



French C-ITS Deployment Coordination committee

Specification of DATEX II v2.3 messages in conjunction with C-ITS messages

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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

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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 terme 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

ASN.1	Abstract Syntax Notation One
CAM	Cooperative Awareness Message
C-ITS	Cooperative Intelligent Transport Systems
DENM	Decentralized Environmental Notification Message
GPS	Global Positioning System
ITS	Intelligent Transport Systems
IVI	Infrastructure to Vehicle Information
IVIM	Infrastructure to Vehicle Information Message
R-ITS-S	Roadside ITS Station (RSU or ITS-S R in the French Terminology)
RWW	Roadworks Warning
TC	Traffic class
TCC	Traffic Control Centre
ITS-G5	<p>ITS-G5 is a European standard for ad-hoc short-range communication of vehicles among each other (V2V) and with Road ITS Stations (V2I). ITS-G5 refers to the approved amendment of the IEEE 802.11 (standard IEEE 802.11p). This technology (possibly others) uses the 5.9 GHz frequency band to support safety- and non-safety ITS applications.</p> <p>In this document ITS-G5 stands for IEEE802.11p/ETSI ITS-G5.</p>

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1 Introduction

1.1 Purpose of the document

This document specifies the DATEX II message(s) for each use case defined in SCOOP, C-ROADS, and INTERCOR.

This document consists in:

- One principal document 2.4.1.4_H,
- Several annexes which illustrates the messages and their construction:
 - Annex 1: DATEX II <-> DENM translation for R-ITS-S, Vro-ITS-S and Nfr-ITS-S
 - Annex 2: Classes to be used by TMS for the DATEX II <-> DENM translation
 - Annex 3: DATEX II <-> IVI Translation for eVMS, for R-ITS-S, Vro-ITS-S and Nfr-ITS-S
 - Annex 5: DATEX II <-> POI translation for R-ITS-S, Vro-ITS-S and Nfr-ITS-S
 - Annex 6: Schema XSD between Platform and R-ITS-S, Vro-ITS-S and Nfr-ITS-S
 - Annex 7: DATEX II <-> IVI translation for Dynamic speed limit
 - Annex 8: DATEX II <-> IVI translation for Lane Management
- Several examples of DATEX II messages.

Note : Annex 4 has been deleted.

1.2 Inputs of the document

The referenced documents are the following:

- [1] CEN Technical Specifications 16157-1 to 6, defining the language DATEX II v2.3.
- [2] DATEX II Documentation (on the site www.datex2.eu, such as user's guide, Software developer's Guide, Walkthrough the model ...)
- [3] Safety related message sets - Selection of DATEX II Codes, TPEG2-TEC-Causes and TMC-Events for EC high level Categories
- [4] The French Guide "les échanges de données pour l'exploitation de la route – Utilisation de Datex II – Partie 1: publication d'une situation de trafic"(Data exchange for road use – DATEX II Use - Part 1: publication of a traffic situation) - November 2015, drawn up by the DATEX II France Working Group
- [5] 2.4.1 - Common set of functional and technical specifications
- [6] 2.4.1.2 - Specifications of DENM fields
- [7] 2.4.1bis - List of standards
- [8] 2.4.1_H - Hybrid Architecture
- [9] 2.4.1.2_H Master - Master specifications of use cases
- [10] 2.4.1.2_H B1a&b - Specification of B1a&b use case
- [11] 2.4.1.2_H C3 - Specification of VMS use case
- [12] 2.4.1.2_H D7 - Specification of wrong way driving use case
- [13] 2.4.1.2_H C2 - Specification of dynamic speed limit use case
- [14] 2.4.1.2_H F1 - Specification POI Parking use case
- [15] Guidance Document for Member States on technical implementation of Delegated Regulation 885/2013 in relation to the European Access Point for Truck Parking Data - Annex I: DATEX II minimum profile for EU core components for static data related to Secured Truck Parking Areas - v1.0 - March 2016 (https://ec.europa.eu/transport/themes/its/road/action_plan/intelligent-truck-parking_en)
- [16] 2.4.1.2_H H2 - dynamic traffic ban to specific vehicle (I2V)
- [17] 2.4.1.2_H H4 - dynamic lane management - reserved lane (I2V)
- [18] 2.4.1.2_H H6 - HGV overtaking ban (I2V)
- [19] 2.4.2.1_H - R-ITS-S Specifications
- [20] 2.4.2.2 - Vro-ITS-S specifications
- [21] 2.4.2.4_H - Nfr-ITS-S specifications
- [22] 2.4.3.2_H - Detailed functional specifications of SCOOP platform

1.3 DATEX II principles

(Extracts from the guide [4] drawn up by the DATEX II France group)

DATEX II is a data exchange specification for traffic and movements. It standardises the interface between the traffic management centres, road information centres and with the service operators. It has become the reference for the applications developed and implemented in Europe over the past 10 years. It includes two definition levels:

- the first level is independent of any implementation. It defines concept modelling based on UML (Unified Modelling Language), which is an international standard;
- the second level concerns the implementations based on the model of the first level. Several implementations are possible, but only the one based on XML (“eXtended Markup Language”) has been defined at present. Others may be defined in the future, especially those based on ASN.1 and the corresponding coding standard, ISO/ICE 8825-2 “Information Technologies -- ASN.1 coding rules: Specification for packed coding rules (PER) -- Part 2”.

A DATEX II message is composed of two parts:

- the first, called **<Exchange>**, contains the data used to characterise the actual exchange.
- the second defines the useful content exchanged. The exchange is based on the publication mechanism that groups data with similar characteristics. The generic name is **<PayloadPublication>**.

The content of a DATEX II message can be exchange via seven major data publication families, modelled distinctly:

- Publication of situations (events sustained and operating actions);
- Publication of measured data (counts and meteorological data);
- Publication of calculated data (transit time – traffic states);
- Publication of traffic states (on a major road or network);
- Publication of data related to the content displayed on variable message panels;
- Publication of status data on parking sites (real-time data for a site or group of sites); and
- Publication of data on vehicles in the parking sites.

In addition to these basic publications, four other utilitarian publications are available (i.e., in support of the previous ones and defining the static characteristics or those that change little:

- Publication of measurement site tables (for the traffic measured data);
- Publication of predefined locations (useful for traffic status in particular);
- Publication of characteristic tables for variable message panels; and
- Publication of site and group characteristics of parking sites.

A simplified version of the structure of a DATEX II message for the publication of situations is provided below:

<D2LogicalModel [name of the versions used]>	
<exchange> [exchange parameters: addressing...] </exchange>	
<PayloadPublication> [publication parameters: name of the publisher, start/end date of publication...]	
	<situation> [parameters describing situation 1: type, location, direction ... Ex: traffic jams] </situation>

<div> <div> <situation>[parameters describing situation 2: type, location, direction ... E.g.:X vehicles in Y minutes]</div> <div></situation></div> </div> <div> <div>[n situations described one-by-one]</div> </div>
</payloadPublication>
</D2LogicalModel>

A simplified version of the structure of a DATEX II message for the publication of VMS is provided below:

<div> <div><D2LogicalModel [name of the versions used]></div> <div> <div> <div><exchange></div> <div>[exchange parameters: addressing...]</div> <div></exchange></div> </div> <div> <div><PayloadPublication>[publication parameters: name of the publisher, start/end date of publication...]</div> <div> <div> <div><VmsUnit>[parameters describing VMS Message: text, pictogram]</div> <div></VmsUnit ></div> </div> <div> <div><VmsUnit>[parameters describing VMS Message: text, pictogram]</div> <div></VmsUnit ></div> </div> <div> <div>[n VmsUnit described one-by-one]</div> </div> </div> </div> </div> <div></payloadPublication></div> </div> <div></D2LogicalModel></div>

The other DATEX II publications fit overall into the same scheme. Different types of publication shall not be mixed in the same content.

The DATEX II protocol provides three exchange modes:

- An “Operating mode 1” (operatingMode1), which the supplier can use to send data directly as soon as the content changes (“on occurrence”);
- An “Operating mode 2” (operatingMode2), which the supplier can use periodically to send data directly; and
- An “Operating mode 3” (operatingMode3), which corresponds to a client’s request / supplier’s reply exchange type.

In the first two modes, the logic is to push information to the consumer (“push”); in the third case, the consumer initiates the exchange (“pull”).

Synchronisation requests are in operating mode 3.

1.4 Vocabulary and language

To make it reading easier, the rest of the document uses the following language simplifications:

- DATEX II refers to DATEX II V2.3 as defined in the Technical Specifications, CEN TS 16157-1 to 6
- CAM refers to the standard EN 302 637-2
- DENM refers to the standard EN 302 637-3
(See the Deliverable [2.4.1bis] for the versions)

We will designate under the term of “sender” the one that constructs the DATEX II message and sends it to

a “recipient”. We also distinguish the content creator (“payload” in DATEX II) from the one who does the exchange (“supplier” in DATEX II). For example, in an “uplink” case from Roadside Unit (R-ITS-S) to platform, the R-ITS-S is a sender, the platform can be a recipient and then a sender and the TMS is a recipient. The R-ITS-S is the message creator and the platform performs the exchange.

In this document, two terms are to be distinguished:

- Class, which is a set of vehicles meeting conditions for a road operator;
- Class, which is a common description of a set of objects for DATEX II (we will then speak of DATEX II class and use the **<class>** notation).

For reasons of simplification, the term “traffic management system” (TMS) is used to designate all or part of the information system that the road operator will use to transmit the DATEX II messages (it can be TMS or OSS (Operation Support System) or a management terminal, etc.).

Furthermore, in DATEX II version 2.3 there is a single namespace for all the XML tags. The **<D2LogicalModel>** tag using the XML parameter named “xmlns” shall explicitly defined this namespace, in the French C-ITS Projects. However, for improving legibility in the body of this document, the names of the XML tags including namespace of the DATEX II classes are not used. The “xml” files in the appendix are complete and are the reference for the development of use cases.

To be clearer:

- Developers shall complete tag name with namespace: **<D2LogicalModel:payloadPublication>**.
- The examples in this document are only simplified tag name without namespace as used below: **<payloadPublication>**.

Formatting conventions are used to distinguish the different elements:

- xml code:

```
<?xml version="1.0" >
```

- DATEX II class declaration in xml code (with namespace in bold and underlined):

```
<D2LogicalModel:D2LogicalModel modelBaseVersion="2"
xmlns:D2LogicalModel="http://DATEX2.eu/schema/2/2_0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="
http://DATEX2.eu/schema/2/2_0 DatexIISchema_2_2_3.xsd">
```

- DATEX II class declaration in xml code (without namespace):

```
<D2LogicalModel modelBaseVersion="2" xmlns="http://DATEX2.eu/schema/2/2_0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="
http://DATEX2.eu/schema/2/2_0 DatexIISchema_2_2_3.xsd">
```

- xml code that will be specified in a different paragraph:

```
[EXCHANGE PARAMETERS see chapter 2.2]
VALUE BASED ON USE CASE
```

The class name is in black, the parameters that accompany the class name are in green and the attributes that are defined from a closed enumeration list are in orange whereas the others are in blue. The elements in red are clarified in another place.

NOTE: in the context of the French C-ITS Projects, several attributes or classes of a DATEX II message that could be completed by a TMS are not presented because, in general, there is no equivalent in DENM. However, it should be noted that the operator could send messages to several recipients at the same time. The operator

could therefore set some attributes or classes of the DATEX II message that are not recommended in this document.

1.5 Functional elements

Those elements are extracts from the French C-ITS Projects documentation. The authentic information is in the deliverables.

1.5.1 Overview of DATEX II messages flow

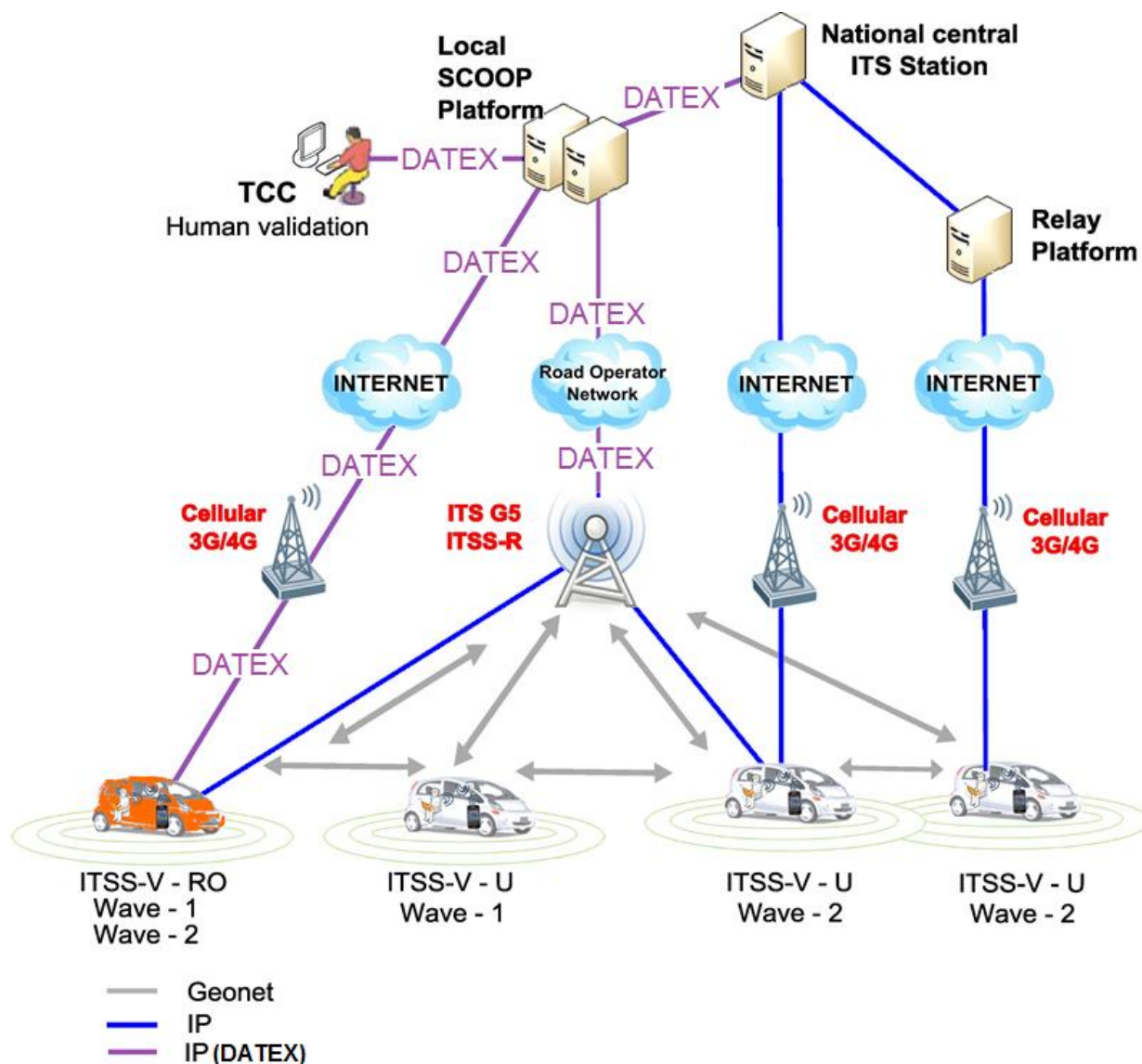


Figure 1 : *Who can send and receive DATEX II Messages?*

This figure shows between which elements can flow DATEX II messages.

1.5.2 Overview of the use cases treated by this document

There are seven types of messages exchanged between the different C-ITS elements, using different DATEX II publications:

DATEX II message "type"	Use Case name or high level description	Details
Measured Data	A1 traffic data (position, speed, direction)	§ 4.3
Configuration of measurement points	Configuration of measurement points in the R-ITS-S	§ 4.2
Situation	B1: warning - scheduled roadwork (stationary and mobile)	§ 5
	B2: Warning - work on lanes	§ 5
	B3: warning - priority winter road maintenance vehicles	§ 5
	A2 and A3: event data produced by the vehicle	§ 5
	C2: Dynamic Speed Limit	§ 8
	D1: warning - temporarily slippery road	§ 5
	D2: Warning - animal or person on the road	§ 5
	D3: Warning - obstacle on the road	§ 5
	D4: warning - stationary vehicles, breakdown	§ 5
	D5: warning - unprotected accident area	§ 5
	D6: Warning - low visibility	§ 5
	D7: warning - wrong way driver	§ 5
	D8: Warning - unmanaged blockage of a road	§ 5
	D10: warning - emergency braking	§ 5
	D11: warning - end of queue	§ 5
	E6: Warning - exceptional weather conditions	§ 5
	H2 - dynamic traffic ban to specific vehicle (I2V)	§ 9
	H4 - dynamic lane management - reserved lane (I2V)	§ 9
	H6 - HGV overtaking ban (I2V)	§ 9
Vms message	C3 : e-VMS: messages in the whole system	§ 6.2.2
Vms table	C3 : e-VMS: location of the VMS from TMS to the platform	§ 6.2.3
Measured Data for a vehicle	Position of the road operators' vehicles	§ 10.1
Sos Activation	SOS activation notification on road operator's vehicles	§ 10.2
Parking Publication	F1 – POI Parking	§ 7

Table 1 : Use Cases treated in this document

2 Construction of any DATEX II message

This paragraph details the construction of each part of a DATEX II message according to the use case.

2.1 Message beginning and end

At the beginning of any xml message, the versions of XML and the DATEX II model used are specified. The end of the message terminates with an end tag.

```
<?xml version="1.0" coding="UTF-8"?>
<!--Potential comments -->
<D2LogicalModel modelBaseVersion="2" xmlns="http://DATEX2.eu/schema/2/2_0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://DATEX2.eu/schema/2/2_0 DatexIISchema_2_2_3.xsd">
...
[EXCHANGE PARAMETERS see chapter 2.2]
...
[MESSAGE CONTENT see the rest of the document]
...
</D2LogicalModel>
```

NOTE 1: The prologue "<?xml version='1.0' coding='UTF-8'?>" is used only once, at the first file line. As French C-ITS projects always used the DATEX II messages with the SOAP protocol, the prologue is not repeated in the SOAP <body> part of the file.

NOTE 2: The name "DatexIISchema-2-2-3.xsd" is the local file name used. This name shall comply the rules of the operating system and file system; it may vary among the different deployed systems.

2.2 Exchange parameters

The first DATEX II class appearing in the message is the **<exchange>** class, which defines the useful parameters to receive the message.

Here is an example of an **<exchange>** class:

```
<exchange>
  <supplierIdentification>
    <country>fr</country>
    <nationalIdentifier>PROJECT_ENTITY_SOURCE </nationalIdentifier>
  </supplierIdentification>
  <subscription>
    <deliveryInterval>VALUE BASED ON THE USE CASE</deliveryInterval>
    <operatingMode>VALUE BASED ON THE USE CASE</operatingMode>
    <subscriptionStartTime>2015-07-17T16:00:00+02:00</subscriptionStartTime>
    <subscriptionState>VALUE BASED ON THE USE CASE</subscriptionState>
    <updateMethod>VALUE BASED ON THE USE CASE</updateMethod>
    <target>
      <address>VALUE BASED ON THE USE CASE</address>
      <protocol>SOAP</protocol>
    </target>
  </subscription>
</exchange>
```

For more information on filling in the blue parameters in this class, refer to chapter "2.2. Definition of a publication envelop" in the situations guide [4].

The red parameters depend on the use case. Therefore, the chapters hereafter address them.

2.2.1 Attribute <nationalIdentifier>

For the **<nationalIdentifier>**, the guide [4] specifies the following limitation: "no accents, no spaces, only ASCII characters, and only CAPITAL letters and digits."

In the context of the C-ITS projects, the following convention is set: PROJECT_ENTITY_SOURCE where the parts are filled in as follows:

- PROJECT = SCOOP, CROADS or INTERCOR for each project, or CITS, for road operators in different projects
- ENTITY = Name in capitals of the organisation for the motorway companies, DExxx for the counties (= Départements) where xxx is their INSEE number, DIRxxx, for DIRs, ...
- SOURCE = UBR12345 (or UBR_12345 or 12345UBR, depending on the road operators' naming...) for an R-ITS-S, PF for a platform, SAGT or TGBretagne or name of the TMS for a TCC ...

Example: SCOOP_DIRIF_UBR12345

NOTE: The guide [4] reckons that this code should be allocated by the country, for a question of unity of the identifier. Since the ministry in charge of this point still has not issued a policy, this convention was proposed in agreement with them. This convention may change in the future. In consequence, the entire <nationalIdentifier> shall be configurable.

NOTE: The SCOOP Platform or the TMS could check the value "SOURCE" or < nationalIdentifier> in its database. The road operators shall check the consistency between the different databases, especially on the value of "SOURCE". See deliverable 2.4.3.2.

2.2.2 Attribute <protocol>

This attribute precised the protocol used.

The detailed platform specifications set the value. See deliverable 2.4.3.2_H.

NOTE: According to deliverables, French C-ITS projects shall always use the DATEX II messages with the SOAP protocol.

2.2.3 Attribute < keepAlive >

The **<keepAlive>** attribute is an indicator of a "filler" message. It indicates that the exchange is made to keep the circuit active. It shall be used when no message has been supplied since a certain configurable time. (In this type of message there is not <PayloadPublication>).

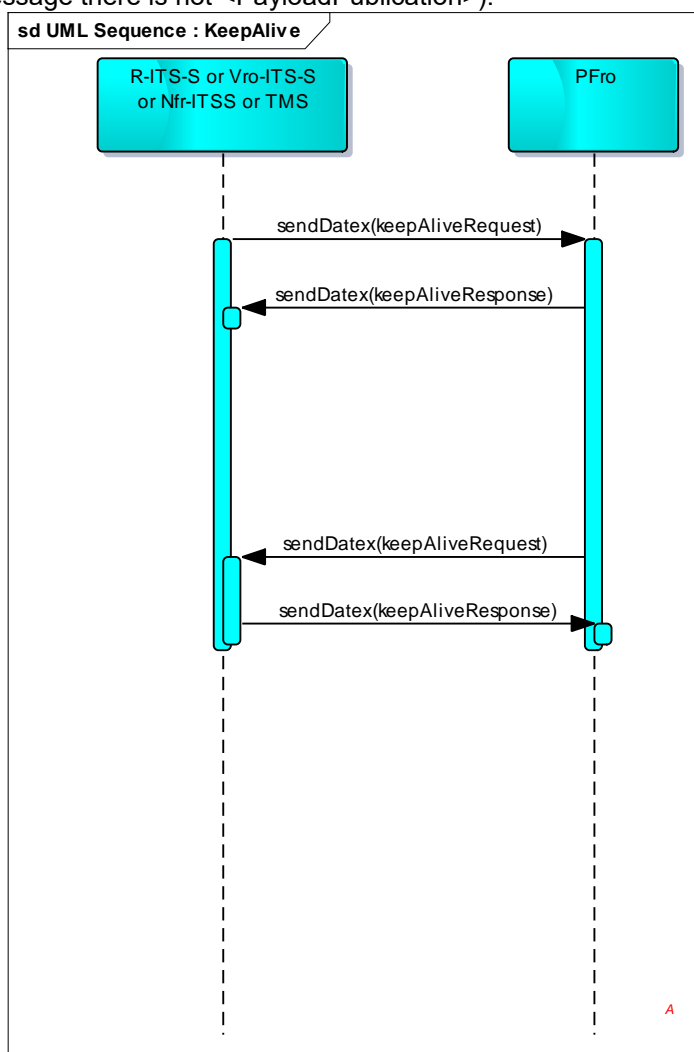


Figure 2 : Keep Alive Messages

The **<response>** attribute indicates that this message is a response to a "Request" message. It is used in

particular in the case of implementing a TMP (Traffic Management Plan). (In this type of message there is not <PayloadPublication>). The possible values are as follows:

- acknowledge: An acknowledgement that the supplier has received and complied with the client's request
- catalogueRequestDenied: A notification that the supplier has denied the client's request for a catalogue
- filterRequestDenied: A notification that the supplier has denied the client's request for a filter.
- requestDenied: A notification that the supplier has denied the client's request for a data.
- subscriptionRequestDenied: A notification that the supplier has denied the client's request for a subscription.

2.2.4 Version number

All version numbers begin at one according to the guide issued by the service of the Ministry in charge of Transport.

2.3 Message content

The message content depends substantially on the use case.

Here are the elements in common:

```
<payloadPublication xsi:type="VALUE BASED ON THE USE CASE" lang="fre">
  <publicationTime>2015-07-20T08:34:14+02:00</publicationTime>
  <publicationCreator>
    <country>fr</country>
    <nationalIdentifier>SCOOP_DIRIF_UBR_12345</nationalIdentifier>
  </publicationCreator>

  [VALUE BASED ON USE CASE]
</payloadPublication>
```

NOTE: the <nationalIdentifier> is present in the <PayloadPublication> part, to identify the content ("payload"), creator, and in the <Exchange> part to identify who does the exchange ("supplier"). Admittedly, it is often the same entity. In an uplink case, for example, when the platform sends to the TMS a message created by an R-ITS-S, then the creator remains the R-ITS-S and the supplier the platform. Thus, there are also differences of dates.

