the same manner as an R-ITS-S cf.deliverable 2.4.4.5_H and 2.4.4.6_H. For example, as an R-ITS-S the Nfr-ITS-S can be triggered to renew it certificate(s).
Additional information	The method to the PKI configuration is defined in 2.4.4.11_H. The specific parameters of the Nfr-ITS-S are defined in deliverable 2.4.4.5_H.

ID	2424H-SECU-002(1)
Component(s)	Nfr-ITS-S, PKI
Requirement	The Nfr-ITS-S shall have a PKI configuration cf.deliverable 2.4.4.8_H and 2.4.4.11_H
Additional information	

5.3.1 Authentication and profiles

ID	2424H-SECU-003(1)
Component(s)	Nfr-ITS-S, PKI
Requirement	The Nfr-ITS-S's configuration, management and monitoring shall be managed by web pages.
Additional information	

ID	2424H-SECU-004(1)
Component(s)	Nfr-ITS-S, PKI
Requirement	Access to the platform and web services shall be authenticated.
Additional information	The authentication tool of the Ministry in charge of Transport called Cerbère (which is a personal secure authentication for one use session) will be usable for this authentication. Cerbère offers a standardized 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. For the non-ministry sites, other solutions will be implemented:

	<ul style="list-style-type: none"> It shall be possible to use Cerbère in dongle mode (with a local management of rights and profiles). The Nfr-ITS-S will be able to work with an authentication tool chosen by the site manager, which will interface with the Nfr-ITS-S (e.g., LDAP authentication server).
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Access to the Central ITS-S through the web pages will be differentiated according to several profiles (administrators, road operators, etc.), where each profile can be configured by the site administrator via the administrator profile.

	User profile	Administrator profile
Log Access	read	Write/read
Profiles administration		Write/read
Amenities configuration	read	Write/read
Connections status	read	read
HMI (with display configuration)	Click/read	Click/read

5.4 Scalability and Evolutions possibility

Scalability of the Nfr-ITS-S.

ID	2424H-SECU-005(1)
Component(s)	Nfr-ITS-S
Requirement	The modules described on the Erreur ! Source du renvoi introuvable. could be supported by different hardware to enable load balancing.
Additional information	To be able to absorb the load of numerous V-ITS-S data flow, the Nfr-ITS-S can be physically duplicated. Functions described below work at application layer and are independent of the hardware. The hardware (CPU, RAM, disk space, network configuration, hosting) will take into account the possible evolution of the system. CA: The Fig 6.Main services of the Nfr-ITS-S show acceptances parameters.

ID	2424H-SECU-006(1)
Component(s)	Nfr-ITS-S
Requirement	The URL to reach the Nfr-ITS-S, shall be a distinguish name and is configurable.
Additional information	

ID	2424H-SECU-007(1)
Component(s)	Nfr-ITS-S, PFro, Centralized Traffic Light Management System, Nx-ITS-S, MCTO transporter, MCTO terminal, PFcm, NAP-SER, V-ITS-S
Requirement	The maximum number of simultaneous connection shall be configurable, 200 by default.
Additional information	

5.5 Documentation

Several manuals have to be written: installation and configuration manual, exploitation manual (including update procedure), user manual.

6 References

ITS and IETF (RFC) standards:

SCOOP deliverable 2.4.1_Bis List of standards.

Other references:

- [1] COCSIC deliverable 2.4.1_H - Hybrid Architecture
- [2] SCOOP deliverable 2.4.1 v2.0 - Common set of functional and technical specifications
- [3] InterCor Project deliverable called InterCor_2.1b_IF2_specs-v2
- [4] website to display the zoom level:
<http://www.maptiler.org/google-maps-coordinates-tile-bounds-projection/>
- [5] COCSIC series of security deliverables
 - 2.4.4.5_H,
 - 2.4.4.6_H,
 - 2.4.4.8_H,
 - 2.4.4.11_H.
 - Etc.
- [6] SCOOP deliverable 2.4.1.2 - Specifications of DENM fields
- [7] COCSIC series of deliverables 2.1.4.2_H Common technical specifications for use cases:
 - 2.4.1.2_H Master - Master specifications of use cases
 - 2.4.1.2_H B1a&b - Specification of B1a&b use case
 - 2.4.1.2_H C3 - Specification of VMS use case
 - 2.4.1.2_H D7 - Specification of wrong way driving use case
 - 2.4.1.2_H C2 - Specification of dynamic speed limit use case
 - 2.4.1.2_H F1 - Specification of POI Parking use case
 - 2.4.1.2_H_Bis MCTO Specification of use cases of Multimodal Cargo Transport Optimization Service