Time management

Precise values have to be given to the different potential attributes like "date":

- Message publication time,
- Measurement time (beginning or end – convention to be established) – For all zone measurements or the event date,
- Calculation time (individual for each value calculated),
- Calculation period (individual for each value calculated)

2.4 Case of end or cancellation message

The "cancel" and "end" attributes of the <lifeCycleManagement> class are used to know whether the situation has ended or been cancelled or neither.

The French C-ITS project forbid an actor to terminate a message which is not his own. In consequence, in uplink usecases, only the “CANCEL” attribute of the class will be specify.

For example, the DATEX II translation of a cancelled DENM will contain:

```
...
<management>
  <lifeCycleManagement>
    <cancel>TRUE< cancel>
  </lifeCycleManagement>
</management>
...
```

In downlink cases, TMS can send message setting “Cancel” or “End” attribute to the value “TRUE”. In the two cases, the R-ITS-S shall understand it as a cancellation of the linked DENM.

2.5 Resynchronisation information and snapshot

In some cases, R-ITS-S or the SCOOP Platform, or the TMS needs to synchronise all information with the other stations.

When a system receives a snapshot message, it shall compare the data in the message, to the data in its LDM or database. This system shall add new messages. This system shall updates messages already presents, if needed.

In addition, it is possible that some messages (DATEX II or DENM or others) will be generated consequently to the snapshot reception, according to the system specifications.

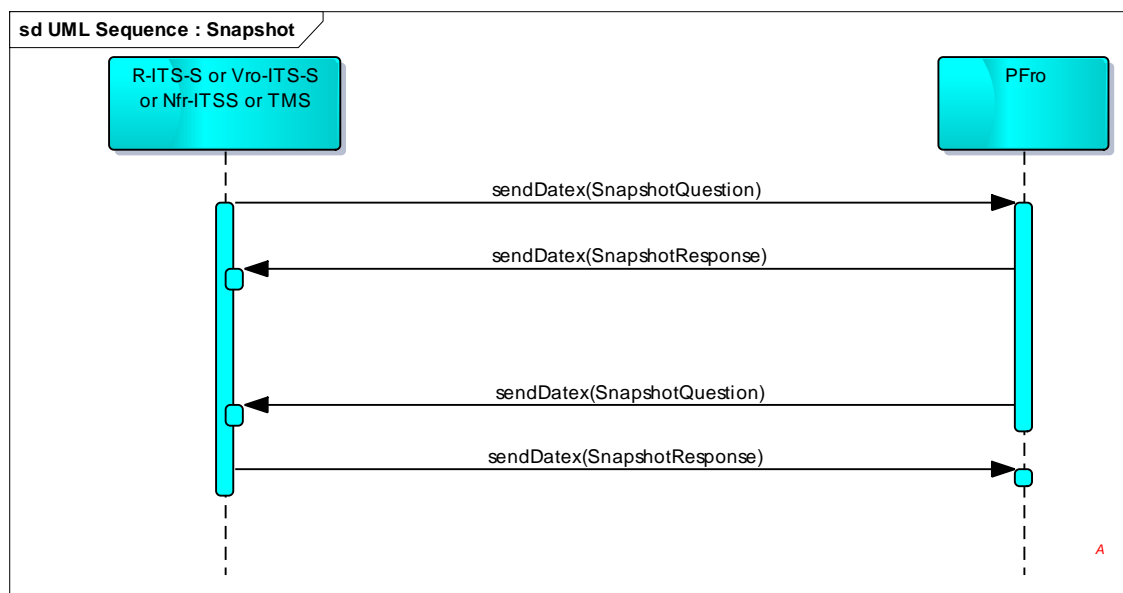


Figure 3 : Snapshot between the platform and any other component

This is not specific to the French C-ITS Projects. Therefore, it is not described here but some extracts from the “DATEX II Software Developer’s Guide” (part of [1]) are provided below:

The classes “Exchange” and “Subscription” shall be implemented to access the attribute “updateMethod” which can have three values:

- "snapshot" is used for snapshots, which means for a photo containing all publications without any link with their previous status
- "singleElementUpdate" is used when only the updated Publication is transmitted on occurrence
- "allElementUpdate" is used when all the elements of a Publication are transmitted on occurrence, even if only one situation record is updated. To be transmitted, the publication shall at least have one updated element.

It is very important for the system that receives the information contained in the XML file, to know the category of update method used.

If the updateMethode is allElementUpdate, that means that all previous elements of the same type of publication received from the same supplier shall be deleted and replaced by the new one. If a SituationRecord is no longer in the new XML File, it means that the event has ended during the time between the two publications and after the mapping, and all these events shall be deleted from the database.

For singleElementUpdate, and also allElementUpdate, the supplier must implement the management class to transmit to the client the end of an event, or that one event is cancelled and so no longer alive.

NOTE: In the French C-ITS projects, only snapshot in pull mode will be done. Snapshot in a push mode shall not be done.

NOTE: The snapshot shall gather:

- from R-ITS-S, for V-ITS-S, for Nfr-ITS-S to the platform, all the data about DENM in one message and CAM in another,
- from the platform to the TMS, all the data about DENM in one message and CAM in another,,
- from platform to the R-ITS-S, for V-ITS-S, for Nfr-ITS-S all the data from the TMS, in as many messages as there are types of publication (situation, VMS...)
- from TMS to the platform all the data from the TMS, in as many messages as there are types of publication (situation, VMS...)

3 Location of events

The range of location systems recognised by DATEX II is broad.

The Annexe 9.2 show the possibilities in the technical specification.

This chapter only presents the specificities of location for the French C-ITS projets, for the exchanges between the platform and the R-ITS-S, or Vro-ITS-S, or Nfr-ITS-S. Sometimes, some indications are given for the exchanges between TMS and plateform.

It should be noted that the location systems used by DATEX II v2.3 do not generate the altitude ("altitude" in DENM) nor the intervals of confidence on the position ("PositionConfidenceEllipse" in DENM). There are a few attributes (based on the enumerations) that can be used to manage the position in relation to the road.

The descriptions for the C-Its messages are made in the documents: 2.4.1, 2.4.1.2., and 2.4.1.2_H.

3.1 Particularities for R-ITS-S – PFro exchanges

This chapter concerns also national Nfr-ITS-S and mobile RSU function of Vro-ITS-S.

As the R-ITS-S may not have maps or specific database, the location using coordinates shall be the one used.

The "Referent" as PR or PLO, can be used, complementary to the coordinates.

The Alert-C and TPEGLoc descriptions shall not be used for exchanges between the SCOOP platform and the R-ITS-S.

3.2 Particularities for TMS – PFro exchanges

As the platform have mapping functionalities, the messages between TMS and platform shall use coordinates or "Referent" as "PR" or "PLO".

The TMS can add other description (Alert-C ...) complementary to one of the two mandatory, but the platform does not use this description.

NOTE: For the different possibilities of geocoding in the platform, see 2.4.3.2_H.

3.3 Differences between C-ITS locations and DATEX II locations

The units used are different:

- tenth of a micro-degree for DENM, or IVI
- decimal degree for DATEX II

The geodetic systems used can be considered as equivalent for these applications:

- WGS84 for DENM
- ETRS89 for DATEX II, better adapted for positioning in Europe

The system based on Lambert93 shall not be used for the C-ITS projects.

The different geographic locations, which are part of a trace/detection zone or an event history/relevance zone, are defined differently:

- in the C-ITS messages, the difference with the previous location (“deltas”) is sent,
- DATEX II defines point locations by geodetic coordinates (latitude and longitude) separately.

The conversion rules (operated by RSUs) are defined below, depending on the use case.

The “roadType” information in the “LocationContainer” (DENM) will not be used in generating the DATEX II location because there is no equivalent in standardised DATEX II.

3.4 Case of point-located event, without Traces nor DetectionZone

3.4.1 Perimeter

This case concerns for example, a DENM send by a V-ITS-S at the startup of the vehicle, or all the point-located events between the TMS and the platform, or a Parking publication from the TMS.

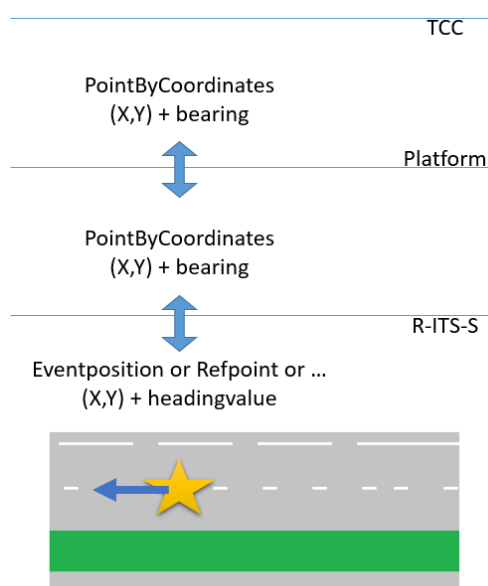


Figure 4 : *point-located event, without Traces*

3.4.2 Coding

In this case (between the platform and the R-ITS-S), the location of the situation element shall contain a “PointByCoordinates” type object with the determination of the “bearing” attribute representing the direction of traffic impacted by the situation element. The following table provides a correspondence between the DATEX II attributes and the DENM data elements (“eventPosition” element).

DATEX II location	DENM location
-------------------	---------------

Class::attribute	Information	Data Frame. Data Element	Information
PointByCoordinates:: bearing	In whole degrees (integer number) <i>(optional but made mandatory for the French C-ITS Projects)</i>	eventPositionHeading. HeadingValue	Integer in tenths of degree
---		eventPositionHeading. HeadingConfidence	Value = 127 (i.e., unavailable)
PointCoordinates: : latitude	In decimal degrees	eventPosition.latitude	In tenths of micro-degree
PointCoordinates: : longitude	In decimal degrees	eventPosition.longitude	In tenths of micro-degree
---		eventPosition.position ConfidenceEllipse	All three integer values (4095, 4095, 3601) indicating the information is unavailable.
---		eventPosition.altitude. altitudeValue	800001 (i.e. unavailable, because altitude is not present in a DATEX II v2.3 message)
---		eventPosition.altitude. altitudeConfidence	15 (i.e. unavailable)
(PointWithRoadType)	(DATEX II extension)	roadType	Filled in by rule based on the operator's map database (see chapter 3.8.2 Definition of the "roadType" DENM data element)
(1)		relevanceTrafficDirection	Enumeration (definition by use case – see deliverable 2.4.1.2)
(1) There is no correspondence of concepts between DATEX II and DENM. The coding rule is defined in the deliverable 2.4.1 and the coding table is defined in the deliverable 2.4.1.2 (depending on the use cases).			

Table 2 : Location parameters for a point located event

The "groupOfLocations" corresponds exactly, and only, to the location of the event. It is a "Point", and gather a "latitude", a "longitude" and a "bearing".

The latitude and longitude correspond to the latitude and longitude in:

- DENM, to the dataelement EventPosition in the container Management,
- IVI, to the referencePosition in the Geographic Location Container,
- POI-Parking, to the refPoint in the Location Container.

The "bearing" attribute of the DATEX II class **<PointByCoordinates>** corresponds to:

- the "eventPositionHeading" information in the "LocationContainer" in DENM,
- the "referencePositionHeading" in IVI,
- nothing in the POI-Parking.

Caution: the units are not the same but the zero corresponds to North of the reference ellipsoid.

In all scenarios, the determined point will mark the beginning of the event from the point of view of the driver, but the length of the event will be unknown.

3.4.3 Example

Hence the corresponding XML coding (values are false):

...


```
<groupOfLocations xsi:type="Point">
  <pointByCoordinates>
    <bearing>108</bearing>
    <pointCoordinates>
      <latitude>50.12345</latitude>
      <longitude>2.12345</longitude>
    </pointCoordinates>
  </pointByCoordinates>
</groupOfLocations>
...
```

3.5 Case of point-located event, with 1 Trace or 1 DetectionZone

3.5.1 Perimeter

This case concerns for example:

- a DENM send by a V-ITS-S, with one trace,
- a situation publication sent by the platform, with only one path leading to the event.

This case only concerns exchanges between platform and R-ITS-S, Vro-ITS, and Nfr-ITS-S, the TMS do not transmit traces nor detectionZones.

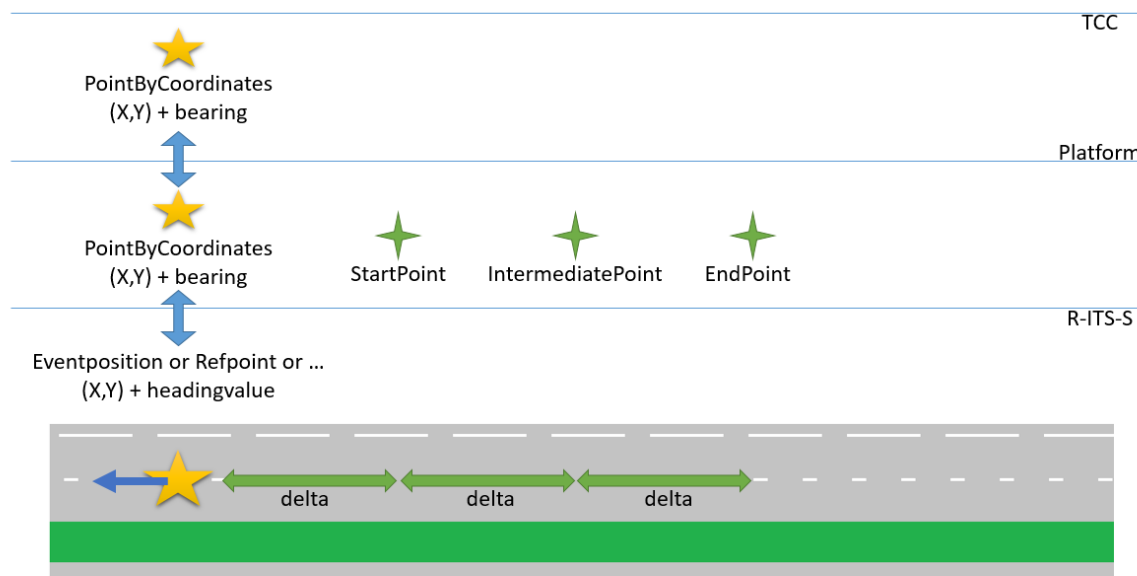


Figure 5 : *point-located event, with 1 trace*

3.5.2 Coding

In the “groupOfLocations” of type “point”, two points will describe the location:

- One is a **<pointByCoordinates>** whose elements are set in the same way as in the case of point-located event, without Traces. This corresponds to the location of the event, and the heading if present.

See 3.4 Case of point-located event, without Traces for the translation of this point in the C-ITS messages.

- The other point will be specialised with the DATEX II **<PointAlongLinearElement>** class. No attribute of this class will be filled in except "directionRelativeAtPoint".

See Chapter: 3.8.1 *LinearReferencingDirectionEnum*

In the second point, the DATEX II **<linearElement>** class will be specialised as **<LinearElementByPoints>** and will be instantiated as follows:

- no attributes will be filled in other than the "roadName" attribute
- the "roadName" attribute will contain "inconnu" information (variable lang = "fre")
- it will be described by at least three points considered as reference points (DATEX II **<Referent>** class):
 - Each point defined this way will include geographic coordinates (DATEX II **<PointCoordinates>** class).
 - The different instances of the DATEX II **<Referent>** class will be defined as follows:
 - the "referentDescription" and "referentName" attributes will not be filled in,
 - the "referentType" attribute will carry the "roadNode" value,
 - the "referentIdentifier" attribute will contain the geographic order number based on one of the points entering into the definition of the linear element. (startPointOfLinearElement has no identifier.)
 - The difference between the coordinates of two consecutive Points in the "LinearElement" corresponds to a pathPoint in the first (and only) pathHistory of the traces, in the LocationContainer in the DENM as follow:

NOTE: a "pathPoint" is a "DeltaReferencePosition" : "deltaLatitude" and "deltaLongitude" elements.

NOTE: the deliverable 2.4.1 set the calculation of the pathpoints. $PP = CP + \text{delta}$ with PP = PathPoint new pathpoint of the trace) and CP = CurrentPoint (or eventposition for the first one)

NOTE : The rules for the Trace creation in the downward direction is specified in the Deliverable 2.4.3.2.

Rule for Trace or detectionZone Encoding or Decoding for R-ITS-S

Considering N pathPoints in the DENM, or N-2 intermediatePointOnLinearElement in the DATEX II message:

- startPointOfLinearElement = pointByCoordinates + pathPoint(1)
- intermediatePointOnLinearElement index="1" = startPointOfLinearElement + pathPoint (2)
- intermediatePointOnLinearElement index="i" = intermediatePointOnLinearElement index="i-1" + pathPoint(i+1)
- endPointOfLinearElement = intermediatePointOnLinearElement index="N-2" + pathPoint(N)

NOTE: $\text{PointA} = \text{PointB} + \text{DeltaReferencePosition}$ is a simplification, and shall be understood as $\text{longitude}(\text{PointA}) = \text{longitude}(\text{PointB}) + \text{deltaLongitude}(\text{DeltaReferencePosition})$ AND $\text{latitude}(\text{PointA}) = \text{latitude}(\text{PointB}) + \text{deltaLatitude}(\text{DeltaReferencePosition})$, AND, if relevant, $\text{altitude}(\text{PointA}) = \text{altitude}(\text{PointB}) + \text{deltaAltitude}(\text{DeltaReferencePosition})$.

- The relative distance (in the form of the DATEX II **<DistanceFromLinearElementReferent>** class) will be connected to the last point of the linear element and set to 0 (the referent identifier will be recalled on this occasion).
- The DATEX II **<ExternalReferencing>** class can be instantiated as follows:
 - the externalReferencingSystem shall be set to «TRACE», for a DENM production, to «DETECTIONZONE» for an IVI production.
 - The "externalLocationCode" attribute will contain the number 1.

3.5.3 Example

Hence the corresponding XML coding (values are false):

```
...
<groupOfLocations xsi:type="Point">
  <!-- In this case, the point is defined linearly based on the trace of the
  transmitting vehicle (via DENM).-->
  <pointByCoordinates>
    <bearing>108</bearing>
    <pointCoordinates>
      <latitude>50.12340</latitude>
      <longitude>2.12340</longitude>
    </pointCoordinates>
  </pointByCoordinates>
  <externalReferencing>
    <externalLocationCode>1</externalLocationCode>
    <externalReferencingSystem>TRACE</externalReferencingSystem>
  </externalReferencing>
  <pointAlongLinearElement>
    <directionRelativeAtPoint>aligned</directionRelativeAtPoint>
    <linearElement xsi:type="LinearElementByPoints">
      <roadName>
        <values>
          <value lang="fre">inconnu</value>
        </values>
      </roadName>
      <startPointOfLinearElement>
        <referentIdentifier>1 </referentIdentifier>
        <referentType>roadNode </referentType>
        <pointCoordinates>
          <latitude>50.12345</latitude>
          <longitude>2.12345</longitude>
        </pointCoordinates>
      </startPointOfLinearElement>
      <intermediatePointOnLinearElement index="1">
        <referent>
          <referentIdentifier>2 </referentIdentifier>
          <referentType>roadNode </referentType>
          <pointCoordinates>
            <latitude>50.12354</latitude>
            <longitude>2.12354</longitude>
          </pointCoordinates>
        </referent>
      </intermediatePointOnLinearElement>
      <intermediatePointOnLinearElement index="2">
        <referent>
          <referentIdentifier>3 </referentIdentifier>
          <referentType>roadNode </referentType>
          <pointCoordinates>
            <latitude>50.12375</latitude>
            <longitude>2.12375</longitude>
          </pointCoordinates>
        </referent>
      </intermediatePointOnLinearElement>
    </linearElement>
  </pointAlongLinearElement>
</groupOfLocations>
```

```

        </pointCoordinates>
    </referent>
</intermediatePointOnLinearElement>
<endPointOfLinearElement>
    <referentIdentifier>4 </referentIdentifier>
    <referentType>roadNode </referentType>
    <pointCoordinates>
        <latitude>50.12397</latitude>
        <longitude>2.12397</longitude>
    </pointCoordinates>
</endPointOfLinearElement>
</linearElement>
<distanceAlongLinearElement xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>0</distanceAlong>
    <fromReferent>
        <referentIdentifier>4</referentIdentifier>
        <referentType>roadNode</referentType>
        <!--No need to repeat the coordinates of referent 4 because they are
already provided above -->
    </fromReferent>
    </distanceAlongLinearElement>
</pointAlongLinearElement>
</groupOfLocations>
...

```

3.6 Case of point-located event, with more than 1 trace or detectionZone

3.6.1 Perimeter

This case concerns for example:

- a situation publication sent by the platform, with up to seven paths leading to the event.

This case only concerns exchanges between platform and R-ITS-S, Vro-ITS, and Nfr-ITS-S, the TMS do not transmit traces.

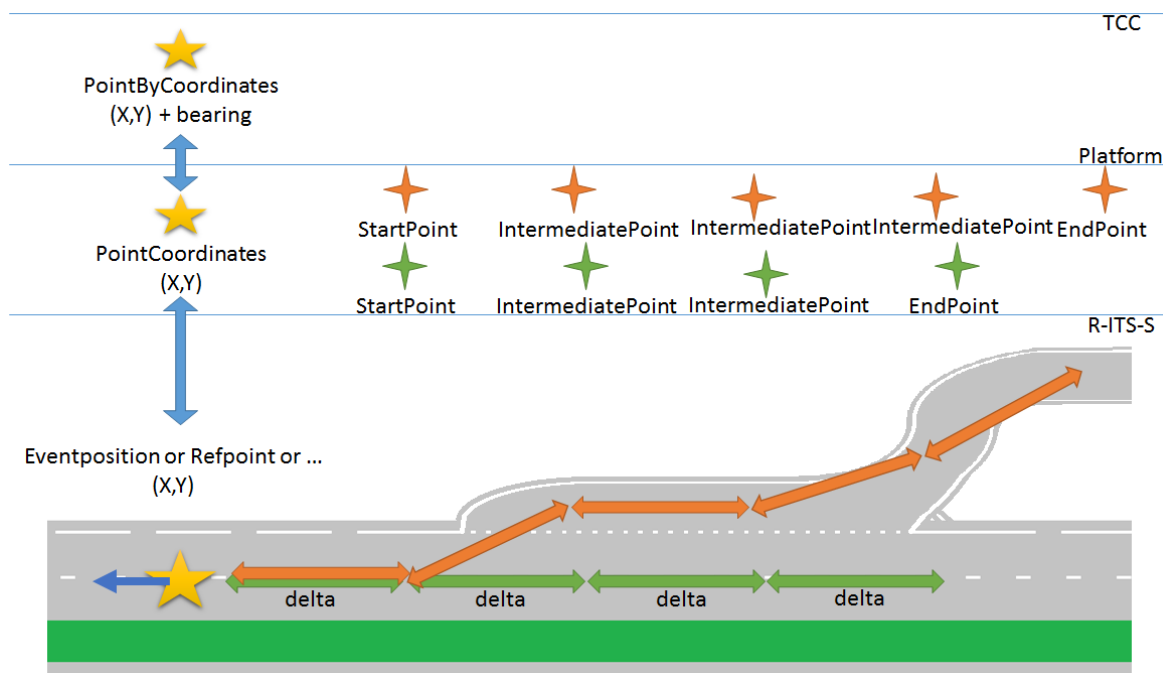


Figure 6 : *point-located event, with 2 traces*

3.6.2 Coding

The <groupOfLocations> shall be of type "NonOrderedLocationGroupByList" containing different "Points".

- The first pointAlongLinearElement corresponds to the first pathHistory in the traces, it contains also a « locationForDisplay », which corresponds to the eventposition.
- The second pointAlongLinearElement corresponds to the second pathHistory in the traces,
- And so on...

The coding principles, in particular the "Rule for Trace Encoding", are the same as the case with one trace.

The following elements shall be added:

- the DATEX II **<ExternalReferencing>** class will be instantiated for each pointAlongLinearElement as follows:
 - The externalReferencingSystem shall be set to "TRACE", for a DENM production, to "DETECTIONZONE" for an IVI production.
 - The "externalLocationCode" attribute can contain any string. Even if DATEX II does not define any rule to fill in this attribute, the following convention shall be adopted, which consists in allocating the value "1" for the first string and then incrementing for the subsequent strings. The pointAlongLinearElement which the externalLocationCode equals 1 contains the locationfordisplay corresponding to the eventposition.
- the locationfordisplay in the first pointAlongLinearElement: the longitude and latitude corresponds to the same elements in the eventposition of the DENM.

Particularity for the downward cases

As there is no bearing attribute in the DATEX II message in this case, the headingvalue, if needed, shall be calculated by the R-ITS-S, based on the locationfordisplay (LFD) and on the startPointOfLinearElement (SP), (or if they are identical, based on the two first different elements present in the first trace) :

NOTE: The theoretical value of heading is :

$$headingvalue = \alpha \tan^{-1} \frac{longitude\ LFD - longitude\ SP}{latitude\ LFD - latitude\ SP} + \beta \frac{\pi}{180}$$

α and β depending on the relative position of the two points, and the part of the globe considered. Special attention should be given to the units.

NOTE: One interpretation of the theoretical value is suggested here, operational only in France:

- 1- If latitude LFD = latitude SP and longitude LFD > longitude SP then headingvalue = 90°;
- 2- If latitude LFD = latitude SP and longitude LFD < longitude SP then headingvalue = 270° ;
- 3- If latitude LFD > latitude SP and longitude LFD = longitude SP then headingvalue = 0°;
- 4- If latitude LFD < latitude SP and longitude LFD = longitude SP then headingvalue = 180°;
- 5- If latitude LFD > latitude SP and longitude LFD > longitude SP then headingvalue = $(\tan^{-1}(\frac{\text{longitude LFD} - \text{longitude SP}}{\text{latitude LFD} - \text{latitude SP}})) * \frac{180}{\pi}$;
- 6- If latitude LFD > latitude SP and longitude LFD < longitude SP then headingvalue = $(270 + \tan^{-1}(\frac{\text{longitude LFD} - \text{longitude SP}}{\text{latitude LFD} - \text{latitude SP}})) * \frac{180}{\pi}$;
- 7- If latitude LFD < latitude SP and longitude LFD > longitude SP then headingvalue = $(90 + \tan^{-1}(\frac{\text{longitude LFD} - \text{longitude SP}}{\text{latitude LFD} - \text{latitude SP}})) * \frac{180}{\pi}$;
- 8- If latitude LFD < latitude SP and longitude LFD < longitude SP then headingvalue = $(180 + \tan^{-1}(\frac{\text{longitude LFD} - \text{longitude SP}}{\text{latitude LFD} - \text{latitude SP}})) * \frac{180}{\pi}$;

NOTE: a 10-degrees approximation is tolerate, so calculation without " \tan^{-1} " can be found, using for example the appropriate Taylor series for approximation:

$$\tan^{-1} x = x + \sum_{n=1}^{\infty} (-1)^n \frac{x^{2n+1}}{2n+1}$$

Particularity for the upward cases

The bearing is not requested in the DATEX II message, so the R-ITS-S shall not translate the heading, if present in the DENM.

3.6.3 Example

Hence the corresponding XML coding (values are false, and the content that is identical to the previous example has been removed for better reading):

```
...
<groupOfLocations xsi:type="NonOrderedLocationGroupByList">
  <locationContainedInGroup xsi:type="Point">
    <externalReferencing>
      <externalLocationCode>1 </externalLocationCode>
      <externalReferencingSystem>TRACE </externalReferencingSystem>
    </externalReferencing>
  </locationContainedInGroup>
</groupOfLocations>
```

```

<locationForDisplay>
  <latitude>48.97518</latitude>
  <longitude>2.48609</longitude>
</locationForDisplay>
<pointAlongLinearElement>
  <directionRelativeAtPoint>aligned</directionRelativeAtPoint>
  <linearElement xsi:type="LinearElementByPoints">
    <roadName>
      ...
    </roadName>
    <startPointOfLinearElement>
      ...
    </startPointOfLinearElement>
    <intermediatePointOnLinearElement index="1">
      ...
    </intermediatePointOnLinearElement>
    <endPointOfLinearElement>
      ...
    </endPointOfLinearElement>
  </linearElement>
  <distanceAlongLinearElement xsi:type="DistanceFromLinearElementReferent">
    ...
  </distanceAlongLinearElement>
</pointAlongLinearElement>
</locationContainedInGroup>
<locationContainedInGroup xsi:type="Point">
  <externalReferencing>
    <externalLocationCode>2 </externalLocationCode>
    <externalReferencingSystem>TRACE</externalReferencingSystem>
  </externalReferencing>
  <pointAlongLinearElement>
    <directionRelativeAtPoint>aligned</directionRelativeAtPoint>
    <linearElement xsi:type="LinearElementByPoints">
      ...
    </linearElement>
    ...
  </pointAlongLinearElement>
</locationContainedInGroup>
</groupOfLocations>
...

```

3.7 Case of the linearly located events

3.7.1 Perimeter

For the following upwards use cases:

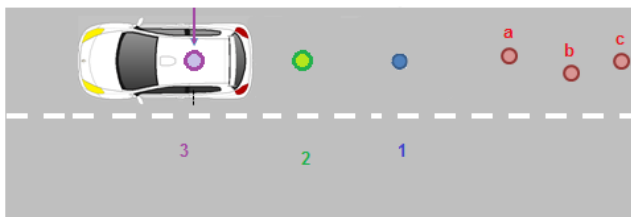
- A2-D1: Temporary slippery road,
- A2-D6: Reduced visibility,

- A2-E6: exceptional weather conditions,
the vehicle-generated DENM may contain the EventHistory data frame that consists of the ordered list (until 23 positions) of the positions along the event.

NOTE: the definition is set in the deliverable 2.4.1.

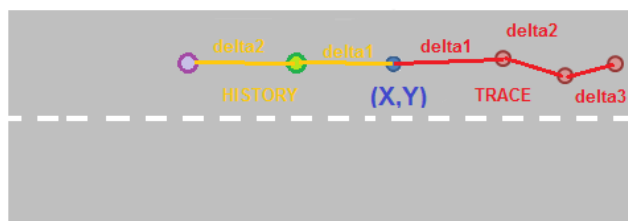
NOTE: However, the standard is unclear on how to implement the event history for dynamic events (essentially for Vu-ITS-S). Both solutions are still under discussions:

- 1 – the event position changes at each update and the previous event position become point of the eventhistory. Trace and eventhistory overlap.
- 2 – the event position remains identical at each update and new event history points are added along with each update.

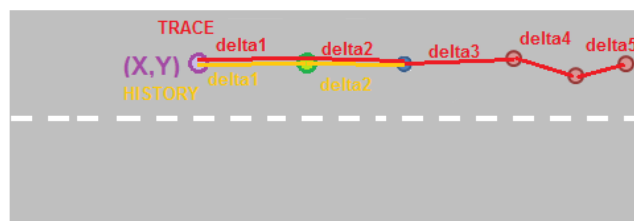


Previous positions of the vehicle :
in red: the vehicle do not detect the event.
other colors: the vehicle detects the event at each position.

Illustration of the DENM sent when the vehicle is in the violet position :



event position remains identical at each update



event position changes at each update

Figure 7 : Coding principles for a linear event from the vehicle

For all the linear downwards uses cases, this chapter applies:

- All the Situation publication with a linear location (Roadworks, D1, D6, E6, C2 ...)
- C3, IVI from a VMS publication,
- C2, IVI from a speedmanagement message,
- ...

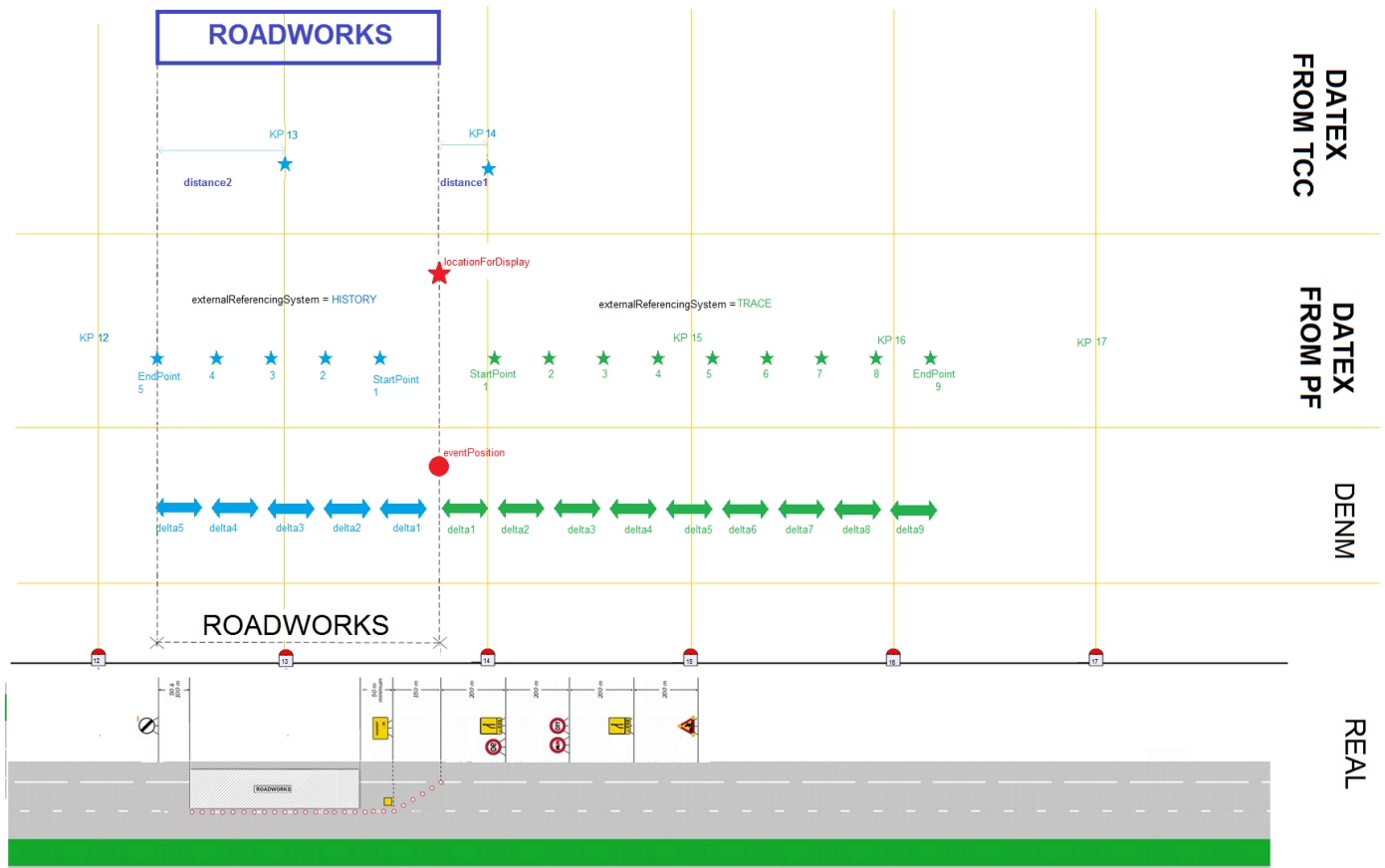


Figure 8 : Coding principles for a linear event from the TMS

3.7.2 Coding

In the C-ITS messages norm, the linear representation of an event is not based on a standardised localisation system that would represent linear type topological objects, whereas DATEX II does it natively and this is certainly the most common localisation mode.

In DENM, the “eventHistory” is a succession of “eventPoint” entities - 23 at most.

In IVI, the “relevancezone” can contains several group of points.

Extract of the C-ITS dictionary:

```
EventPoint ::= SEQUENCE {
    eventPosition DeltaReferencePosition,
    eventDeltaTime PathDeltaTime OPTIONAL,
    informationQuality InformationQuality
}
```

On the other hand, DATEX II does not include a linear localisation system equivalent to the **<PointByCoordinates>** of points. The mandatory data elements to generate a DENM have to be determined by using the embedded road geographic database in the platform.

In DATEX II, the two locations representing respectively the trace (DENM) or the detection zone (IVI) and the history (DENM) or the relevance zone (IVI) will be grouped into the **<groupOfLocations>** class. This **<groupOfLocations>** shall be of type “NonOrderedLocationGroupByList” containing different “Linear”.

The first element shall corresponds to the linear of the event, using the **<LinearWithinLinearElement>** class instantiated from the positions defined in « eventHistory » (DENM) or relevance zone (IVI) according to the following rules:

- No attribute of this class is filled in except the “directionRelativeOnLinearSection” attribute, that is a “LinearReferencingDirectionEnum”.

See Chapter: 3.8.1 LinearReferencingDirectionEnum.

- The class <locationForDisplay> is made mandatory in this case, and gives the precise values of “eventPosition”
- The DATEX II <ExternalReferencing> class will be instantiated as follows:
 - The “externalReferencingSystem” attribute will contain the “HISTORY” string for a DENM production, or “RELEVANCEZONE” for an IVI production;
 - The “externalLocationCode” attribute can contain any string. Even if DATEX II does not define any rule to fill in this attribute, the following convention shall be adopted, which consists in allocating the value “1” for this linear, corresponding to the EventHistory. The linear element that the externalLocationCode equals 1 contains the locationForDisplay corresponding to the eventposition.
- The DATEX II <linearElement> class is specialised as <LinearElementByPoints> and is instantiated as follows:
 - All the attributes are kept void but the “roadName” attribute, which is filled in with the value “inconnu” (variable lang = “fre”).
 - The linear location is described by using at least three points defined as distance markers (DATEX II <Referent> class),
 - Every defined point includes geographic coordinates (DATEX II <PointCoordinates> class).
 - The different instances of the DATEX II <Referent> class are defined as follows:
 - The “referentDescription” and “referentName” attributes are kept void;
 - The “referentType” attribute is filled in with the enumeration value: “roadNode”;
 - The “referentIdentifier” attribute is filled in with an order number starting at 1 according to the geographic order of the points shaping the road link.
 - They are ordered using the driving direction.
 - The difference between the coordinates of two consecutive Points in the “LinearElement” corresponds to an EventPoint in the eventHistory, in the SituationContainer in the DENM as follow.

Rule for History/Relevance zone Encoding:

Considering N EventPoints in the DENM, or N-2 intermediatePointOnLinearElement in the DATEX II message:

- startPointOfLinearElement = pointByCoordinates + EventPoint (1)
- intermediatePointOnLinearElement index=“1”= startPointOfLinearElement + EventPoint (2)
- intermediatePointOnLinearElement index=“i”= intermediatePointOnLinearElement index=“i-1” + EventPoint (i+1)
- endPointOfLinearElement = intermediatePointOnLinearElement index=“N-2” + EventPoint (N)

- The relative distance (using the DATEX II <DistanceFromLinearElementReferent> class) is linked to the last point of the road link and filled in with the value “0”. The referent identifier is repeated in this instance.

NOTE: in consequence of the description above, and as it is described in the specific deliverables, the “fromPoint” and the “toPoint” in a message from the platform, will not be used by the R-ITS-S. The R-ITS-S uses directly the points in “xxPointOfLinearElement”, and calculate the deltas for the eventHistory and traces.

NOTE: in consequence, there shall be N+1 coordinates in the DATEX II message, including locationfordisplay, start, intermediate and end points, for N deltas in the trace/eventHistory in the DENM, as can be seen on the Figure 8.

The next elements shall corresponds to the traces or the detection zones of the event, using the <LinearWithinLinearElement> class instantiated from the positions defined in « traces » according to the

previous rules. Some logical differences are raised below:

- the « externalLocationCode » shall be incremented from the number of History or relevancezone plus one, up to the number of traces, maximum 7, or to the number of detection zone,
- the externalReferencingSystem shall be set to « TRACE », for a DENM production, to « DETECTIONZONE » for a IVI production.
- the « Rule for Trace Encoding » shall be applied to each element.

3.7.3 Example

The XML extract shows the coding obtained in the exchange file exiting the platform for a DENM case:

```
...
<groupOfLocations xsi:type="NonOrderedLocationGroupByList">
  <locationContainedInGroup xsi:type="Linear">
    <externalReferencing>
      <externalLocationCode>1 </externalLocationCode>
      <externalReferencingSystem>HISTORY</externalReferencingSystem>
    </externalReferencing>
    <locationForDisplay>
      <latitude>48.97518</latitude>
      <longitude>2.48609</longitude>
    </locationForDisplay>
    <supplementaryPositionalDescription>
      <affectedCarriagewayAndLanes>
        <carriageway>mainCarriageway </carriageway>
        <lane>lane1</lane>
        <lengthAffected>1800</lengthAffected>
      </affectedCarriagewayAndLanes>
    </supplementaryPositionalDescription>
    <linearWithinLinearElement>
      <directionRelativeOnLinearSection>aligned </directionRelativeOnLinearSection>
      <linearElement xsi:type="LinearElementByPoints">
        <roadNumber>A1</roadNumber>
        <linearElementReferenceModel>RIU V2 France </linearElementReferenceModel>
        <linearElementReferenceModelVersion>2015
      </linearElementReferenceModelVersion>
      <startPointOfLinearElement>
        <referentIdentifier>95PR14G </referentIdentifier>
        <referentType>referenceMarker </referentType>
        <pointCoordinates>
          <latitude>48.97318</latitude>
          <longitude>2.48709</longitude>
        </pointCoordinates>
      </startPointOfLinearElement>
      <intermediatePointOnLinearElement index="1">
        <referent>
          <referentIdentifier>93PR13G </referentIdentifier>
          <referentType>referenceMarker </referentType>
          <pointCoordinates>
```

```

        <latitude>48.96695</latitude>
        <longitude>2.47769</longitude>
    </pointCoordinates>
</referent>
</intermediatePointOnLinearElement>
<endPointOfLinearElement>
    <referentIdentifier>93PR12G </referentIdentifier>
    <referentType>referenceMarker </referentType>
    <pointCoordinates>
        <latitude>48.96060</latitude>
        <longitude>2.46806</longitude>
    </pointCoordinates>
</endPointOfLinearElement>
</linearElement>
<fromPoint xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>550</distanceAlong>
    <fromReferent>
        <referentIdentifier>95PR14G </referentIdentifier>
        <referentType>referenceMarker </referentType>
    </fromReferent>
</fromPoint>
<toPoint xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>150</distanceAlong>
    <fromReferent>
        <referentIdentifier>93PR12G </referentIdentifier>
        <referentType>referenceMarker </referentType>
    </fromReferent>
</toPoint>
</linearWithinLinearElement>
</locationContainedInGroup>

```

```

<locationContainedInGroup xsi:type="Linear">
    <externalReferencing>
        <externalLocationCode>2 </externalLocationCode>
        <externalReferencingSystem>TRACE</externalReferencingSystem>
    </externalReferencing>
    <linearWithinLinearElement>
        <directionRelativeOnLinearSection>aligned
    </directionRelativeOnLinearSection>
        <linearElement xsi:type="LinearElementByPoints">
            <roadNumber>A1</roadNumber>
            <linearElementReferenceModel>RIU V2 France </linearElementReferenceModel>
            <linearElementReferenceModelVersion>2015
        </linearElementReferenceModelVersion>
            <startPointOfLinearElement>
                <referentIdentifier>95PR16G </referentIdentifier>
                <referentType>referenceMarker </referentType>
            </startPointOfLinearElement>
        </linearElement>
    </linearWithinLinearElement>
</locationContainedInGroup>

```

```

        <pointCoordinates>
            <latitude>48.98318</latitude>
            <longitude>2.49709</longitude>
        </pointCoordinates>
    </startPointOfLinearElement>
    <intermediatePointOnLinearElement index="1">
        <referent>
            <referentIdentifier>95PR15G </referentIdentifier>
            <referentType>referenceMarker </referentType>
            <pointCoordinates>
                <latitude>48.96695</latitude>
                <longitude>2.47769</longitude>
            </pointCoordinates>
        </referent>
    </intermediatePointOnLinearElement>
    <endPointOfLinearElement>
        <referentIdentifier>95PR14G </referentIdentifier>
        <referentType>referenceMarker </referentType>
        <pointCoordinates>
            <latitude>48.96060</latitude>
            <longitude>2.46806</longitude>
        </pointCoordinates>
    </endPointOfLinearElement>
</linearElement>
<fromPoint xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>0</distanceAlong>
    <fromReferent>
        <referentIdentifier>95PR16G </referentIdentifier>
        <referentType>referenceMarker </referentType>
    </fromReferent>
</fromPoint>
<toPoint xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>0</distanceAlong>
    <fromReferent>
        <referentIdentifier>95PR14G </referentIdentifier>
        <referentType>referenceMarker </referentType>
    </fromReferent>
</toPoint>
</linearWithinLinearElement>
</locationContainedInGroup>
</groupOfLocations>
...

```

3.8 Special points

3.8.1 LinearReferencingDirectionEnum

Different attributes are based on this enumeration: “directionRelativeAtPoint”, “directionRelativeOnLinearSection”

See deliverable 2.4.1, the usage of this attribute is illustrated.

It should be noted that contrary to the localisation systems used in DATEX II (except for “PointByCoordinates”), it seems not very relevant in the case of a divided road for a DENM to define a traffic element or an operating action as bidirectional (i.e., affecting both directions of traffic). Consequently, the French C-ITS Projects has decided (deliverable 2.4.1) to duplicate the DENMs generated with the same geographic location (“eventPosition”) but with the “Trace” entities and “HeadingValue” attributes representing the opposite directions of traffic (angle reading increased 180°).

Different values are set in this enumeration.

- “both” is used if the event concerns all the directions (the same as the DENM “alltraficdirection” value).
- “aligned”, if the event is in the same direction that the one defined by the order of the markers used.

Particularity for the downward cases

- if the PFro receives it from the TMS, it means “in the PR upwards” with reference to the RIU,
- if the R-ITS-S receives it from the PFro, it means in the same direction as the markers, so it shall translate it into “upstream” in the DENM,

Particularity for the upward cases

- the R-ITS-S translates the “upstream” from the DENM into “aligned”, and organize the markers in the **<linearElement>**, in the same direction as the event,
- if the TMS receives it from the PFro, it means “in the PR upwards” with reference to the RIU,
- “opposite”, if the event is in the opposed direction of the markers.

Particularity for the downward cases

- if the PFro receives it from the TMS, it means “in the PR downwards” with reference to the RIU, it shall translate it into “aligned”, and sent the markers in the other direction than the “PR upward”.
- the R-ITS-S shall not receive the value “opposite” from the PFro.

Particularity for the upward cases

- in the French C-ITS projects, the R-ITS-S shall not receive an “opposite direction” from the DENM, so the R-ITS-S does not send the value “opposite” to the platform
- the Platform can translate an “aligned” message from the R-ITS-S, if the marker from the R-ITS-S are in the other direction than the PR upwards. It means “in the PR downwards” with reference to the RIU.

3.8.2 Definition of the “roadType” DENM data element

There is no way in the DATEX II data model to convey usable information to define this piece of data for messages generated by TMS. It is the duty of the platform to fulfil this task. To allow it a DATEX II level B extension is proposed in the “RoadTypeScoopExtension” package:

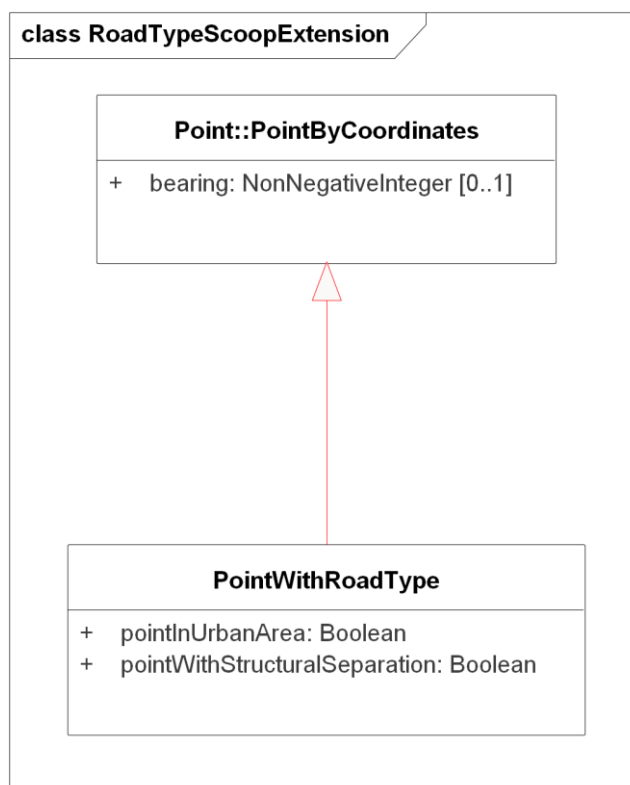


Figure 9 : Extension for the “roadType” definition

Each Boolean is set to “true” if the corresponding definition is fulfilled according to the platform map content at the given point.

Knowing the ASN.1 definition of the “roadType” data element in ETSI TS 102 894-2:

```

RoadType ::= ENUMERATED {
    urban-NoStructuralSeparationToOppositeLanes (0),
    urban-WithStructuralSeparationToOppositeLanes (1),
    nonUrban-NoStructuralSeparationToOppositeLanes (2),
    nonUrban-WithStructuralSeparationToOppositeLanes (3)
}
    
```

the formula to calculate the “roadType” value is defined as follows:

$$\text{roadType} = (\text{pointWithStructuralSeparation?1:0}) + (\text{pointInUrbanArea?0:2})$$

The XML extract below shows the coding obtained in the exchange file exiting the platform:

```

...
<pointByCoordinates>
  <bearing>210</bearing>
  <pointCoordinates>
    <latitude>50.12345</latitude>
    <longitude>1.23456</longitude>
  </pointCoordinates>
  <pointByCoordinatesExtension>
    <pointWithRoadType>
      <pointInUrbanArea>false</pointInUrbanArea>
      <pointWithStructuralSeparation>true</pointWithStructuralSeparation>
    </pointWithRoadType>
  </pointByCoordinatesExtension>
</pointByCoordinates>
    
```

```

    </pointByCoordinatesExtension>
  </pointByCoordinates>
  ...

```

3.8.3 Lane and carriageway positioning

If data is relevant and if the TMS treat this type of data, the location part will be completed by the transverse positioning information on the lane.

The value in the lane enumeration are not all allowed.

The value of the lane shall be of type

- "laneXX", with a number beginning by 1 for the lane the most on the right,
- or « rightlane », « leftlane », and « middlelane », but, in this case, shall precise the number of original lanes (in the impact class).

NOTE: TIPI accepts the value rightlane, leftlane, but the PFro do not have the number of lane on the carriageway.

This type of data can be added by the TMS, but cannot be added by the PFro.

The syntax is as:

```

...
<supplementaryPositionalDescription>
  <affectedCarriagewayAndLanes>
    <carriageway>mainCarriageway</carriageway>
    <lane>lane1</lane>
    <lane>lane2</lane>
    <lengthAffected>1800</lengthAffected>
  </affectedCarriagewayAndLanes>
</supplementaryPositionalDescription>
...

```

NOTE: that the transverse positioning information is attached to a linear or point location. When it is a question of a group of locations (e.g., in the case of the definition of an "Itinerary" object), the information will be repeated for each element in the group.

NOTE: The information will contribute to generate the DENM entity "RoadWorksContainerExtended".

3.8.4 Case of location on slip roads and auxiliary lanes for downward use case, between TMS and Platform

The DENM standard (ETSI EN 302 637-3) does not specify specific values for locations on a slip road or another auxiliary lane unlike DATEX II, where several and practices are possible. Therefore, for messages issued by infrastructure (cases B and D), if the DATEX II **<SupplementaryPositionalDescription>** and **<AffectedCarriagewayAndLanes>** classes are instantiated and explicitly indicates the given location is

e.g. on a slip road, a parallel carriageway or on rest/service area it may mean the provided location (point or linear element) is not the actual location depending on the used TMS. In such cases, the corresponding location is the position of the nose (French “musoir”), where the slip road crosses the road. And the provided distance corresponds to the distance between the nose and the event.

The platform shall transform such a location into a location usable by R-ITS-S for creating DENM, in coordinates. See Deliverable 2.4.3.2 for the transformation rules.

Example: The event is on the slip road on 260m.

```
<groupOfLocations xsi:type="Point">
...
    <supplementaryPositionalDescription>
        <affectedCarriagewayAndLanes>
            <carriageway>entrySlipRoad</carriageway>
            <lengthAffected>260</lengthAffected>
        </affectedCarriagewayAndLanes>
    </supplementaryPositionalDescription>
...
    <pointAlongLinearElement>
        <directionRelativeAtPoint>aligned</directionRelativeAtPoint>
        <linearElement>
            <roadNumber>A0001</roadNumber>
            <linearElementReferenceModel>RIU_2012</linearElementReferenceModel>
        </linearElement>
        <distanceAlongLinearElement xsi:type="DistanceFromLinearElementReferent">
            <distanceAlong>618</distanceAlong>
            <fromReferent>
                <referentIdentifier>59PR201D</referentIdentifier>
                <referentType>referenceMarker</referentType>
            </fromReferent>
        </distanceAlongLinearElement>
...
    </pointAlongLinearElement>
...
</groupOfLocations>
```

3.8.5 Special case of Speed limit positions for road works (only the use cas Roadworks (B), not dynamic speed limit (C2))

Speed limits attached to a roadwork are defined the DATEX II **<SpeedManagement>** class that instantiates a second or third situation record (only accepted for use cases B).

NOTE: this chapter does not apply to the C2, dynamic speed limit, whose <SpeedManagement> class instantiates the first situation record.

This class inherits from the DATEX II **<NetworkManagement>** class, this latter being itself a specialisation of the **<OperatorAction>** as **<RoadWorks>**.

As for any <situationrecord>, a location reference shall be attached to the **<SpeedManagement>** class. From TMS this location is generally defined linearly. On the other hand, in the DENM "AlacarteContainer"

including the "roadWorks" data frame, the "speedLimit" data element defines the speed limit value (only in kilometre per hour) and the "startingPointSpeedLimit" data element defines the speed limit start being applicable. This point is not defined by absolute geographic coordinates but differentially in relation to the "eventPoint" pinpointing the beginning of the considered roadwork.

The method to convert the provided initial linear location consists, in the platform, in extracting it upwards point (it may be the first or the last point of the linear according to the adopted location referencing method). Then to determine its geographic coordinates (if they are not provided) using the map included. The corresponding coordinates can be transferred to R-ITS-S using the DATEX II **<PointByCoordinates>** class.

At the R-ITS-S the DENM data frame is calculate as coordinates differences according to the following rule:

Rule:

$$\Delta Lat_{i+1} = Lat_{i+1} - Lat_i$$

$$\Delta Long_{i+1} = Long_{i+1} - Long_i$$

4 Processing of the traffic data

4.1 Description of the use case A1: Traffic Data

The R-ITS-S receives CAMs. It filters and aggregate the messages and sends the information calculated based on these CAMs to the platform.

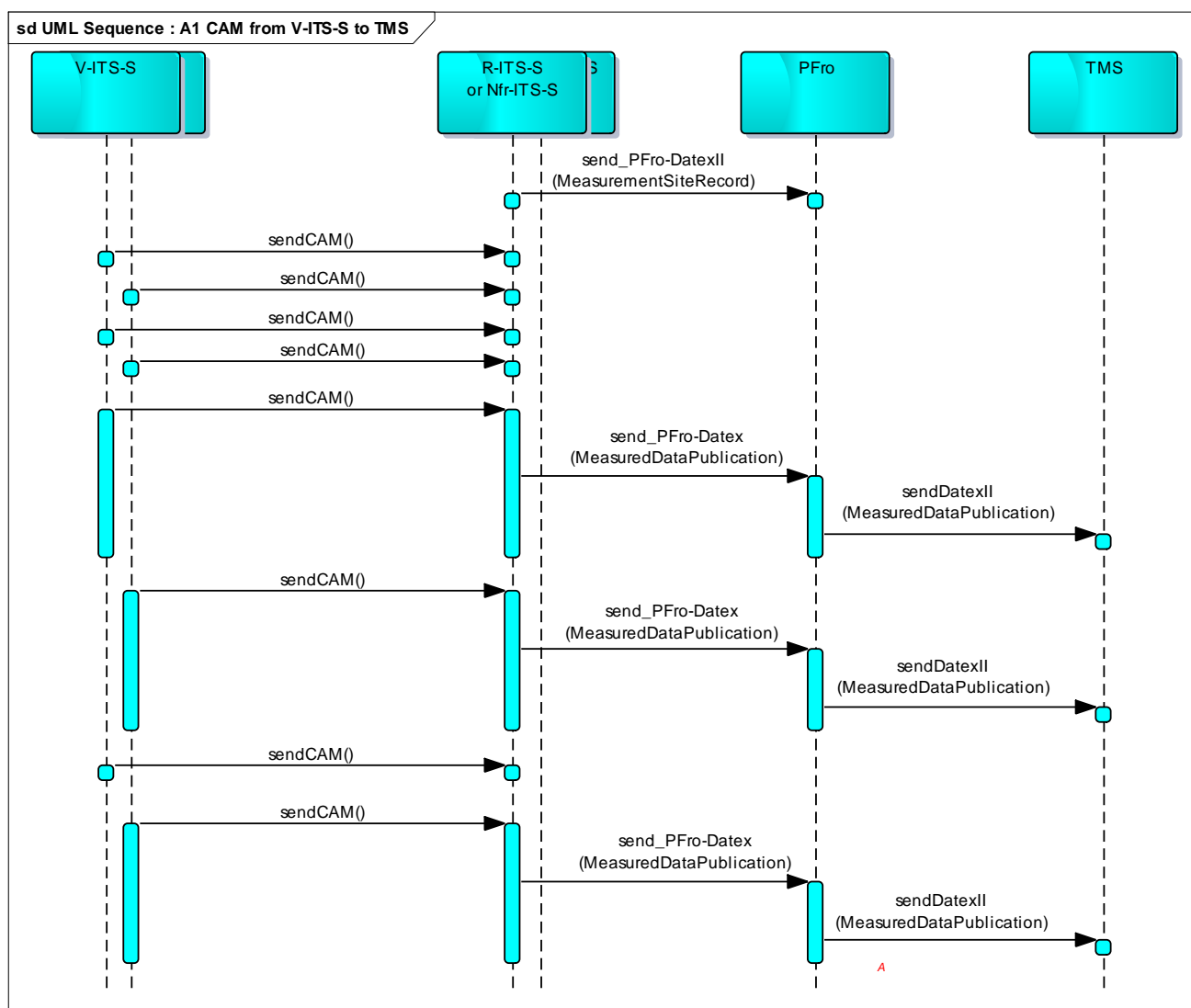


Figure 10 : UML sequence diagram for the Traffic data collection from V-ITS-S to TMS, uplink flow

Here is an example of the information that could be available in the end to the user.

Type	Beginning of considered period	End of considered period	Considered measurement zone	Considered length class	Average harmonic speed	Average length	Number of vehicles
1	HH:MM:SS	HH:MM:SS	All zones	All classes	V _{avg}	L _{avg}	Number

Type	Beginning of considered period	End of considered period	Considered measurement zone	Considered length class	Average harmonic speed	Average length	Number of vehicles
	DD/MM/YYYY	DD/MM/YYYY					
2	HH:MM:SS DD/MM/YYYY	HH:MM:SS DD/MM/YYYY	Zone x	All classes	$V_{avg}(Zone_x)$	$L_{avg}(Zone_x)$	Number($Zone_x$)
3	HH:MM:SS DD/MM/YYYY	HH:MM:SS DD/MM/YYYY	All zones	Class Y	$V_{avg}(Class_y)$	$L_{avg}(Class_y)$	Number($Class_y$)
4	HH:MM:SS DD/MM/YYYY	HH:MM:SS DD/MM/YYYY	Zone x	Class Y	$V_{avg}(Zone_x, Class_y)$	$L_{avg}(Zone_x, Class_y)$	Number($Zone_x, Class_y$)

Table 3 : Example of information calculated based on CAMs

4.2 Construction of the DATEX II message

Configuration of measurement points in the R-ITS-S

4.2.1 Message principles

The platform and the R-ITS-S shall know the description of the zones and the measurement classes. Consequently, this assumes that there is an exchange message between the TMS, the platform and the RSUs concerning the definition of these zones and classes. Here are some paths to explore, if these measurement points shall be configured in DATEX II (see deliverable "platform specifications").

A zone will be named: ZoneX (e.g., Zone01 or Zone135).

- The geometric definition of a Zone in DATEX II consists of 3 points (in coordinates) and an orientation (**<bearing>** indicated by a point).
- The version number of the zone is incremented if one of the zone characteristics is updated.
- The CAM aggregation zones will be exchanged via the **<measurementSiteTablePublication>**. For the other parameters, this should involve an extension based on the **<genericPublication>** class (if possible, level B).

A measurement class will be named: ClasseY (e.g., Classe01 or Zone135).

- The guide [4] recommends using the DATEX II **<MeasurementSiteRecord>** class, which can be used to describe the static data for the exchange of aggregated traffic data.

```
<measurementSiteReference id="UBR12345-Zone01-Classe01" targetClass=
"MeasurementSiteRecord" version="1"/>
```

- The **<measurementSiteRecord>** class will be completed by the DATEX II **<VehicleCharacteristics>** class. For example: with the DATEX II **<LengthCharacteristic>** class (>12 m, =3 m...), to be combined with one or two comparison operators for the case "included between."

NOTE: This would make it possible, in the future, to define new groups of vehicles: by height, by number of axles, etc.

4.3 Construction of the DATEX II message Reporting traffic data

4.3.1 Exchange parameters

4.3.2 Choosing the distribution mode

The OM2 mode, called Push at a regular interval, shall be used for this use case. The R-ITS-S transmits all the data at a regular interval to the platform.

The publication contains the aggregation of a set of CAMs.

The parameters concerned are:

```
...
<subscription>
  <operatingMode>operatingMode2</operatingMode>
  <updateMethod>allElementUpdate</updateMethod>
...
</subscription>
...
```

4.3.2.1 Data reporting period

In "OM2" mode, the reporting period shall be configured for each R-ITS-S. Its value is in seconds.

```
...
<subscription>
...
<deliveryInterval>360</deliveryInterval>
...
</subscription>
...
```

4.3.2.2 Message content

The message in DATEX II contains all the data for all zones for all classes over a given period. Based on "Table 3 :Example of information calculated based on CAMs", this signifies that a DATEX II message between an R-ITS-S and the platform will only contain the data defined according to the type 4 in this table.

The **<payloadPublication>** class is a **<MeasuredDataPublication>** type. This class will contain, in addition to the elements already presented in chapter 2.3 Message content, several elements:

- a **<measurementSiteTableReference>** class,
- and as many DATEX II **<siteMeasurements>** classes as pairs (ZoneX, ClasseY). (A **<siteMeasurements>** class instance corresponds to a line (type 4) as defined in)

4.3.2.3 <measurementSiteTableReference> class

The identifier is used to identify the transmitting R-ITS-S. The value proposed for the identifier is the nationalIdentifier. See chapter 2.2.1 Attribute **<nationalIdentifier>**.

The **<targetclass>** is used to identify the type of data: **<MeasurementSiteTable>**.

```
...
<measurementSiteTableReference id="SCOOP_DIRIF_UBR12345 "
targetClass="MeasurementSiteTable" version="1"/>
...
```

4.3.2.3.1 LOCATIONS OF CAM AGGREGATIONS

As explained in chapter 4.3 Construction of the DATEX II message Reporting traffic data, in the case of reporting aggregated messages from CAMs, the static part describing the aggregation zone (and the class) will be converted by means of the specific DATEX II publication, **<MeasurementSiteTablePublication>**.

In particular, the CAM aggregation zone will be defined in this publication by the DATEX II class **<groupOfLocations>**, specialised as **<NonOrderedLocationGroupByList>**, which will include three points defined by coordinates, corresponding to three summits of the rectangle defining the zone. The first point can also include angular bearing information corresponding to the traffic direction in the zone.

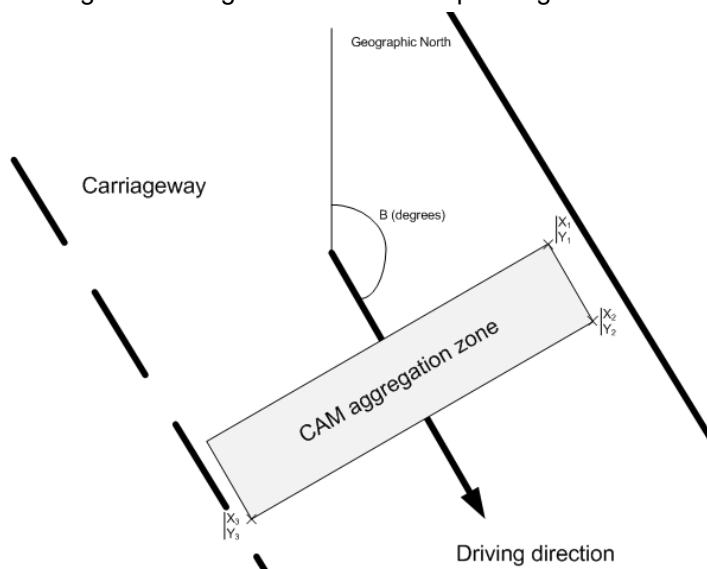


Figure 11 : *Defining the CAM aggregation area*

This provides the following file:

```
...
<measurementSiteLocation xsi:type="NonOrderedLocationGroupByList">
  <locationContainedInGroup xsi:type="Point">
    <pointByCoordinates>
      <bearing>108</bearing>
      <pointCoordinates>
        <latitude>50.12345</latitude>
        <longitude>2.12345</longitude>
      </pointCoordinates>
    </pointByCoordinates>
  </locationContainedInGroup>
  <locationContainedInGroup xsi:type="Point">
    <pointByCoordinates>
      <pointCoordinates>
        <latitude>50.12348</latitude>
        <longitude>2.12346</longitude>
      </pointCoordinates>
    </pointByCoordinates>
  </locationContainedInGroup>
  <locationContainedInGroup xsi:type="Point">
    <pointByCoordinates>
      <pointCoordinates>
```

```

        <latitude>50.12347</latitude>
        <longitude>2.12347</longitude>
    </pointCoordinates>
</pointByCoordinates>
</locationContainedInGroup>
</measurementSiteLocation>
...

```

4.3.2.4 DATEX II <siteMeasurements> Class

First of all, the class type used has to be specified. For this type of information, the guide [4] recommends using the DATEX II **<MeasurementSiteRecord>** class, which can be used to describe the static data for the exchange of aggregated traffic data.

4.3.2.4.1 <SITE MEASUREMENTS> ATTRIBUTES

The **<siteMeasurements>** Class contains two attributes: **measurementSiteReference** and **MeasurementTimeDefault**.

- **measurementSiteReference**: a reference to a versioned measurement site record defined in a Measurement Site table.

It is the reference to the zone and the traffic class.

```

...
<measurementSiteReference id="UBR12345-Zone01-Classe01"
targetClass="MeasurementSiteRecord" version="1"/>
...

```

The version number of the zone is incremented if one of the zone characteristics is updated.

The identifier identifies the pair (ZoneX, ClasseY) concerned. We propose the following naming rule: **Stationxx_ZoneX_ClasseY**,

For example: « UBR12345-Zone01-Classe02 » or « NN_Zone02_Classe1254 ».

NOTE: there is another option to identify a class: The solution described above is the preferred solution to identify a class, for this type of message exchanges. Indeed, it minimises the volume of data exchanged. The <MeasurementSiteRecord> class can be completed with, for example, the DATEX II <LengthCharacteristic> class (> 12 m, =3 m, etc.). This would also make it possible to define new groups of vehicles: by height, by number of axles, etc. This is what is used in the "Configuration" message.

- **MeasurementTimeDefault**: the time associated with the set of measurements.

```

...
<measurementTimeDefault>2015-07-20T08:24:00+01:00</measurementTimeDefault>
...

```

This time is the date and time of these uploaded measures. The time is in a format local time with the time zone, in GMT.

4.3.2.4.2 <MEASUREDVALUE> CLASS

This **<siteMeasurements>** class will contain as many **<measuredValue>** classes as values to measure. In theory, there are three values: average speed, average length and number of vehicles. It should be noted that the **<measuredValue>** classes should be indexed.

4.3.2.4.2.1 Average speed

We use the **<basicData>** class, **<TrafficSpeed>** type.

```
<measuredValue index="1">
  <measuredValue>
    <basicData xsi:type="TrafficSpeed">
      <averageVehicleSpeed>
        <speed>88</speed>
      </averageVehicleSpeed>
    </basicData>
  </measuredValue>
</measuredValue>
```

4.3.2.4.2.2 Average length

There is no class to report an average length. But Cerema had proposed an extension for classified speeds. An extension can also be created to report the average lengths. This extension can be treated in SCOOP Wave 2.

4.3.2.4.2.3 Number of vehicles

The **<BasicData>** class with the **<TrafficFlow>** type is used.

```
<measuredValue index="2">
  <measuredValue>
    <basicData xsi:type="TrafficFlow">
      <measurementOrCalculationPeriod>60</measurementOrCalculationPeriod>
      <vehicleFlow>
        <vehicleFlowRate>1200</vehicleFlowRate>
      </vehicleFlow>
    </basicData>
  </measuredValue>
</measuredValue>
```

4.3.2.4.2.4 Additional information

A **<measuredValue>** class can optionally be specified by the type of equipment used to make the measurement.

```
<measurementEquipmentTypeUsed>
  <values>
    <value lang=fr>UBR A86E PR37 </value>
  </values>
```



```
</measurementEquipmentTypeUsed>
```

NOTE: For the record, other information can be reported in DATEX II: data specific to a vehicle, occupancy rate, concentration, inter-vehicle distances, etc.

4.3.2.5 Example of a DATEX II message from an R-ITS-S to the platform.

For example, if the R-ITS-S, named UBR12345, has calculated the following data:

Beginning of period in question	End of period in question	Measurement zone in question	Length class in question	Average harmonic speed	Number of vehicles
2015-07-01T00:00:00	2015-07-01T00:06:00	Zone1	Class1	88	3
2015-07-01T00:00:00	2015-07-01T00:06:00	Zone1	Class2	110	50
2015-07-01T00:00:00	2015-07-01T00:06:00	Zone2	Class1	95	1
2015-07-01T00:00:00	2015-07-01T00:06:00	Zone2	Class2	130	20

Table 4 : Example of data from the UBR12345

Line 1 will be represented by a <siteMeasurements> class completed as follows:

```
<payloadPublication xsi:type="MeasuredDataPublication">
<siteMeasurements>
  <measurementSiteReference id="UBR12345-Zone01-Classe01" targetClass=
"MeasurementSiteRecord" version="1"/>
  <measurementTimeDefault>2015-07-20T08:24:00+01:00</measurementTimeDefault>
  <measuredValue index="1">
    <measuredValue>
      <measurementEquipmentTypeUsed>
        <values>
          <value>UBR A86E PR37</value>
        </values>
      </measurementEquipmentTypeUsed>
      <basicData xsi:type="TrafficFlow">
        <measurementOrCalculationPeriod>360</measurementOrCalculationPeriod>
        <vehicleFlow>
          <vehicleFlowRate>3</vehicleFlowRate>
        </vehicleFlow>
      </basicData>
    </measuredValue>
  </measuredValue>
  <measuredValue index="2">
    <measuredValue>
      <basicData xsi:type="TrafficSpeed">
        <averageVehicleSpeed>
          <speed>88</speed>
        </averageVehicleSpeed>
      </basicData>
    </measuredValue>
  </measuredValue>
</siteMeasurements>
... *
</payloadPublication>
```

The other lines in table 4 are described identically to the location noted * in the xml code above.

4.3.2.6 Example of DATEX II message from the platform to TMS

There are two possibilities for this message:

1. the platform sends as many messages to the TMS as messages received from the R-ITS-S (The platform modifies the exchange parameters, but it keeps the content unchanged):
 - this solution does not optimise the traffic between the platform and the TMS; and
 - the platform has a very reduced role.
2. the platform aggregates the data from the R-ITS-S into a single publication with a unique **<MeasurementSiteTable>** class. For example:

```
...
<measurementSiteTableReference id="SCOOP_DIRIF" targetClass="MeasurementSiteTable"
version="1"/>
...
<siteMeasurements>
  <measurementSiteReference id="UBR1-Zone1-Classe1"
targetClass="MeasurementSiteRecord" version="1"/>
...
</siteMeasurements>
...
<siteMeasurements>
  <measurementSiteReference id="UBR1-Zone2-Classe1"
targetClass="MeasurementSiteRecord" version="1"/>
...
</siteMeasurements>
...
<siteMeasurements>
  <measurementSiteReference id="UBR1-Zone2-Classe1" targetClass=
"MeasurementSiteRecord" version="1"/>
...
</siteMeasurements>
</payloadPublication>
```

In order to optimise the traffic between the platform and the TMS, solution 2 shall be used.

5 Traffic Events and Operator Actions Messages

This chapter is completed by :

- 2.4.1.4 Annex 1 : translation between Datex II SituationPublication and DENM
- 2.4.1.4 Annex 2 : situationPublication authorised from the TMS

5.1 Description of use-cases

The Roadworks and the events usecases, and the two directions of information flow are grouped in this chapter because they are the same in DATEX II from the point of view of the format of the exchanged message. However, the content changes.

In the "uplink" direction, the R-ITS-S receives DENMs. It analyses the DENMs and reports the DATEX II message to the SCOOP platform, if it is relevant. The platform reports the DATEX II message to the TMS, if it is relevant.

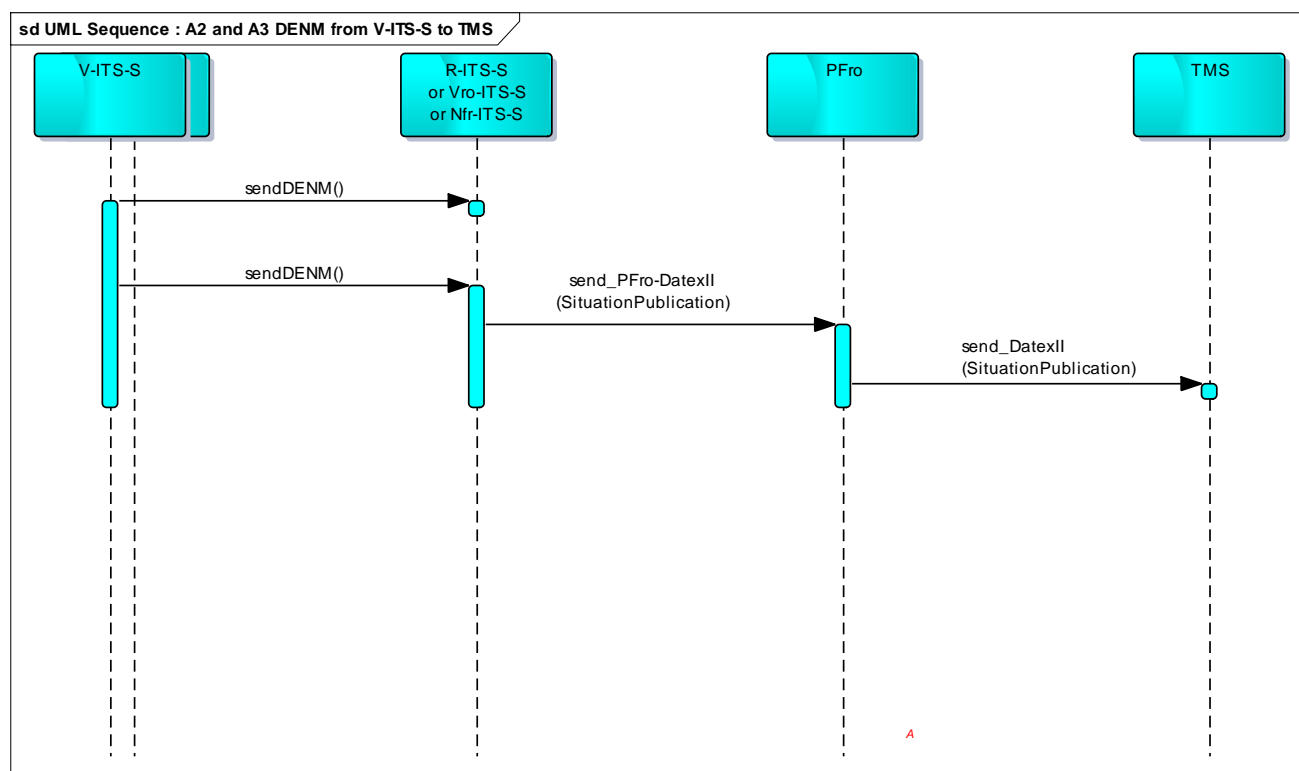


Figure 12 : UML sequence diagram for the data collection based on DENM from V-ITS-S to TMS, uplink flow

There are also the messages from the Vro-ITS-S, in the uplink direction. The operator vehicle send DATEX II Messages, for example to indicate the roadwork to the TMS. The Vro-ITS-S creates the DATEX II message then sends it to the platform.

The platform send a DATEX II message to the TMS (eventually the same message, or an aggregation of several DATEX II Messages). See 2.4.3.2_H about DENM treatment and aggregation.

In the meantime, if the DATEX II message is a message created by the Vro-ITS-S in a operator mode, the platform shall send it directly to the Nfr-ITS-S. (According to the annex1 of this document, this means that the sourcetype is set to roadAuthorities (for a trailer), or otherOfficialVehicle.

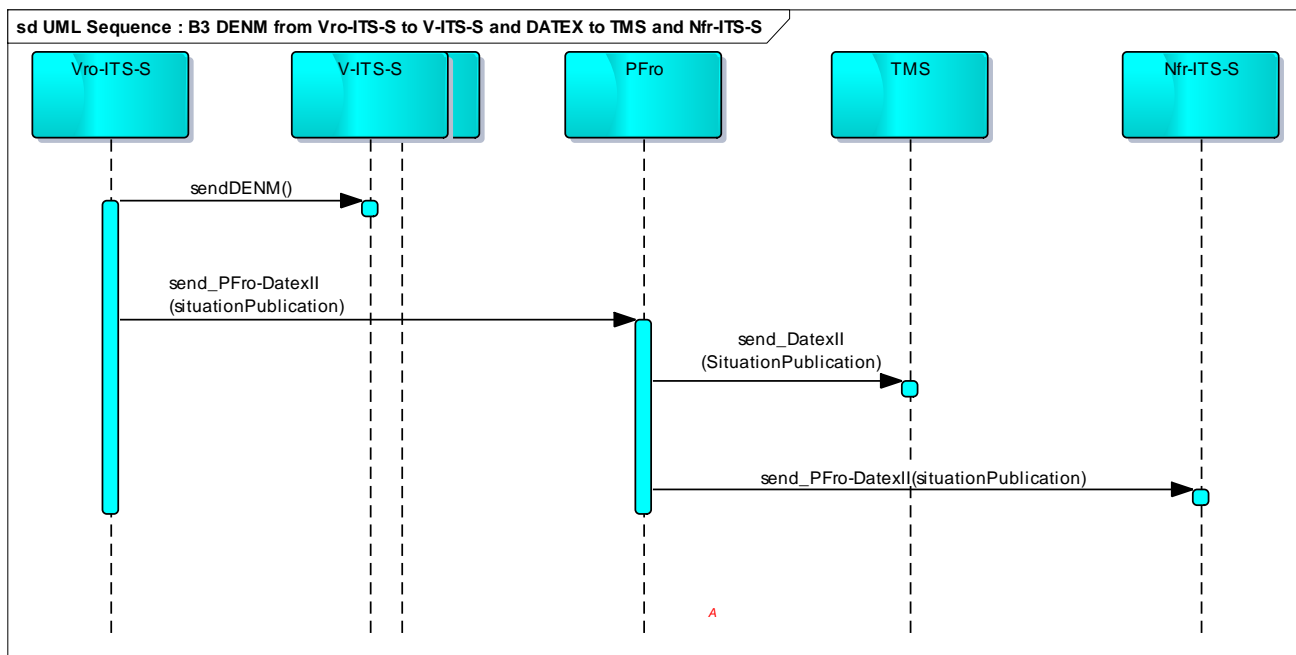


Figure 13 : UML sequence diagram for the traffic information based on DENM from Vro-ITS-S to TMS and Nfr-ITS-S, uplink flow

In the "downlink" direction, the TMS sends the information to the platform, which sends it to the R-ITS-S. The R-ITS-S sends DENMs based on the parameters received.

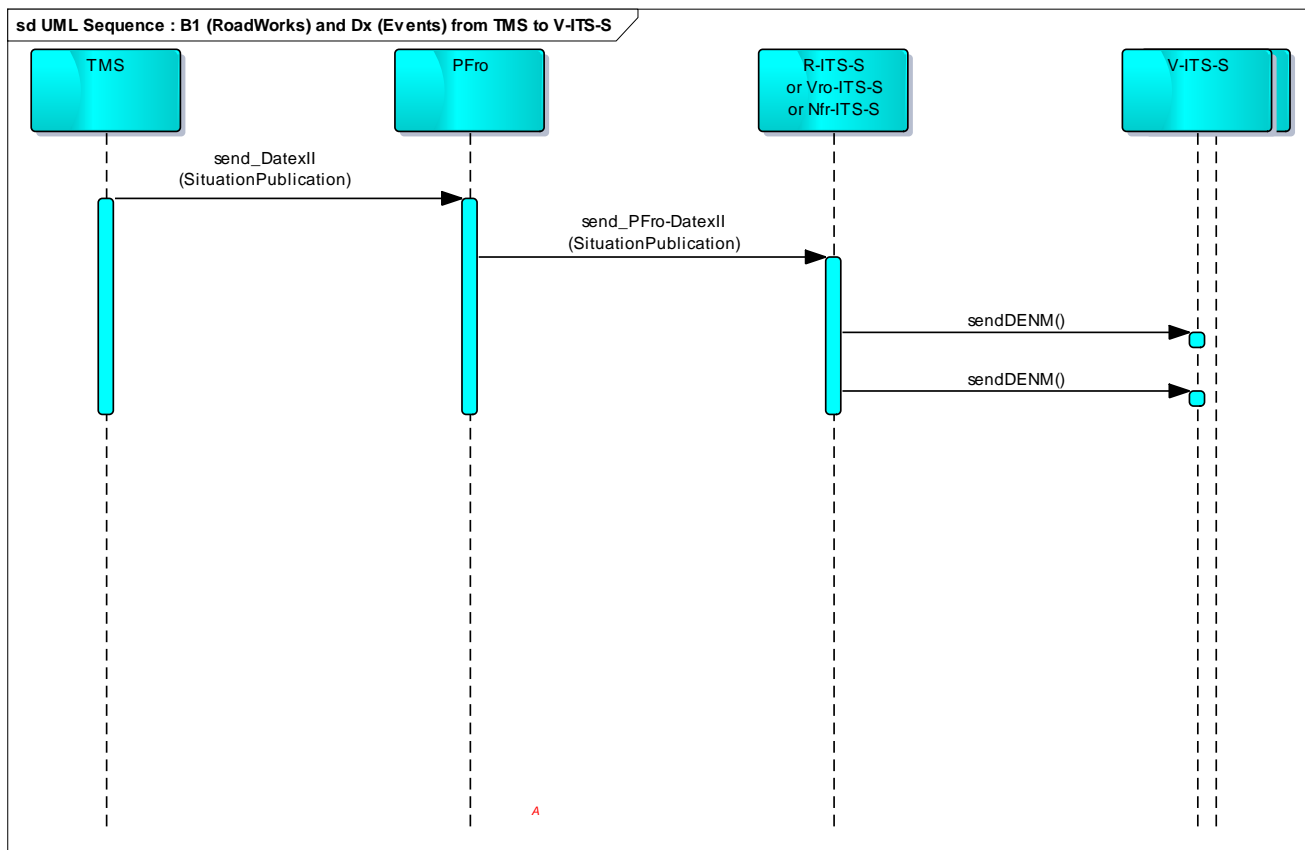


Figure 14 : UML sequence diagram for the events and roadworks from TMS to V-ITS-S,

downlink flow

A great part of the recommendations of this document is from the proposals of the TISA [2].

NOTE: However, it should be noted that the guide [2] is based on the TPEG2-TEC standard, which was used initially to construct the cause codes of the DENM standard. Subsequently, this standard diverged. Consequently the version of the DENM standard adopted in the French C-ITS Projects presents variances from this document. This will be specified below, where applicable.

NOTE: The network management, such as rerouting, speed limit, or other advertisements to the users, is not covered by this chapter, as the meaning is not covered by a DENM, but by another type of C-ITS messages (IVI, POI, MAPS...). The list of types of situationrecord covered by this chapter the list in the table 8, and in the table 11.

5.2 Construction of DATEX II messages of event data

5.2.1 Exchange parameters: Choosing the distribution mode

The "Push on occurrence" mode shall be used for this use case. When the data changes, the sender returns a DATEX II message (OM1 mode).

The sender transmits the data as soon as it is relevant (according to the use case) to the recipient (R-ITS-S=>PF for the upwards cases, PFro=>R-ITS-S for the downwards cases).

```
...
<operatingMode>operatingModel</operatingMode>
...
<updateMethod>allElementUpdate</updateMethod>
...
```

5.2.2 Message content (<PayloadPublication> and <SituationPublication>)

A message in DATEX II (for the publication) contains at least one situation (= one event or roadworks, named <SituationRecord>), and so, can contain several. The DATEX II class used to describe a situation is <SituationPublication>.

We need to specify the <publicationTime> attribute of the <PayloadPublication> class and the <situationVersionTime> attribute of the DATEX II <Situation> class. See Table 6 : Dates and times of a situation.

The roadwork declaration is made through the DATEX II class: <SituationPublication> (as for the D cases), which can contain one or more <SituationRecord> objects.

The <OperatorAction> class inherits from this <SituationRecord> class. And several classes inherit from this <OperatorAction> class, including the following two which can be used in the C-ITS project:

- the <RoadWorks> class: description of the type of roadwork, type of operator vehicles involved, etc.
- the <NetworkManagement> class: description of the operating actions, including in particular: signalling setting up, lane closures, speed limits, user information, etc.

In the French C-ITS projects, one <Situation> class correspond exactly to one C-ITS message. It means,

that all the **<situationRecord>** class inside this situation class are about the same C-ITS message. It also, means, for example, that if there are four valid **<Situation>** classes in a DATEX II message, the R-ITS-S should create four C-ITS messages.

NOTE: this chapter only refers to the DENM, but some situationrecord can be translated into another C-ITS message, such as IVI for the C2 use case, described in the chapter 8.2 Overview of the DATEX II Model.

The events can be linked by the DATEX II attribute "Relatedsituation", which corresponds to the DENM attribute "referenceDenms". These linked events, can be in the same DATEX II message, or in separate DATEX II messages.

Simplified DATEX	Simplified DENM
<datex> ... <situation ID1> Relatedsituation =ID3 <situationRecord Roadworks> <ID1> <groupOfLocations>... </groupOfLocations> </situationRecord> <situationRecord speedmanagement> <ID2> <speedLimit> <groupOfLocations>... </groupOfLocations> </speedmanagement > </situationRecord> <situationRecord lanemanagement> <ID5> <Lane> <groupOfLocations>... </groupOfLocations> </situationRecord> </situation>	 ActionID: ID1 referenceDenms = ID3 CauseCode = 3 Eventposition / EventHistory /Traces temporarySpeedLimit TrafficFlowRule
<situation ID3> Relatedsituation =ID1 <situationRecord travaux> <ID4> <groupOfLocations>... </groupOfLocations> </situationRecord> <situationRecord speedmanagement> <ID5> <speedLimit> <groupOfLocations>... </groupOfLocations> </situationRecord> <situationRecord lanemanagement> <ID6> <Lane> <groupOfLocations>...	ActionID: ID3 referenceDenms = ID1 CauseCode = 3 Eventposition / EventHistory /Traces temporarySpeedLimit TrafficFlowRule

</groupOfLocations> </situationRecord> </situation>	
... </datex>	

Table 5 : Extremely simplified example of DATEX II message, and its conversion in DENM

5.2.2.1 The DATEX II <HeaderInformation> class

The DATEX II <HeaderInformation> class, which is associated with all the publications defined in DATEX II, is mandatory. Exceptionally, for the publication of situations, this class is attached to each situation and not to the publication level itself.

It includes four attributes, two of which are mandatory: It is proposed not to fill in the two optional attributes. For the two mandatory attributes:

- The "confidentiality" attribute will be filled in systematically with the "noRestriction" value; and
- The "informationStatus" attribute will be filled in systematically with the "real" value.

```
<headerInformation>
  <confidentiality>noRestriction</confidentiality>
  <informationStatus>real</informationStatus>
</headerInformation>
```

NOTE: for the test or validation cases, the "informationStatus" attribute could be filled in with "technicalExercise" or "test".

5.2.2.2 The DATEX II <Situation> class

5.2.2.2.1 IDENTIFIER OF THE CLASS

For the French C-ITS projects, a situation publication only contains one situation that is "versionIdentifiable". The creation rules for identifier and version are the following:

- In case of downlink usecases (use cases Dx): the identifier and version are defined by the platform depending on what is sent by TMS;
- In case of uplink usecases (use cases A2Dx and A3Dx):
 - the identifier is created by concatenating:
 - The "actionID" DENM attribute;
 - The R-ITS-S "stationID" (it allows making the identifier unique);
 - The value "0".

NOTE: Adding the value 0 allows for using the same rule for creating identifiers for situations and situation record and guarantying unicity.

- The version attribute is an integer, incremented (starting from 1) and is updated for each DENM update based on the "referenceTime" DENM attribute.

5.2.2.2.2 TWO OR MORE SITUATIONS LINK

If there is a link between two or more situations, then attributes "relatedSituation" will be fulfilled with the reference to a related situation via its unique identifier. There are as many attributes in one situation as the

situations linked. All the situations linked shall have this attributes fulfilled.
In this case, all these situations can be in the same DATEX II publication, or in different messages.

These attributes are to be used to express the “ReferenceDenms” attribute in the roadwork container, specified in the COCSIC deliverable 2.4.1.4_H: B1a&b.

Note : The ReferenceDenms is a sequence of ActionIDs, For the translation,

5.2.2.3 The DATEX II <SituationRecord> class

A situation can contain several DATEX II <SituationRecord> class instances to describe each element of the situation. However, all elements of a situation are connected by a causality link. They cannot be independent elements.

A DATEX II <SituationRecord> class includes several attributes. It is also associated with other classes that complete it:

- Comment (see chapter 5.2.2.3.2.3 The DATEX II <Comment> class)
- Impact (see chapter 5.2.2.3.2.1 The DATEX II <Impact> class)
- Source (see chapter 5.2.2.3.2.2 The DATEX II <Source> class)
- Validity (Mandatory) (see chapter 5.2.2.3.2.5 The DATEX II <Validity> class)
- groupOfLocations (see chapter 5.2.2.3.2.6 The DATEX II <groupOfLocations>); (Mandatory)
- Cause (See chapter 5.2.2.3.2.4 The DATEX II <Cause> class)
- And other optional classes, not described in this document.

5.2.2.3.1 THE <SITUATIONRECORD> CLASS ATTRIBUTES

5.2.2.3.1.1 The class identifier

The class identifier is mandatory (“versionedIdentifiable”):

- In case of downlink usecases (use cases D); the identifier is defined by platform from what is provided by the traffic information and control system;
- In case of uplink usecases (use cases A2Dx and A3Dx): the identifier is equal to the value of the “situationRecordCreationReference” (see chapter 5.2.2.3.1.2 The “situationRecordCreationReference” attribute).

5.2.2.3.1.2 The “situationRecordCreationReference” attribute

In the French C-ITS Projects, the attribute of the situation record, called <situationRecordCreationReference> becomes mandatory. This attribute contains a unique alphanumeric reference (external or GUID) of the first <SituationRecord> class occurrence version when created by the original supplier.

NOTE: it is not mandatory in the standard or in the guide [4].

Particularity for the downlink cases

This reference, in the form of a text chain, may therefore not be provided by the traffic information and control system. In any case, the platform creates it because it is used for defining the DENM “actionID” data frame (B.7).

The platform creates the “situationRecordCreationReference” attribute by concatenating the following information:

- its “stationID” (32-bit integer in hexadecimal format left padded with 0),
- followed by an incremental number (16-bit integer in hexadecimal format left padded with 0),
- followed by a sequence number in each situation starting from 1 (0 is allocated for the situation itself) (4-bits integer in hexadecimal format left padded with 0).

One number in the hexadecimal base corresponds exactly 4 numbers in binary base.
The SituationRecordCreationReference is on 13 hexadecimal characters.

Example of a "SRCR" from PFro	0	0	D	5	E	1	5	6	0	0	E	7	1
Meaning for an R-ITS-S:	To use to fill the OriginatingStationID								To use to fill the SequenceNumber				This R-ITS-S shall take the situationrecord with the number 1 to find the eventType.
Value in DENM	14016854								231				Nothing

Figure 15 : *example of translation of the SituationRecordCreationReference in the downlink cases.*

There is no need for a separation character between the different concatenated elements due to the fix format.

The R-ITS-S that receives this message recovers the incremental number and the "stationID" from the platform (considered as the "originatingStationID" to fill in the "actionID" attribute of the DENM to transmit.

Particularity for the uplink cases

In the case of a DATEX II message generated from a DENM, the "actionID" data element of the DENM will be used to generate this reference. The R-ITS-S constructs the DATEX II <situationRecordCreationReference> attribute by concatenating the following information (all the elements in hexadecimal format – as for the downlink cases):

- "actionID" attribute of the DENM (keeping the "stationID" of generating V-ITS-S makes possible for the platform to verify if the same DENM is uploaded from two different RSUs)¹
- followed by the "stationID" of the R-ITS-S
- followed by a sequence number in each situation starting from 1² (this last point in order to make the identifier unique³), 4-bits integer in hexadecimal format left padded with 0.

One number in the hexadecimal base corresponds exactly 4 numbers in binary base.
The SituationRecordCreationReference is on 13+8 hexadecimal characters :

Example of a "SRCR" from R-ITS-S	0	0	D	5	E	1	5	6	0	0	E	7	0	0	0	0	0	0	A	1
Meaning	To fill with the actionID												R-ITS-S StationID							The PFro shall take the situationrecord with the number 1 to find the eventType.
Value in DENM	14016854								231				10							Nothing

Figure 16 : *example of translation of the SituationRecordCreationReference in the uplink cases.*

5.2.2.3.1.3 Time attributes

¹ Note 1: This implies that the <situationRecordCreationReference> can be different from the "stationID" in the "actionID" (Forward by vehicles before the treatment by R-ITS-S).

² Note 2: as quite all the situations only include one situation record the corresponding sequence number is 1.

³ Note 3: The uniqueness of the reference must be provided since it also serves as an ID for the situation record.

NOTE: there are two possible formats in DATEX II: either local (2015-09-29 T 10:20:00 +2:00 which represents the difference with GMT) or universal i.e. GMT ("2015-09-29 T 10:20:00 Z").

The universal time i.e. GMT shall be used in the French C-ITS projects, for DATEX II messages.

NOTE: Timestamps in DENM messages are in TAI (International Atomic Time), so R-ITS-S shall do a conversion. See SCOOP Deliverables "R-ITS-S specifications" for more information.

The creation timestamp of a record is mandatory: **<situationRecordCreationTime>**.

The version timestamp of the situation record is mandatory: **<situationRecordVersion>**.

The version timestamp of the situation record by the first supplier is optional, made mandatory in C-ITS Projects: **<situationRecordFirstSupplierVersionTime>**.

The observation timestamp of the situation element is mandatory: **<situationRecordObservationTime>**.

Particularity for each use case

The table lists the values according to the use cases. It also presents in the interest of coherence, the situation version time (<situationVersionTime> of the DATEX II <situation> class - optional) and the publication time (<publicationTime> of the DATEX II <PayloadPublication> class - mandatory).

Class::attribute	Mand.	R-ITS-S=>PF message	TMS=>PF and PFro=>R-ITS-S message
PayloadPublication::publicationTime	Y	Message creation time by the R-ITS-S	Message creation time by the platform. Not used to generate the DENM.
Situation::situationVersionTime	N	Not used	Not used
SituationRecord::situationRecordCreationTime	Y	Creation time of the first version of the message when the first DENM considered as the source of the situation record is processed by R-ITS-S.	Fill in (because mandatory) but not used by the R-ITS-S to create DENM.
SituationRecord::situationRecordFirstSupplierVersionTime	Y	Creation time of the current version of the message by processing the first DENM considered as an update of the situation record; this is the time contained in the "referenceTime" data element of the DENM.	Not used by the R-ITS-S.
SituationRecord::situationRecordObservationTime	Y	Time contained in the "detectionTime" data element of DENM where the current version of the situation record came from.	Not used by the R-ITS-S.
SituationRecord::situationRecordVersionTime	Y	This is the time of the current version of the situation record via the current relay (for an R-ITS-S, it is the same piece of data as that contained in <situationRecordFirstSupplierVersionTime>)	Time used to fill in the DENM "referenceTime" data element.
validity.overallStartTime	Y	Time contained in the "detectionTime" data element of DENM where the current version of the situation record came from.	Time used by the R-ITS-S to construct the "detectionTime" data element of DENM Time used by the R-ITS-S to construct the "validityduration" data element of DENM, with difference with the overallEndTime.
validity.overallEndTime	Y	Time obtained by the following calculation: detectionTime + validityduration	Time used by the R-ITS-S to construct the "validityduration" data element of DENM, with difference with the overallStartTime.

Table 6 : Dates and times of a situation for DENM use cases

5.2.2.3.1.4 “probabilityOfOccurrence” attribute

This is an evaluation of the probability of occurrence of the situation element signalled. It is mandatory. The possible values in DATEX II are “certain”, “probable” and “riskOf”.

In the French C-ITS Projects, a DENM can be transmitted with 3 quality levels (“InformationQuality” attribute of a DENM). The correspondence is presented in table 6:

probabilityOfOccurrence	Level of Quality
riskOf	Q1 = risk
Probable	Q2 = Probable
Certain	Q3 = Certain

Table 7 : Correspondence between “Level of Quality” and “probabilityOfOccurrence”

Particularity for the downlink linear cases

In each element of the eventHistory, an “InformationQuality” is requested. The R-ITS-S shall use the same “probabilityOfOccurrence” to fill in this attribute for all the points.

Particularity for the uplink linear cases

In the uplink linear cases, the InformationQuality related to the points of the eventHistory is not used by the R-ITS-S. Only the principal “InformationQuality” is filled in.

NOTE: deliverable “2.4.1.” does not specify the default value, but requires that the DENM data element is filled in.

NOTE: deliverable “2.4.1” lists for each use case the values of the InformationQuality data element corresponding to the Level of Quality used here.

5.2.2.3.1.5 The <OperatorAction> class attributes (roadworks only)

This DATEX II class is used to describe the operating actions (i.e., any action that an operator can decide to prevent or correct dangerous or deteriorated traffic conditions, including roadwork). The attributes of this class are not used in the context of the C-ITS project because they are not mandatory and they do not have an equivalent in DENM.

NOTE: for the record the attributes are actionOrigin (internal/external), actionPlanIdentifier (PGT identifier) and operatorActionStatus (status).

5.2.2.3.1.6 The other attributes

<confidentialityOverride> and <severity> are not retained in the context of the French C-ITS Projects. They are not mandatory in DATEX II and do not have an equivalent in DENM.

5.2.2.3.2 THE CLASSES LINKED TO THE <SITUATIONRECORD> CLASS

5.2.2.3.2.1 The DATEX II <Impact> class

The DATEX II <impact> class is used to provide an evaluation of the impact of an event or operating action (defined by the situation element) on the driving conditions. It can be expressed both in terms of lane capacity and in terms of time lost on the travel time.

The DATEX II <impact> class serves to qualify and quantify the lane and road restrictions. Concerning divided roads, two situation elements, one per direction, shall be created. The two attributes, “capacityRemaining” and “originalNumberOfLanes”, should preferably be used when they are known. When this is not possible, use the “trafficConstrictionType” attribute.

- capacityRemaining: Capacity remaining: Percentage compared to the normal traffic capacity, in the direction concerned.

- originalNumberOfLanes: in the direction concerned
- trafficConstrictionType: Type of traffic restriction: Based on an enumeration whose possible values are: "carriagewayBlocked", "carriagewayPartiallyObstructed", "lanesBlocked", "lanesPartiallyObstructed", "roadBlocked", "roadPartiallyObstructed".

NOTE: The semantic difference in DATEX II between "blocked" and "partially obstructed" is important.

Particularity for messages created from a DENM (except A3-D8)

In the French C-ITS use cases corresponding to data from vehicles (A2 or A3, except A3D8), it will be impossible to fill the DATEX II **<impact>** class from a DENM.

Particularity for A3-D8 and D8 use cases: "unmanaged blockage of a road"

In the A3-D8 cases, the impact class makes it possible to qualify the blockage of the road because there is no predefined corresponding event (i.e., no class inherited from **<SituationRecord>** to describe a blockage. Indeed, in DATEX II, a blockage is considered as the impact of an event.

Use case	Class::attribute	Instruction and comment
A3-D8	Impact::trafficConstrictionType	Fill in with the "lanesBlocked" value. <i>NOTE: according to the capacities of the V-ITS-S, the DENM could be more complete. The R-ITS-S should verify the completeness of all data elements to verify whether it can fill in this attribute with the "carriagewayBlocked" value (case of a divided road) or "roadBlocked" value (case of a bidirectional road or case of a divided road).</i>
D8	Impact::capacityRemaining	Fill in with the percentage (in the form of a whole number), the capacity that remains open to traffic. The opening of an emergency lane to traffic enters into account.
	Impact::originalNumberOfLanes	The theoretical number of traffic lanes open does not take into account the emergency lane when it is not usually open to traffic.
	Impact::trafficConstrictionType	Only fill in when it is impossible to fill in the preceding attributes (especially for bidirectional roads). Use the "roadBlocked" value when the blockage is total and "lanesBlocked" value otherwise.

Table 8 : Attributes for UC "D8" & "A3-D8"

*NOTE: For the French C-ITS Projects, it is proposed to not use the DATEX II **<Delays>** class (linked to the **<Impact>** class), with which one can describe the delay created either by an estimated duration ("delayTimeValue"), or by duration attributes ("DelayBandEnum") or finally by a more subjective qualification ("DelaysTypeEnum").*

5.2.2.3.2.2 The DATEX II **<Source>** class

The DATEX II **<Source>** class is used to provide information on the source of traffic information (e.g., reliable (yes/no), sourceType (camera, authority, cell phone, etc.)).

We recommend filling in the following attributes:

- "sourceName": Name of the organisation that produced the information / Corresponds to "supplierIdentification" when the creator is the supplier (in the case where the publication is relayed, the name of the source of the original publication shall be kept).

- “sourceIdentification”: Coded information of the organisation or active equipment that produced the information concerning the version in question of the “sourceIdentification”.

Particularity for messages created by TMS or PFro

The Platform uses the information received from the TMS.

NOTE: there are no general rules for the TMS, since there is no equivalent in a DENM, the R-ITS-S will not use its content in preparing the messages.

Particularity for messages created from a DENM

In the case of an upload from the vehicles (use case A2 and A3), this class could be used to distinguish the modes. The “sourceType” attribute can be filled in with the “vehicleProbeMeasurement” value for the A2Dx cases and “registeredMotoristObserver” value for the A3Dx cases.

So the R-ITS-S uses the “stationID” data element of the DENM to fill the “sourceIdentification” of the DATEX II message which corresponds to the “transmitterID”.

5.2.2.3.2.3 The DATEX II <Comment> class

The DATEX II <comment> class is used to enter open comments that the operator can use to exchange unstructured information or observations. The comments can be for general use or restricted use.

It is proposed not to use such information.

5.2.2.3.2.4 The DATEX II <Cause> class

The DATEX II <Cause> class is used when a situation is the cause of the event defined here. When, for example, roadwork is the consequence of an accident.

There are two types of Cause in datex. From the SCOOP Platform to the V-ITS-S, only the <NonManagedCause> class will be used. The description attribute is not mandatory. The attribute <causeType> shall be complete to precise the type of event.

This attribute will be used to fill in the “linkedCause” in the DENM.

NOTE: the values to use or not to use in DENM, are not yet specified by the Deliverable 2412H. So the correspondence between DATEX II and DENM will be define in anupdate of the document.

5.2.2.3.2.5 The DATEX II <Validity> class

In the French C-ITS Projects and in all use cases, the <overallStartTime> shall be filled in for all messages.

If the end date is unknown, , the DATEX II <Validity> class is instantiated as follows:

```
...
<validity>
  <validityStatus>active</validityStatus>
  <validityTimeSpecification>
    <overallStartTime>2015-01-01T17:13:39+01:00</overallStartTime>
  </validityTimeSpecification>
</validity>
...
```

If the end date is known, the DATEX II <Validity> class should be instantiated as follows:

```
...
<validity>
  <validityStatus>definedByValidityTimeSpec</validityStatus>
```



```
<validityTimeSpecification>
  <overallStartTime>2015-01-01T17:13:39+01:00</overallStartTime>
  <overallEndTime>2015-05-25T19:13:39+01:00 </overallEndTime>
</validityTimeSpecification>
</validity>
```

In the French C-ITS Projects, the **<overallEndTime>** shall be filled in for the messages from the Platform to the R-ITS-S, Nfr-ITS-S or Vro-ITS-S. These two attributes will be used to construct the “validityDuration” data element of the DENM.

Consequently, for messages coming from TMS, if the end date is not filled in, the platform modifies the validity definition of the original DATEX II message such that the “validityStatus” attribute is made as “definedByValidityTimeSpec”. The “overallEndTime” is filled in from the “overallStartTime” value and adding the duration defined in deliverable 2.4.1.2 depending on the considered use case.

These elements are presented in the Table 5.

NOTE: The platform receive scheduled events sent from TMS. See the deliverable 2.4.3..2_H for details.

NOTE: The platform, under conditions, can send updates of an event if it is not finish (modifying overallStartTime and overallEndTime)

5.2.2.3.2.6 The DATEX II <groupOfLocations>

For the event related messages transmitted, one should specify the location of the event, with the class <groupOfLocations>.

In the case of point locations (e.g. there is no eventHistory in DENM message):

- If there is no trace
 - Use **<groupOfLocations>** of type "point"
 - pointByCoordinates (= eventPosition)
 - See: 3.4

NOTE: for the case of an event positioned manually on the SCOOP application: the bearing will probably not be filled in. For more information, see C-ITS deliverables.

- If there is 1 trace:
 - Use **<groupOfLocations>** of type "point"
 - <PointAlongLinearElement> (= “trace”)
 - pointByCoordinates (= “eventPosition”)
 - See: 3.5
- If there are 2 traces or more:
 - Use **<groupOfLocations>** of type "NonOrderedLocationGroupByList" containing "Point"
 - point 1 ==> Trace 1
 - pointAlongLinearElement (= trace)
 - pointByCoordinates (= eventPosition)
 - point 2 ==> Trace 2
 - pointAlongLinearElement (= the trace)
 - Optionally: pointByCoordinates (= eventPosition)
 - point 3 ==> Trace 3
 - pointAlongLinearElement (= the trace)
 - Optionally: pointByCoordinates (= eventPosition)
 - Etc.
 - See: 3.6

In the case of linear locations (EventHistory present in DENM message):

- If there is 1 trace or more
 - **<groupOfLocations>** of type "NonOrderedLocationGroupByList" containing "Linear"
 - linearWithinLinearElement: index = 1 (EventHistory)
 - "PointCoordinates" with the relation "locationForDisplay" (= eventPosition))
 - FromPoint: (=eventPosition = beginning of the EventHistory)
 - ToPoint: (= end of the EventHistory)
 - linearWithinLinearElement: index = 2 (Trace 1)
 - linearWithinLinearElement: index = 3 (Trace 2)
 - etc.
 - See: 3.7.

NOTE: The coordinates transmitted by the platform, are not necessarily those of a "PR" or "PLO" ... In consequence, when the coordinates are not "PR" or "PLO", the "referentType", set to "referenceMarker" in the examples in the present document, shall not be set to "RIU", but to "roadNode", as for R-ITS-S. For more information, see deliverables for the platform.

NOTE: The vehicles have their own algorithm for the points. Sometimes, there can be no points inside a trace. For more information, see deliverables for the V-ITS-S.

5.2.2.3.2.7 The kinematics of events

DATEX II can be used to manage versions of messages and therefore events. This particularity of DATEX II is not detailed in this deliverable. Readers should refer to the DATEX II [4] guide.

5.2.2.3.3 THE CLASSES INHERITED FROM THE <SITUATIONRECORD> CLASS: <ACCIDENT>, <GENERALOBSTRUCTION>, ETC. EXCEPT ROADWORKS

Several classes inherit the abstract **<SituationRecord>** class. These derivative classes are used to define the type of use case encountered.

Here is an extract of an xml message indicating how to perform this heritage between the **<SituationRecord>** class and the **<accident>** class.

```
...
<situationRecord xsi:type="Accident" version="1" id="GUID2A22530C-D452-4ae8-B942-
993BC2923D14">
...
  <accidentType>accidentInvolvingHazardousMaterials</accidentType>
...
</situationRecord>
```

The following table describe the correspondence in the context of the French C-ITS Projects between the DATEX II messages and the DENMs. This table describes:

- the messages sent by the R-ITS-S to the platform
- the messages sent by the platform to the R-ITS-S
- the messages sent by the platform to the TMS

The messages sent by the TMS to the platform shall refer to this table. However, TMS may know other classes. In order to be as interoperable as possible, this document proposes a second table in the appendix, with the correspondence between the classes recommended by the DATEX II France WG and the French C-ITS DENMs.

The "TISA" column in the following table indicates whether the correspondence proposed for the case in question complies with the correspondence of the document defined in the document [2] written by TISA. The "DATEX II France" column indicates whether the correspondence proposed for the case is present in

the guide [4].

The appendix of this document contains the list of all derivative classes of **<SituationRecord>** and a correspondence in DENM.

NOTE: there is not always strict correspondence of the meanings between the DATEX II class and the DENM (for example: loss of the “temporary” aspect of a slippery road in DENM, to a DATEX, or the DATEX II message signalling “black ice” in DATEX, implies that the road is slippery).

the French C-ITS use cases Name	CC subC	/	TISA	DATEX II France	Derivative class of <SituationRecord>	Typical attribute of the derivative class and value of the attribute	Comments
A3-D5: Unprotected accident area	2	0	no	yes	GeneralObstruction	obstructionType = UnprotectedAccidentArea	This attribute value is not recommended by the DATEX II France WG, but corresponds to the DENM.
D5: Unprotected accident area	2	0	no	yes	Accident	accidentType = accident	
D5: Unprotected accident area	2	1	no	yes	Accident	accidentType = multivehicleAccident	
D5: Unprotected accident area	2	2	no	no	Accident	accidentType = seriousAccident	
D5: Unprotected accident area	2	3	no	yes	Accident	accidentType = accidentInvolvingHeavyLorries	
D5: Unprotected accident area	2	4	no	yes	Accident	accidentType = accidentInvolvingBuses	
D5: Unprotected accident area	2	5	no	yes	Accident	accidentType = accidentInvolvingHazardousMaterials	
D5: Unprotected accident area	2	6	no	yes	Accident	accidentType = accident	This use case (accident on oncoming lane) will eventually be withdrawn from 2.4.1.1.
D5: Unprotected accident area	2	7	yes	yes	GeneralObstruction	obstructionType = UnprotectedAccidentArea	This attribute value is not recommended by the DATEX II France WG, but corresponds exactly to the DENM.
A2-D1 and D1: temporarily slippery road	6	0	yes	no	WeatherRelatedRoadCondition	weatherRelatedRoadConditionType = slipperyRoad	
D1 Temporarily slippery road - persistent frost	6	1	no	yes	poorEnvironmentConditions	poorEnvironmentType = frost	
D1 Temporarily slippery road - diesel fuel	6	2	yes	yes	NonWeatherRelatedRoadConditions	nonWeatherRelatedRoadConditionType = petrolOnRoad	
D1 Temporarily slippery road - mud	6	3	yes	yes	NonWeatherRelatedRoadConditions	nonWeatherRelatedRoadConditionType = mudOnRoad	
D1 Temporarily slippery road - snow	6	4	no	yes	WeatherRelatedRoadCondition	WeatherRelatedRoadConditionType = snowOnTheRoad	
D1 Temporarily slippery road - ice	6	5	yes	no	WeatherRelatedRoadCondition	weatherRelatedRoadConditionType = ice	

2.4.1.4_H_SPECIFICATION OF DATEX II V2.3 MESSAGES IN CONJUNCTION WITH C-ITS MESSAGES

the French C-ITS use cases Name	CC / subC		TISA	DATEX II France	Derivative class of <SituationRecord>	Typical attribute of the derivative class and value of the attribute	Comments
D1 Temporarily slippery road - black ice	6	6	yes	yes	WeatherRelatedRoadCondition	weatherRelatedRoadConditionType = blackIce	
D1 Temporarily slippery road - oil	6	7	yes	yes	NonWeatherRelatedRoadConditions	nonWeatherRelatedRoadConditionType = oilOnRoad	
D1 Temporarily slippery road - gravel	6	8	yes	yes	NonWeatherRelatedRoadConditions	nonWeatherRelatedRoadConditionType = looseChippings	
D1 Temporarily slippery road - black ice	6	9	no	yes	WeatherRelatedRoadCondition	WeatherRelatedRoadConditionType = freezingRain	
D1 Road temporarily slippery - roads salted	6	10	no				No possibility currently in DATEX II to send a message signifying "The road is slippery, even though it has been salted." The following message cannot be sent with the DATEX II standard version. Therefore it is proposed to operators to send two messages: "slippery road" and/or "salting underway", which will result in 2 different DENMs: 6/0 and 3/3.
A3-D8 and D8: Unmanaged obstacle on the road	9	0	no	yes	GeneralObstruction	ObstructionType = obstructionOnTheRoad	The trafficConstrictionType = roadBlocked attribute should be specified. See 5.2.2.3.2.1 The DATEX II <Impact> class. In DATEX II, this class does not automatically imply blockage.
D8: Unmanaged obstacle on the road	9	1	yes	yes	EnvironmentalObstruction	environmentalObstructionType = rockfalls	The trafficConstrictionType = roadBlocked attribute should be specified. See 5.2.2.3.2.1 The DATEX II <Impact> class. In DATEX II, this class does not automatically imply blockage.
D8: Unmanaged obstacle on the road	9	4	no	yes	EnvironmentalObstruction	environmentalObstructionType = subsidence	The trafficConstrictionType = roadBlocked attribute should be specified. See 5.2.2.3.2.1 The DATEX II <Impact> class. In DATEX II, this class does not automatically imply blockage.
D8: Unmanaged obstacle on the road	9	5	yes	yes	WeatherRelatedRoadCondition	weatherRelatedRoadConditionType = snowDrifts	The trafficConstrictionType = roadBlocked attribute should be specified. See 5.2.2.3.2.1 The DATEX II <Impact> class. In DATEX II, this class does not automatically imply blockage.
D8: Unmanaged obstacle on the road	9	7	no	yes	InfrastructureDamageObstruction	infrastructureDamageType = burstPipe	The trafficConstrictionType = roadBlocked attribute should be specified. See 5.2.2.3.2.1 The DATEX II <Impact> class. In DATEX II, this class does not automatically imply blockage.
A3-D3 and D3: Obstacle on the road	10	0	yes	yes	GeneralObstruction	obstructionType = objectOnTheRoad	
A3-D2a and D2a: animal on the road	11	0	yes	yes	AnimalPresenceObstruction	animalPresenceType = animalsOnTheRoad	For the D2a case, we should give priority to express the "animalsOnTheRoad" attribute in DENM. In DATEX, one cannot specify "wild" or "small".

2.4.1.4_H_SPECIFICATION OF DATEX II V2.3 MESSAGES IN CONJUNCTION WITH C-ITS MESSAGES

the French C-ITS use cases Name	CC subC	/	TISA	DATEX II France	Derivative class of <SituationRecord>	Typical attribute of the derivative class and value of the attribute	Comments
D2a Animal on the road - wild	11	1	no	yes	AnimalPresenceObstruction	animalPresenceType animalsOnTheRoad =	No exact correspondence in DATEX II. Preferably use the subcausecode 0 in the platform to R-ITS-S direction. Note that the notion "wild animal" is present in TPEG. A request to upgrade DATEX II should be made to that end.
D2a Animal on the road - herd	11	2	yes	no	AnimalPresenceObstruction	animalPresenceType herdOfAnimalsOnTheRoad =	
D2a Animal on the road - small animal	11	3	no	yes	AnimalPresenceObstruction	animalPresenceType animalsOnTheRoad =	No exact correspondence in DATEX II. Preferably use the subcausecode 0 in the platform to R-ITS-S direction. Today there is no exact correspondence in DATEX II nor in TPEG. The DENM 11/3 will not be sent by an R-ITS-S but the R-ITS-S can interpret the message if it receives it.
D2a Animal on the road - big animal	11	4	yes	no	AnimalPresenceObstruction	animalPresenceType largeAnimalsOnTheRoad =	
A3-D2b and D2b: People on the road	12	0	yes	yes	GeneralObstruction	obstructionType peopleOnRoadway =	
E6: Warning - exceptional weather conditions	17	1	yes	yes	poorEnvironmentConditions	poorEnvironmentType stormForceWinds =	In DATEX II, the code to use depends on the wind speed. We assume that we are talking of severe winds currently encountered in France: between 90 km/h and 120 km/h (preconized by Météo France)
E6: Warning - exceptional weather conditions	17	4	no	no	poorEnvironmentConditions	poorEnvironmentType thunderstorms =	
A2-D6 and D6: Warning - reduced visibility	18	0	yes	no	poorEnvironmentConditions	poorEnvironmentType visibilityReduced =	
D6: Warning - reduced visibility	18	1	yes	yes	poorEnvironmentConditions	poorEnvironmentType = fog	
D6: Warning - reduced visibility	18	2	yes	no	poorEnvironmentConditions	poorEnvironmentType smokeHazard =	Even though not present today, "smokeHazard" should be quickly added to the guide [4].
D6: Warning - reduced visibility	18	3	yes	yes	poorEnvironmentConditions	poorEnvironmentType snowFall =	
D6: Warning - reduced visibility	18	4	no	yes	poorEnvironmentConditions	poorEnvironmentType heavyRain =	
D6: Warning - reduced visibility	18	5	no	no	poorEnvironmentConditions	poorEnvironmentType = hail	
A2-E6: Warning - exceptional weather conditions	19	0	no	yes	poorEnvironmentConditions	poorEnvironmentType badWeather =	Note, there is no exact correspondence in DATEX II. The DATEX II value signifies "bad weather" while the DENM value signifies "rain".
A2-D11 and D11: warning - end of queue	27	0	no		AbnormalTraffic	abnormalTrafficType queuingTraffic =	Note, there is no exact correspondence in DATEX II. The DATEX II value signifies "low speed, stop and go traffic", while the DENM value signifies "End of hazardous end of queue".
A2-D4a and D4a: stationary vehicle	94	0	no	yes	VehicleObstruction	vehicleObstructionType vehicleStuck =	We can add the vehicle's characteristics Note, there is no exact

the French C-ITS use cases Name	CC subC	/	TISA	DATEX II France	Derivative class of <SituationRecord>	Typical attribute of the derivative class and value of the attribute	Comments
							correspondence in DATEX II. The DATEX II value signifies that the vehicle is blocked due to environmental conditions, while the DENM value signifies that the vehicle is stationary (but not a case of a breakdown or accident). The DATEX II France WG will propose to extend this value to the case of a stationary vehicle for a reason other than a breakdown or accident.
A2-D4b and D4b: broken down vehicle	94	2	no	yes	VehicleObstruction	vehicleObstructionType = brokenDownVehicle	We can add the vehicle's characteristics. In the A2-D4b case, the DENM transmitted does not specify whether the vehicle blocks the road or is on the side of the road. In the D4b case, we can specify this.
A2-D5: Unprotected accident area	94	3	no	yes	VehicleObstruction	vehicleObstructionType = damagedVehicle	We can add the vehicle's characteristics (In DATEX II, the same logic as the DENM, we do not report the accident, but the fact that the vehicle is damaged). The DENM transmitted does not specify whether the vehicle blocks the road or is on the side of the road.
A2-D10 warning emergency brake	99	1	no		VehicleObstruction	vehicleObstructionType = dangerousSlowMovingVehicle	Note, there is no exact correspondence in DATEX. The DATEX II value signifies "slow moving vehicles", while the DENM value signifies "Brake lights on."
D7: Wrong way vehicle	14	2	yes	yes	VehicleObstruction	vehicleObstructionType = vehicleOnWrongCarriageway	Some vehicle's characteristics can be added to the message, but won't be used in the DENM.

Table 9 : Correspondence between the DATEX II messages and the DENM messages

5.2.2.3.4 THE <ROADWORKS> CLASS

5.2.2.3.4.1 The <RoadWorks> class attributes

The following attributes can be filled in:

- "underTraffic": Roadwork under traffic indicates if the roadwork is done under traffic (Boolean). "underTraffic = True" means that the roadwork encroaches on the carriageway and can affect road traffic. "underTraffic = False" means that the roadwork does not affect road traffic or that the road is closed.
- "urgentRoadworks": **Urgent roadwork** indicates if the roadwork is considered urgent (Boolean)

Since there is no equivalent in a DENM, the R-ITS-S will not use these two attributes in preparing the messages.

5.2.2.3.4.2 The classes linked to the <RoadWorks> class

5.2.2.3.4.2.1 The DATEX II <Mobility> class

This class is used to specify the mobility of the roadworks:

- "mobilityType" can be "stationary", "mobile" or "unknown" or absent

Particularity for the uplink cases

In the obstruction cases, if the eventSpeed is present in the DENM and positive, then the mobilityType shall be set to mobile.

In the obstruction cases, if the eventSpeed is zero, then the mobilityType shall be set to stationary.
In Roadworks cases, the mobilityType shall correspond to the DENM SubCauseCode:

DENM CauseCode/SubCauseCode	DATEX II mobilityType
3/3 (Slow moving Road Maintenance)	mobilityType = mobile
15/0 (Rescue and recovery work in progress)	mobilityType = mobile
26/1 (maintenance Vehicle)	mobilityType = mobile
95/0 (Emergency vehicle approaching)	mobilityType = mobile
26/6 (snow plough)	mobilityType = mobile
26/8 (salting vehicle)	mobilityType = mobile
3/6 (winter service)	mobilityType = mobile

Table 10 : Correspondance for "mobilityType" for uplink cases

In any other case, mobility class shall not be present.

Particularity for the downlink cases

Here is the translation table for the C-ITS Projects, for the messages from the platform to the R-ITS-S:

Data in the DATEX II message from the platform	R-ITS-S shall change into this value:
Value = Stationary	3/0 or 3/1 (depending on the other DATEX II values)
Value = Mobile	3/3
Value = Unknown	3/0
Data Absent	3/0

Table 11 : Correspondance for "mobilityType" for downlink cases

NOTE: This class is only usable with three DATEX II classes. Besides road works, it can be found with the **<Activity>** and **<Obstruction>** classes. This does not allow determining the DENM "EventSpeed" data element.

5.2.2.3.4.2.2 The DATEX II <MaintenanceVehicles> class (optional)

This class provides information about the vehicles involved in the roadwork.

- "numberOfMaintenanceVehicles": the number of vehicles involved (not used because there is no equivalent in DENM).
- "maintenanceVehicleActions": this attribute details the action mode of the operator vehicles (several simultaneous values are possible):
 - "maintenanceVehiclesMergingIntoTrafficFlow" (operator vehicle in traffic)
 - "saltAndGritSpreading" (salting / grit spreading)
 - "slowMoving" (slow moving operator vehicle)
 - "snowClearing" (snow clearing)
 - "stoppingToServiceEquipment" (stopping to service on or near the road)

This class is used to clarify the "EventType" data element of the DENM.

5.2.2.3.4.2.3 The DATEX II Subjects class (optional)

This class is used to specify what the roadwork concerns:

- "numberOfSubjects": number of subjects concerned
- "subjectTypeOfWorks": attribute that specifies the type, for example: "bridge", "gasMainWork" (gas main), "junction" (intersection), "roadSigns" (VMS), etc. (not used because there is no equivalent in DENM).

Since there is no equivalent in a DENM, the R-ITS-S will not use its content in preparing the messages.

5.2.2.3.4.3 The inherited classes of the <RoadWorks> class

The <RoadWorks> class shall be instantiated in the form of one of its two inherited classes.

5.2.2.3.4.3.1 The DATEX II <ConstructionWorks> class

It only includes one attribute: “**constructionWorkType**”, which specifies the type of construction work underway. The possible values are:

- “blastingWork” (blasting)
- “constructionWork” (Construction work)
- “demolitionWork” (Demolition work)

(The other values are not recommended in France).

Since there is no equivalent in a DENM, the R-ITS-S will not use its content in preparing the messages.

5.2.2.3.4.3.2 The DATEX II <MaintenanceWorks> class

It only includes one attribute: “roadMaintenanceType”, which specifies the type of work, including equipment maintenance or installation. The values are, for example:

- “maintenanceWork”
- “repairWork”
- “roadsideWork”
- “saltingInProgress”
- “snowploughsInUse”
- “treeAndVegetationCuttingWork”
- ...

This class is used to clarify the “EventType” data element of the DENM.

5.2.2.3.4.4 The <NetworkManagement> class

This chapter only concerns the networkmanagement class as a second, or third, situationrecord in the publication. It means when DATEX II data are used to enhanced information inside a DENM.

5.2.2.3.4.4.1 The class attributes

The following attributes should be used:

- “applicableForTrafficDirection”: The direction concerned by the network management operation
- “applicableForTrafficType”: The type of traffic concerned by the network management operation
- “automaticallyInitiated”: Indicates if the network management operation is implemented automatically by a system
- “complianceOption”: Indicates if the action is advisory or mandatory
- “placesAtWhichApplicable”: Locations concerned by the network management operation.

The “applicableForTrafficDirection” attribute will be used to establish the DENM data element “relevanceTrafficDirection”: “upstream” or “allTrafficDirection”.

NOTE: This attribute is used for defining the actually impacted driving direction(s) regarding the traffic management actions and the ones where road works are located. The given direction is either geographic (e.g. “northBound”) or topologic (e.g. “outerRing”). To do this the DATEX II <AffectedCarriagewayAndLanes> class is also used.

Particularity for the uplink cases

In case of upload messages from DENM that do not include the “closedLanes” or “restriction” attributes, the R-ITS-S does not instantiate the DATEX II <NetworkManagement> class. If the uploaded message includes one or the other of these attributes a DATEX II <NetworkManagement> is instantiated with “complianceOption” attribute set to “mandatory”.

Particularity for the downlink cases

In case of downlink messages, the platform will fill in the attribute depending on what is sent by TMS.

5.2.2.3.4.4.2 The classes linked to the **<NetworkManagement>** class

The DATEX II **<VehicleCharacteristics>** class used to describe the characteristics of the vehicle is linked to the **<NetworkManagement>** class by the “forVehiclesWithCharacteristicsOf” association. This reusable class contains the description of the vehicle categories that the operating applications apply to.

This attribute can be used to fill in the “Restriction” data element of the DENM:

- The DATEX II **<VehicleCharacteristics>** class or if this class is present the “vehicleType” attribute is missing then the DENM “restriction” data frame is missing.
- The restriction applies to all vehicle types: when the DATEX II “vehicleType” attribute = “anyVehicle” then the DENM restriction = {all stations}
- The restriction applies to some vehicle types: when the DATEX II “vehicleType” attribute = {some stations} then the DENM restriction = {same stations}
- Information is unknown: when the DATEX II “vehicleType” attribute = “unknown” then the DENM restriction = “unknown”

5.2.2.3.4.4.3 The inherited classes of the **<NetworkManagement>** class

In the French C-ITS projects, the **<NetworkManagement>** class can be instantiated by one of the following classes:

5.2.2.3.4.4.3.1 The DATEX II **<GeneralNetworkManagement>** class

The attributes are as follows:

- “generalNetworkManagementType”: Type of action, for example: “convoyService”, “obstacleSignalling”, “temporaryTrafficLights”, “tollGatesOpen”, etc.
- “trafficManuallyDirectedBy”: Type of person who manages the traffic (applicable if “generalNetworkManagementType” is “trafficBeingManuallyDirected”). For example, police officer, etc.

These attributes are not used to generate the DENM.

5.2.2.3.4.4.3.2 The DATEX II **<SpeedManagement>** class

This class is used to provide the speed limit to comply with on the roadwork.

The attributes are as follows:

- “speedManagementType”: Type of action on the speed, for example: “reduceYourSpeed”, “observeSpeedLimit”, “policeSpeedChecksInOperation” (speed camera check in progress), etc.
- “temporarySpeedLimit”: Temporary speed that can correspond to a recommended or mandatory speed (expressed in km/h)

This attribute will be used to fill in the “B.44 SpeedLimit” data element of the DENM.

5.2.2.3.4.4.3.3 The DATEX II **<RoadOrCarriagewayOrLaneManagement>** class

This class is used to specify the type of action expected by users.

The attributes are as follows:

- “roadOrCarriagewayOrLaneManagementType”: Type of road, carriageway or lane management action. The values are, for example: “clearALaneForEmergencyVehicles”, “carPoolLaneInOperation”, “clearALaneForSnowploughsAndGrittingVehicles”, “keepToTheLeft”, etc.

- “minimumCarOccupancy”: Minimum number of people required in the vehicle if “roadOrCarriagewayOrLaneManagementType” = “carPoolLaneInOperation”.

This class will not be used in SCOOP wave 1. It will be studied for SCOOP wave 2.

5.2.2.3.4.4.3.4 The DATEX II <WinterDrivingManagement> class

The attribute is as follows:

- “winterEquipmentManagementType”: Type of winter equipment to use (e.g., chains, snow tyres, etc.)

This class will not be used in SCOOP wave 1. It will be studied for SCOOP wave 2.

5.2.2.3.4.4.3.5 The DATEX II <GeneralInstructionOrMessageToRoadUsers> class

The attributes are as follows:

- “generalInstructionToRoadUsers”: Type of general instruction to users (e.g., “allowEmergencyVehiclesToPass”, “avoidTheArea”, “observeAmberAlert”, “observeSigns”, “switchOffEngine”, “useFogLights”, etc.
- “generalMessageToRoadUsers”: free composition to signal a general message to users (e.g. kidnapping warning).

This class will not be used in SCOOP wave 1. It will be studied for SCOOP wave 2.

5.2.2.3.4.5 Correspondence between DENM and the DATEX II <RoadWorks> class

Name	CC/ SCC	MaintenanceWorks:: RoadMaintenanceType =	MobilityType =	MaintenanceVehicleActions =
B1 Roadwork Warning - planned roadwork - stationary	3/0	roadworks	stationary	Absent
B1 Roadwork Warning - planned roadwork - mobile	3/3	roadworks	mobile	Absent
B2 Roadwork Warning – road operator intervention – operator vehicle on patrol	26/1	roadworks	mobile	slowMoving
B2 Roadwork Warning – road operator intervention – operator vehicle stopped in protected mode	15/0	roadworks	stationary	stoppingToServiceEquipments
B2 Roadwork Warning – road operator intervention – operator vehicle out on service call	95/0	roadworks	mobile	maintenanceVehicleMergingIntoTrafficFlow
B3 – Roadwork Warning - winter maintenance – winter road maintenance vehicle on road	3/6	saltingInProgress	mobile	slowMoving
B3 – Roadwork Warning - winter maintenance – winter road maintenance vehicle clearing snow	26/6	snowploughsInUse	mobile	snowClearing
B3 – Roadwork Warning - winter maintenance – winter road maintenance vehicle is salting	26/8	saltingInProgress	mobile	saltAndGritSpreading

Table 12 : Correspondence between DENM and the DATEX II <RoadWorks> class

Some other values may be transmitted by TMS in case of downlink DATEX II messages. All these values

are translated by the platform into a DATEX II “MaintenanceWorks” class with the “roadMaintenanceType” attribute set to “roadworks”. This includes all the cases defined by the DATEX II “ConstructionWorks” class.

5.2.2.3.5 CASE OF THE TEMPERATURE

For all use cases using the **<PoorEnvironnementConditions>** class, the outside temperature can be sent.

```
<situationRecord xsi:type="PoorEnvironmentConditions" version="1" id="GUID2A22530C-D452-4ae8-B942-993BC2923D14">
...
  <temperature>
    <airTemperature>-1</airTemperature>
  </temperature>
...
</situationRecord>
...
```

This attribute will be used to fill in the “B.18 ExternalTemperature” data element of DENM.

5.2.2.3.6 SPECIAL CASES FOR END OF QUEUE

In DATEX II, this case will be covered by the messages where the type of “SituationRecord” is “AbnormalTraffic::abnormalTrafficType = queuingTraffic”.

It should also be noted that, if operators use this case, in the downlink direction, the message shall include the precise queue length. In order to construct the DENM “EventPosition” attribute for this use case, the R-ITS-S will use the secondary point of the DATEX II message (i.e., “LinearWithinLinearElement::fromPoint”). R-ITS-S shall ignore the “queueLength” attribute, because it does not represent the real position of the end of queue.

6 VMS publication

This chapter is completed by :

- 2.4.1.4 Annex3 : Translation of a VMS Datex II message into an IVI,
- 2.4.1.4 Annex6 : DATEXIISchema_2_2_3_PFroDatexII.xsd.

6.1 Description of the use case

This C3 use case is only in the downlink direction.

Two types of data are required by a IVI message.

- Some are static: position, contact data..
- And the others are dynamic: text or pictogram...

The IVI message contains dynamics mandatory attributes.

The TMS or VMS control system sends the static data, in the table of the location of the e-VMS to the platform.

The TMS or VMS control system sends the dynamic information of the DATEX II VMS messages to the platform.

The platform, with the two precedent publications, sends one relevant publication to the R-ITS-S, Vro-ITS-S and the national Nfr-ITS-S. The ITS Station sends IVIs based on the parameters received.

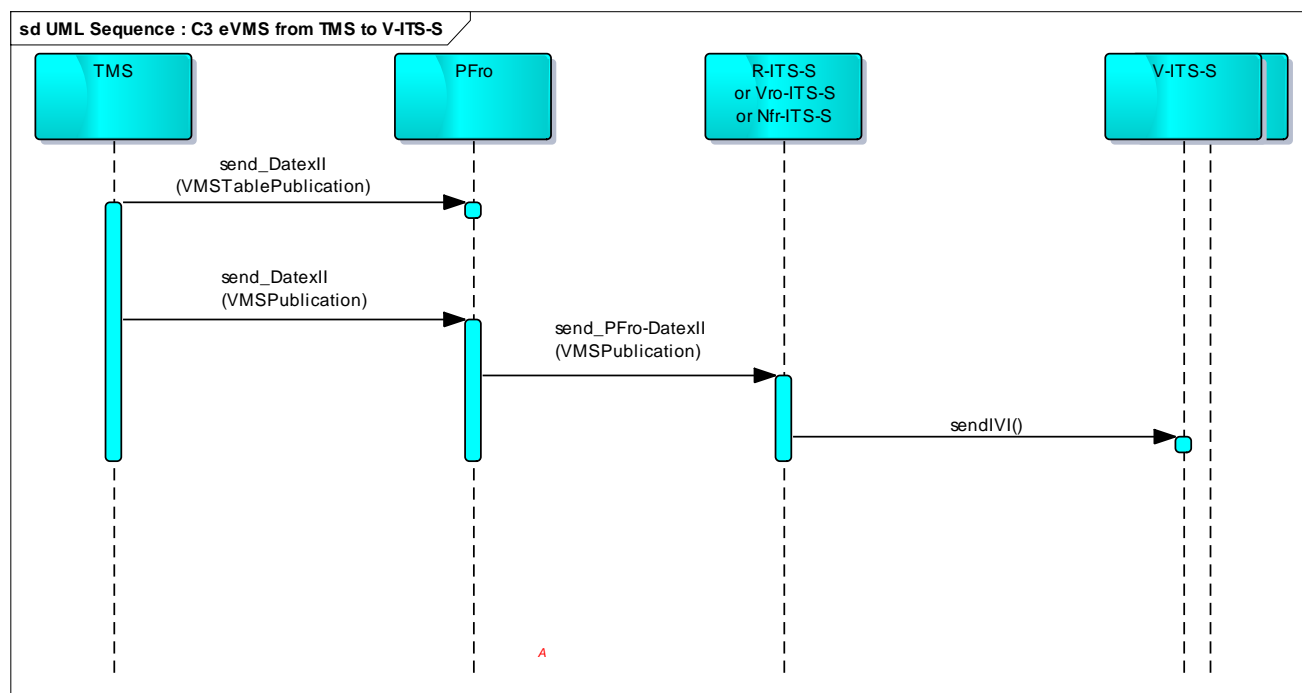


Figure 17 : UML sequence diagram for the VMS locations and messages from TMS to V-ITS-S, downlink flow

NOTE: more details about the translation of the DATEX II into the IVI structure are in the Annex3.

6.2 Overview of the DATEX II model

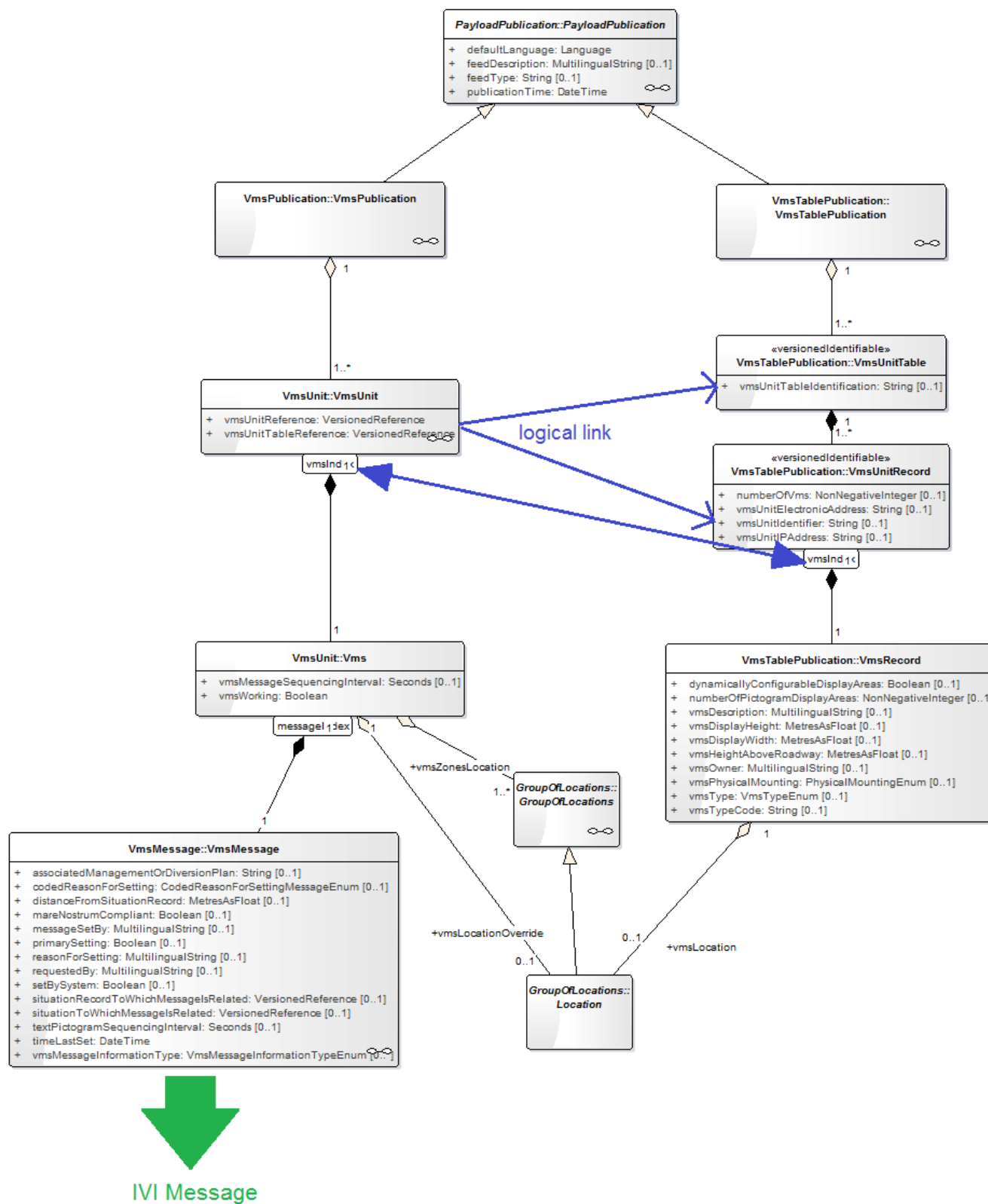


Figure 18 : *Overview of the DATEX II model about VMS*

NOTE: This is only an extract; the entire model is available on the datex2.eu website and in the 2.4.1.4 Annex xsd : DATEXII Schema_2_2_3_PFroDatexII.xsd.

6.3 Configuration of the VMS location between TMS and Platform based on <VmsTablePublication>

This publication will only be used between TMS and the platform to send the position and characteristics of the VMS.

There is no change in this publication, than in the DATEX II one. Consequently, the reader will refer to DATEX II documentation about this publication (TS 16157-4).

A synthesis of the publication is set here for information.

- A <VmsTablePublication> (= the message) includes numerous <VmsUnitTable> (= numerous sets of groups of VMS, example all of DIRIF).
- Each one includes numerous <VmsUnitRecord> (a logical group of Vms, example all with two pictogram display areas of the A4 road, or the 3 "red cross / green arrow" just before a tunnel).
- Each one includes numerous <VmsRecord> (= a Vms)
- Each one has a location, and its characteristics.

The location is not mandatory in DATEX II, but it is set mandatory for C-ITS projects.

Each VMS shall be match a VMSRecord in at least one VMSTable publication sent to the platform. These VMS can correspond to a real VMS on the road, or can be virtual ones.

The attributes <VmsUnitReference> and <VmsUnitTableReference> in the following publication (<VmsPublication>), shall be set according to the data of this publication (<VmsTablePublication>).

6.4 Construction of VMS message in DATEX II

6.4.1 Difference between TMS=>PF VMS message and PFro => R-ITS-S VMS message

The "VmsPublication" used between the platform and the R-ITS-S is the one from the TMS, completed with the extension <VmsZonesLocation> which contains the location of the VMS, the relevance zone and the detection zone. The platform shall find the location in the VMSTablePublication, thanks to the linked attributes <VmsUnitReference> and <VmsUnitTableReference>, and completes it with its maps information.

6.4.2 Exchange parameters: Choosing the distribution mode

This use case shall use the "push on occurrence" mode. When the data changes, the sender returns a DATEX II message (OM1 mode).

The sender transmits the data as soon as it is relevant (according to the use case) to the recipient (TMS=> PFro=>R-ITS-S).

```
...  
<operatingMode>operatingModel</operatingMode>  
...  
<updateMethod>allElementUpdate</updateMethod>  
...
```

6.4.3 Message content (<VmsPublication>)

6.4.3.1 The DATEX II <HeaderInformation> class

It includes four attributes, two mandatory and two optional. It is proposed to not fill in the two optional attributes.

For the two mandatory attributes:

- The "confidentiality" attribute will be filled in systematically with the "noRestriction" value; and
- The "informationStatus" attribute will be filled in systematically with the "real" value.

6.4.3.2 The DATEX II <VmsUnit> class

In one VmsPublication, there can be one or more group of Vms, called VmsUnit. A VmsUnit correspond to one or more, real or virtual, VMS panels. For example, a VmsUnit can gather all the VMS of a road operator, or all the VMS with the same characteristics.

Example: The three VMS on the picture could be gathered in a VmsUnit:



Figure 19 : *Example of a VmsUnit*

6.4.3.2.1 THE <VMSUNIT> CLASS ATTRIBUTES

6.4.3.2.1.1 <VmsUnitTableReference>

This attribute is a reference to a versioned VMS Unit table in a <VmsTablePublication>.

This attribute is mandatory for the message from TMS to the platform. The Platform shall use this attribute (and <VmsUnitReference>) to find the location of the VMS and complete the location of the VMS in the message for the R-ITS-S.

6.4.3.2.1.2 <VmsUnitReference>

This attribute is a reference to a versioned VMS unit record in a VMS Unit table in a <VmsTablePublication>, which defines the characteristics of the VMS unit.

This attribute is mandatory for the message from TMS to Platform. The Platform shall use this attribute (and <VmsUnitTableReference>) to find the location of the VMS and complete the location of the VMS in the message for the R-ITS-S.

6.4.3.2.2 THE CLASSES LINKED TO THE <VMSUNIT> CLASS: <VMS>

In one VmsUnit, there can be one or more Vms, which can show one or more messages. As on the real VMS, there can be different messages at different times shown on the panel.

6.4.3.2.2.1 <Vms> Attributes

- This class has two attributes. Only one is mandatory: <vmsWorking> shall be set to the correct value (true if the Vms shall be considered by the platform and the R-ITS-S).

Between TMS and the platform, the index shall be completed in accordance with the VmsTablePublication.

6.4.3.2.2.2 The classes linked to the <Vms> Class

6.4.3.2.2.2.1 <Location> (VmsLocationOverride)

Particularity for messages sent by TMS to the PFro

This class is not mandatory in the message from TMS to the platform, as the two uses the VmsTablePublication. Please, note that, according to the DATEX II rules, if the class is present in the TMS message, then the platform should use this data and not the one in the VMSTablePublication.

Particularity for messages sent by PFro to the R-ITS-S

This class shall not be used in the message from the platform to the R-ITS-S (and Nfr-ITS-S). The locations shall be described with the next described class below :

6.4.3.2.2.2.2 <groupOfLocations> (VmsZonesLocation))

Particularity for messages sent by TMS to the PFro

This class shall not be used.

Particularity for messages sent by PFro to the R-ITS-S

This class refers to the position of the VMS, and to the positions of zones relevant for an IVI message. This class is mandatory in the message from the platform to the R-ITS-S (and Nfr-ITS-S).

In the published DATEX II schema, <vmsUnit> is linked with a simple location. For the needs of the C-ITS projects, an extended aggregation has been added between <vmsUnit> and <groupOfLocations> : <vmsZonesLocation>. This <groupOfLocations> shall be construct by the platform, and will be a "NonOrderedLocationGroupByList" type, containing "Linear":

- linearWithinLinearElement: index =1 (externalReferencingSystem = "RELEVANCEZONE")
 - "PointCoordinates" with the relation "locationForDisplay" (= eventPosition))
 - FromPoint: (=eventPosition = beginning of the EventHistory)
 - ToPoint: (= end of the EventHistory)
- ...
- linearWithinLinearElement: index = X (Relevance Zone X, externalReferencingSystem = "RELEVANCEZONE")
- linearWithinLinearElement: index = X+1 (Trace 1, externalReferencingSystem = "DETECTIONZONE")
- ...
- linearWithinLinearElement: index = X+Y (Detection Zone Y, externalReferencingSystem = "DETECTIONZONE"))

NOTE: As explain in the Deliverable 2.4.1.2, the "direction" attribute in IVI, is set to "samedirection". Contrary to the DENM direction, there is no upstream or downstream consideration.

The construction rules are explain in the chapter: 3.7 Case of the linearly located events.

6.4.3.2.2.2.3 <VmsMessage>

This part contains the text and the pictogram of the Vms.

6.4.3.2.2.3.1 Attribute of the <VmsMessage>

<timeLastSet>, the date/time at which the sign was last set, is the only attribute mandatory in DATEX II.

For the needs of the C-ITS projects, the TMS shall complete <vmsMessageInformationType>.

Extension attribute: <ivIdentificationNumber>

For the needs of the C-ITS French project, in the message between the platform and the R-ITS-S, a new attribute shall be created. Its name is the name of the IVI attribute that shall be filled with.

This attribute shall not be used for the message from TMS to the platform.

This attribute is mandatory for the message from the platform to R-ITS-S. The Platform will complete the value according to the table of the current VMS.

All the rules for the same IVI attribute shall be apply to this DATEX II attribute.

NOTE: See Deliverables 2.4.1.2_H master and 2.4.3.2_H: 2.4.1.2_H set it is an integer from 1 to 32767 and the platform set the value of this id.

Extension attribute: <validTo>

For the needs of the C-ITS French project, in the message between the platform and the R-ITS-S, a new attribute shall be created. Its name is the name of the IVI attribute that shall be filled with.

This attribute shall not be used for the message from TMS to the platform.

This attribute is mandatory for the message from the platform to R-ITS-S. The Platform will complete the value according to the table of the current VMS.

As this IVI attribute is a "Timestamp", the corresponding DATEX II attribute is a time in GMT.

NOTE: See Deliverables 2.4.1.2_H master and 2.4.3.2_H: 2.4.1.2_H set it is the "end time of the validity period of the message."

6.4.3.2.2.3.2 Class <VmsText>

This class contains the text of the Vms.

One <VmsMessage> shall have at least one page called <textPage>. One <VmsMessage> can have more than one page. The pages are indexed by their <pageNumber>, attribute mandatory in the case of numerous pages.

Each page shall contain at least one line, called <VmsTextLine>, of type "string". One <textPage> can have more than one line. The lines are indexed by their <lineIndex>, attribute mandatory in the case of numerous lines.

No attribute are mandatory, for the class <vmsText> and <vmsTextLine>, except the attribute called <vmsTextLine>.

The values of the indexes give an indication of the order in which items should appear on the screen. (1 = the first, then, the second, and so on...)

NOTE: the Deliverable [2.4.1.2_H_IVI] about IVI set the maximum number of lines and pages:

Set in VMS pilot system: FR consortium choose that max VMS may contain (as IISR9 application) a text of at most four lines of 21 characters each [...] with 2 pages max (alternate screening of two VMS).

In consequence, in the C-ITS projects, the <VmsMessage> shall contain a maximum of two <textPage>.

A <textPage> shall contain a maximum of four <VmsTextLine>.

The maximum number of characters in the string <VmsTextLine> shall be 21.

6.4.3.2.2.2.3.3 Class <VmsPictogramDisplayArea>

6.4.3.2.2.2.3.3.1 DATEX II explanations

This class contains the pictograms associated to the Vms.

No attribute of the class <VmsPictogramDisplayArea> is mandatory.

One <VmsMessage> shall have at least one area called <VmsPictogramDisplayArea>. One <VmsMessage> can have more than one area for pictograms. The areas are indexed by their <PictogramDisplayAreaIndex>, attribute mandatory in the case of numerous areas.

Each area shall contain at least one pictogram, called <VmsPictogram>. One <VmsPictogramDisplayArea> can have more than one pictogram. The pictograms are indexed by their <pictogramSequencingIndex>, attribute mandatory in the case of numerous pictograms.

The attribute <presenceOfRedTriangle> of the <VmsPictogram>, indicates the presence of a red triangle around the pictogram, often used to indicate imminence, typically within 2km, of signed danger. This attribute is a Boolean, and is mandatory in DATEX II. It does not match any IVI attribute.

Each <VmsPictogram> can have a supplementary text (called in French "Pannonceau"), with the class <VmsSupplementaryPanel>, containing <VmsTextLine> or <VmsSupplementaryPictogram>.

The values of the indexes give an indication of the order in which items should appear on the screen. (1 = the first, then, the second, and so on...)

6.4.3.2.2.2.3.3.2 French C-ITS project application

NOTE: the Deliverable [2.4.1.2_H_IVI] about IVI, set the maximum number of pictograms and:

Set in VMS pilot system: FR consortium choose that max VMS may contain [...] one pictogram with sub-text eight characters max [...].

In consequence, in the C-ITS projects, only the following <VmsMessage> types are authorised:

All other types shall be not created by the TMS. (It implies for example: PageNumber shall be 1 or 2, pictogramSequencingIndex shall be equal to 1 or 2...).

All other types shall be rejected by the elements (R-ITS-S, PFro... For example if PageNumber >2 ...).

Note: the VmsPictogramDisplayArea contains the VmsPictogram classes.

Constitution of the DATEX II VmsMessage			Constitution of the IVI	
Number of "VmsText" presents in the Message	Number of "VmsPictogram"	Value of "synchronized Sequencing WithTextPages"	First container of gic	Second container of gic
0	1	whatever	Vmspictogram	No present
0	2	Whatever	Vmspictogram with pictogramSequencingIndex = 1	Vmspictogram with pictogramSequencingIndex = 2

1	/	/	VmsText	No present
1 VmsText with Pagenumber	1 Vmspictogram with pictogramSequencingIndex = Pagenumber	True	VmsText + Vmspictogram	No present
1 VmsText with Pagenumber	1 Vmspictogram with pictogramSequencingIndex > Pagenumber	True	VmsText	Vmspictogram
1 VmsText with Pagenumber	1 Vmspictogram with pictogramSequencingIndex < Pagenumber	True	Vmspictogram	VmsText
1	1	False or absent	VmsText	Vmspictogram
1 VmsText with Pagenumber = 1	2	True	VmsText + Vmspictogram with pictogramSequencingIndex = 1	Vmspictogram with pictogramSequencingIndex = 2
1 VmsText with Pagenumber = 2	2	True	Vmspictogram with pictogramSequencingIndex = 1	VmsText + Vmspictogram with pictogramSequencingIndex = 2
1	2	False or absent	VmsText + Vmspictogram with pictogramSequencingIndex = 1	VmsText + Vmspictogram with pictogramSequencingIndex = 2
2	/	/	VmsText with Pagenumber = 1	VmsText with Pagenumber = 2
2	1 Vmspictogram with pictogramSequencingIndex = 1	True	VmsText with Pagenumber = 1 + Vmspictogram	VmsText with Pagenumber = 2
2	1 Vmspictogram with pictogramSequencingIndex = 2	True	VmsText with Pagenumber = 1	VmsText with Pagenumber = 2 + Vmspictogram
2	1	False or absent	VmsText with Pagenumber = 1 + Vmspictogram	VmsText with Pagenumber = 2+ Vmspictogram
2	2	whatever	VmsText with Pagenumber = 1+ Vmspictogram with pictogramSequencingIndex = 1	VmsText with Pagenumber = 2+ Vmspictogram with pictogramSequencingIndex = 2

Each <VmsPictogram> can be complete with one <VmsSupplementaryPanel>, containing one <VmsTextLine>, which attribute <VmsTextLine> will be a text of eight characters max.

NOTE: the Deliverable [2.4.1.2_H_IVI] about IVI, set that: "coding of sub-roadsign panel is coded between "/" (example: //25km/) in the first container of extraText" in the IVI message.

The R-ITS-S shall take into account the DATEX II attribute <VmsSupplementaryPanel> for the IVI extratext. The R-ITS-S shall add the « // » before and after the text.

Moreover, in the C-ITS projects, the attribute <pictogramCode> of the <VmsPictogram> is set mandatory. This attribute will be filled by the TMS, based on IISR or on the standard 14 823, as stated by the IVI standards.

See the 2.4.1.4_H annex 3 for the translation details.

In some cases, the 14823 code can be the same for different meanings. For these case, the TMS shall complete the corresponding attribute “distanceAttribute”, “lengthAttribute”, “speedAttribute”, “weightAttribute”, ... according to the deliverable “TMS”.

For example, 5-57 in 14823 is a speed limit. It can correspond to a pictogram “50 km” or “120 km”.

6.5 Examples

6.5.1 From TMS to the platform

Here is a part of an example of VmsPublication (be careful, some attributes are voluntary omitted in the example):

```
...
<vmsUnit>
  <vmsUnitTableReference targetClass="vmsUnitTable" version="12" id="MY_TABLE_OF_PMV"/>
  <vmsUnitReference targetClass="vmsUnitRecord" version="12" id="MY_GROUP_OF_PMV"/>
  <vms vmsIndex="1">
    <vmsWorking>true</vmsWorking>
    <vmsMessage messageIndex="1">
      <vmsMessage>
        <timeLastSet>2018-04-12T10:35:54+02:00</timeLastSet>
        <vmsMessageInformationType>travelTime</vmsMessageInformationType>
        <textPage pageNumber="1">
          <vmsText>
            <vmsTextLine lineIndex="1">
              <vmsTextLine> N104>A6:      </vmsTextLine>
            </vmsTextLine>
            <vmsTextLine lineIndex="2">
              <vmsTextLine>      33 min      </vmsTextLine>
            </vmsTextLine>
          </vmsText>
        </textPage>
        <textPage pageNumber="2">
          ...
        </textPage>
        <vmsPictogramDisplayArea pictogramDisplayAreaIndex="1">
          <synchronizedSequencingWithTextPages> True
          </synchronizedSequencingWithTextPages>
          <vmsPictogram pictogramSequencingIndex="1">
            <pictogramCode>32-111</pictogramCode>
            <presenceOfRedTriangle>>false</presenceOfRedTriangle>
          </vmsPictogram>
        </vmsPictogramDisplayArea>
      </vmsMessage>
    </vms>
  <vms vmsIndex="2">
```

```
...
</vms>
</vmsUnit>
...
```

Associated to this part of a VmsTablePublication:

```
...
<vmsUnitTable id=" MY_TABLE_OF_PMV" version="12">
  <vmsUnitRecord id="MY_GROUP_OF_PMV" version="12">
    <vmsRecord vmsIndex="1">
      <vmsLocation xsi:type="Point">
        <pointAlongLinearElement>
          <directionRelativeAtPoint>aligned</directionRelativeAtPoint>
          <linearElement>
            <roadNumber>My_ROAD_NAME</roadNumber>
          </linearElement>
          <distanceAlongLinearElement xsi:type="DistanceFromLinearElementReferent">
            <distanceAlong>190</distanceAlong>
            <fromReferent>
              <referentIdentifier>MY_PR</referentIdentifier>
              <referentType>referenceMarker</referentType>
            </fromReferent>
          </distanceAlongLinearElement>
        </pointAlongLinearElement>
      </vmsLocation>
    </vmsRecord>
    <vmsRecord vmsIndex="2">
      ...
    </vmsRecord>
  </vmsUnitRecord>
  <vmsUnitRecord ...>
    ...
  </vmsUnitRecord>
</vmsUnitTable>
...
```

6.5.2 From SCOOP platform to R-ITS-S and Nfr-ITS-S

The platform shall change the precedent xml messages into this example:

```
...
<vmsUnit>
  <vmsUnitTableReference targetClass="vmsUnitTable" version="12" id="MY_TABLE_OF_PMV"/>
  <vmsUnitReference targetClass="vmsUnitRecord" version="12" id="MY_GROUP_OF_PMV"/>
  <vms vmsIndex="1">
    <vmsWorking>true</vmsWorking>
    <vmsMessage messageIndex="1">
```

```

<vmsMessage>
  <timeLastSet>2018-04-12T10:35:54+02:00</timeLastSet>
  <vmsMessageInformationType>travelTime</vmsMessageInformationType>
  <textPage pageNumber="1">
    <vmsText>
      <vmsTextLine lineIndex="1">
        <vmsTextLine> N104>A6:      </vmsTextLine>
      </vmsTextLine>
      <vmsTextLine lineIndex="2">
        <vmsTextLine>      33 min      </vmsTextLine>
      </vmsTextLine>
    </vmsText>
  </textPage>
  <textPage pageNumber="2">
    ...
  </textPage>
  <vmsPictogramDisplayArea pictogramDisplayAreaIndex="1">
    <synchronizedSequencingWithTextPages> True
  </synchronizedSequencingWithTextPages>
    <vmsPictogram pictogramSequencingIndex="1">
      < pictogramCode >32-111</ pictogramCode >
      <presenceOfRedTriangle>>false</presenceOfRedTriangle>
    </vmsPictogram>
  </vmsPictogramDisplayArea>
</vmsMessage>
<vmsZonesLocation xsi:type="NonOrderedLocationGroupByList">
  <locationContainedInGroup xsi:type="Linear">
    <externalReferencing>
      <externalLocationCode>1</externalLocationCode>
      <externalReferencingSystem>RELEVANCEZONE</externalReferencingSystem>
    </externalReferencing>
    <locationForDisplay>
      <latitude>48.817291</latitude>
      <longitude>2.422936</longitude>
    </locationForDisplay>
    <linearWithinLinearElement>
      < directionRelativeOnLinearSection>aligned</
directionRelativeOnLinearSection>
      < linearElement xsi:type=" LinearElementByPoints">
        < roadNumber>MY_ROAD_NUMBER</ roadNumber>
        <startPointOfLinearElement>
          <referentIdentifier>1</referentIdentifier>
          <referentType>roadNode</referentType>
          <pointCoordinates>
            <latitude>48.817291</latitude>
            <longitude>2.42509</longitude>
          </pointCoordinates>
        </startPointOfLinearElement>
        <intermediatePointOnLinearElement index="1">

```

```

        <referent>
          <referentIdentifier>2</referentIdentifier>
          <referentType>roadNode</referentType>
          <pointCoordinates>
            <latitude>48.81717</latitude>
            <longitude>2.427258</longitude>
          </pointCoordinates>
        </referent>
      </intermediatePointOnLinearElement>
      <intermediatePointOnLinearElement index="2">
        ...
      </intermediatePointOnLinearElement>
    ...

    <endPointOfLinearElement>
      <referentIdentifier>23</referentIdentifier>
      ...
    </endPointOfLinearElement>
  </linearElement>
  <fromPoint xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>0.0</distanceAlong>
    <fromReferent>
      <referentIdentifier>1</referentIdentifier>
      <referentType>roadNode</referentType>
    </fromReferent>
  </fromPoint>
  <toPoint xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>0.0</distanceAlong>
    <fromReferent>
      <referentIdentifier>23</referentIdentifier>
      <referentType>roadNode</referentType>
    </fromReferent>
  </toPoint>
</linearWithinLinearElement>
</locationContainedInGroup>
<locationContainedInGroup xsi:type="Linear">
  <externalReferencing>
    <externalLocationCode>2</externalLocationCode>
    <externalReferencingSystem>DETECTIONZONE</externalReferencingSystem>
  </externalReferencing>
  <linearWithinLinearElement>

<directionRelativeOnLinearSection>aligned</directionRelativeOnLinearSection>
  <linearElement xsi:type="LinearElementByPoints">
    <roadNumber>MY_ROAD_NUMBER</roadNumber>
    <startPointOfLinearElement>
      <referentIdentifier>1</referentIdentifier>
      <referentType>roadNode</referentType>
      <pointCoordinates>
        <latitude>48.817315</latitude>

```



```
        <longitude>2.422835</longitude>
      </pointCoordinates>
    </startPointOfLinearElement>
    <intermediatePointOnLinearElement index="1">
      ...
    </referent>
  </intermediatePointOnLinearElement>
  ...
</linearWithinLinearElement>
</locationContainedInGroup>
</vmsZonesLocation>
</vms>
<vms vmsIndex="2">
  ...
</vms>
</vmsUnit>
...
```

7 Parkings position and availability message

This chapter is completed by :

- 2.4.1.4 Annex 5 : Translation of a Parking Datex II message into an POI-Parking

7.1 Description of the use case

This use case is described in the deliverable 2.4.1.2_H – F1 POI Parking.

It is only in the downlink direction.

Two types of data are required by a POI parking message:

- Some are static: position, contact data...
- And the others are dynamic: number of free places...

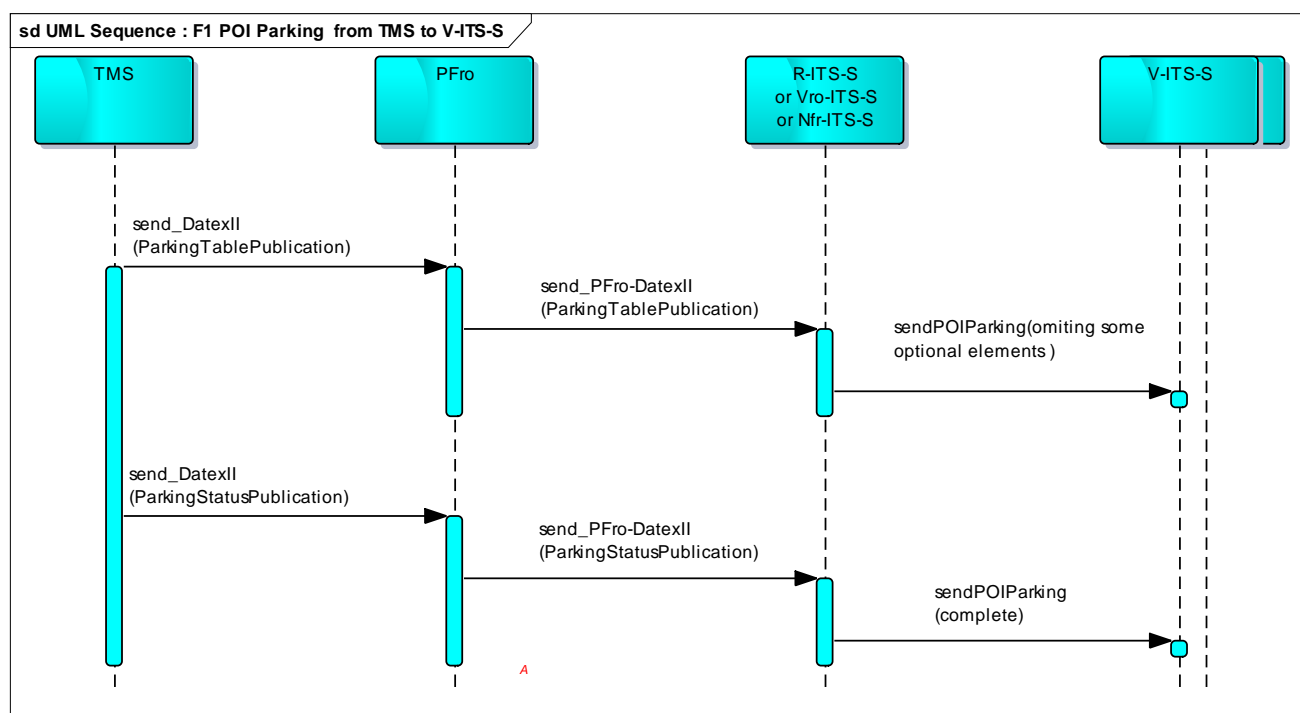


Figure 20 : UML sequence diagram for the POI-Parking publication

The TMS or parking control system sends the static data, in a <ParkingTablePublication> format to the platform. The platform completes data accordingy to the Nfr-ITS-S DATEX II rules (location...) and sends it to the R-ITS-S. The R-ITS-S shall record the data, and sends a POI Message, with the available data (no current disponibility for example).

The TMS or Parking control system sends the dynamic information, in the ParkingStatusPublication, to the Platform. The platform complete data accordingy to the PFro-DATEX II rules (location...) and send it to the R-ITS-S. The R-ITS-S shall record the data, and, if relevant, will send a new or updated POI Message.

7.2 Construction of ParkingTablePublication DATEX II Message by the TMS

This message is created by the TMS, and relayed by the PFro.

The creation shall be done accordingly to the Minimum Truck Parking Profile in DATEX II, completed by the points described in the next chapter.

This Profile is described in the document:

Guidance Document for Member States on technical implementation of Delegated Regulation 885/2013 in relation to the European Access Point for Truck Parking Data - Annex I: DATEX II minimum profile for EU core components for static data related to Secured Truck Parking Areas - v1.0 - March 2016

The entire documentation is available on:

https://ec.europa.eu/transport/themes/its/road/action_plan/intelligent-truck-parking_en

7.2.1 Exchange parameters: Choosing the distribution mode

Exactly the same as:

5.2.1 Exchange parameters: Choosing the distribution mode

7.2.2 Message Content

The publication shall be a genericPublication, specified in <parkingTablePublication>.

The <publicationTime> shall be present. It corresponds to the "timestamp" in the POI Message.

The <publicationCreator> shall be present.

The R-ITS-S shall have a table to translate the <country> in the <publicationcreator> into the country code. (« FR » into « 10110 01010 » (value in the 2412H(C3))).

PFro will send the <internationalIdentifier> in the <publicationcreator> as the issuerIdentifier format required by the table in the 2.4.1.2_H(F1).

NOTE: two fields « country » and two fields « InternationalIdentifier » are present in the DATEX II Message. PFro and R-ITS-S shall translate the appropriate ones.

Example:

```
<payloadPublication xsi:type="GenericPublication" lang="fre">
  <publicationTime>2015-07-20T08:34:14+02:00</publicationTime>
  <publicationCreator>
    <country>fr</country>
    <nationalIdentifier>SEE 2.4.1.2_H</nationalIdentifier>
  </publicationCreator>
  <genericPublicationName>ParkingTablePublication</genericPublicationName>
  <genericPublicationExtension>
    <parkingTablePublication>
      ...
    </parkingTablePublication>
  </genericPublicationExtension>
</payloadPublication>
```

7.2.2.1 The <parkingTablePublication> and the <parkingTable> Classes

The < parkingTablePublication> may contain 1 to n parkingTable.

For easier rules, C-ITS French projects requires to create only one <parkingTable> in the <parkingTablePublication>.

The <parkingTable> is a group of parkings of an operator, or an entity.

The <parkingTable> is "versionedIdentifiable", so version and class identifier are mandatory. They will be used to link dynamic and static data.

The <parkingTableVersionTime> is mandatory, and will be used by PFro and R-ITS-S to determine the most up-to-date DATEX II Message.

The <parkingTable> may contain as many <parkingRecord> as necessary.

A <parkingRecord> corresponds to a physical parking.

The <parkingRecord> is "versionedIdentifiable", so version and class identifier are mandatory.

The identifier, for the needs of the C-ITS projects, shall be of type interger between 1 and 65535. It will correspond to the basicPoiNumber.

Example

```
<parkingTablePublication>
  <parkingTable id="PARKING_DE_LA_DIR" version="1">
    <parkingTableVersionTime>2019-01-01T00:00:00+01:00 </parkingTableVersionTime>
    <parkingRecord
...
    </parkingRecord>
  </parkingTable>
</parkingTablePublication>
```

7.2.2.1.1 THE <PARKINGRECORD> CLASS

The <ParkingRecord> shall be instanciated in a <groupOfParkingSite>, a <InterUrbanParkingSite>, a <UrbanParkingSite>, or a <SpecialLocationParkingSite>. Each one has different attributes, that are not used by the R-ITS-S.

In the C-ITS projects, the following attributes are mandatory :

- <parkingName> corresponds to the « name » in the POI.
- <parkingNumberOfSpaces> corresponds to the « totalSpots » in the POI.
- <parkingRecordVersionTime> is used by PFro and R-ITS-S to determine the most up-to-date DATEX II Message.

The following attributes are used to construct the POI, if they are presents :

- < urlLinkAddress> corresponds to « webSite »

Example :

```
<parkingRecord id="4901" version="1" type="InterUrbanParkingSite">
  <parkingName>
    <values>
      <value lang="fr">Parking de l'aire_du_meleze</value>
    </values>
  </parkingName>
  <parkingRecordVersionTime>2019-01-01T00:00:00+01:00 </parkingRecordVersionTime>
  <urlLinkAddress>www.myparking.com<Erreur ! Référence de lien hypertexte non valide.>
  <parkingNumberOfSpaces>1200</parkingNumberOfSpaces>
...
```

```
</parkingRecord>
```

7.2.2.1.2 THE CLASSES LINKED TO THE <PARKINGRECORD> CLASS

7.2.2.1.2.1 The <groupOfLocations> class

The <groupOfLocations> linked with the <parkingLocation> to the <parkingRecord>, shall be of type <PointByCoordinates>. Bearing can be omitted, as it cannot be translated in POI. It corresponds to the "latitude" and "longitude" in the "refPoint".

The detail is described in the chapter : 3.4 Case of point-located event, without Traces.

```
<parkingLocation type="Point">
  <pointByCoordinates>
    ...
  </pointByCoordinates>
</parkingLocation>
```

7.2.2.1.2.2 The <contact> class

Different links are set with the <contact> class.

The < parkingSiteAddress> should be present. (linked with the parkingSite directly, and not with the <parkingRecord>). Two options are possible :

- The <contactDetailsAddress> is present
- Or the three following classes are presents : <contactDetailsStreet>, <contactDetailsPostcode> and <contactDetailsCity>

The data will be used for the "address" in POI.

NOTE: "address" is not mandatory.

The <owner> is recommended. It will be used for the "phoneNumber" in POI. If not present, the telephone of the < parkingSiteAddress> will be translated.

NOTE: "phoneNumber" is not mandatory.

Other can be presents, but will not be used.

Example

```
<owner id="Gestionnaire_du_parking_34003" version="1" type="ContactDetails">
  <contactOrganisationName>
    <values>
      <value lang="de">Les parkings du Haut Meleze</value>
    </values>
  </contactOrganisationName>
  <contactDetailsTelephoneNumber>+33 123456789</contactDetailsTelephoneNumber>
</owner>
```

Example

```
<parkingSiteAddress id="ADRESSE_PARKING_7834" version="1" type="ContactDetails">
```

```
<contactDetailsAddress>3 rue de Berry, 75001, Paris</contactDetailsAddress>
<contactDetailsPostcode>75001</contactDetailsPostcode>
<contactDetailsCity>
  <values>
    <value lang="de"> Paris </value>
  </values>
</contactDetailsCity>
<country>fr</country>
</parkingSiteAddress>
```

7.2.2.1.2.3 The <ParkingUsageScenario> class

Several <ParkingUsageScenario> can be linked.
Several types of <ParkingUsageScenario> exist.

The attribute <ParkingUsageScenario> will be used to determine the type of POI:

ParkingUsageScenario. ParkingUsageScenario	poiType
parkAndRide	ParkAndRide
truckParking	CoachandLorryParking
If the two are presents	The R-ITS-S should create two POI, one for each type.
No presents / others values	See <TariffsAndPayment> class

Figure 21 : Table between ParkingUsageScenario and poiType

Example

```
<parkingUsageScenario scenarioIndex="1">
  <parkingUsageScenario>
    <parkingUsageScenario>truckParking</parkingUsageScenario>
  </parkingUsageScenario>
</parkingUsageScenario>
<parkingUsageScenario scenarioIndex="2">
  <parkingUsageScenario>
    <parkingUsageScenario>ParkAndRide</parkingUsageScenario>
  </parkingUsageScenario>
</parkingUsageScenario>
```

7.2.2.1.2.4 The <OpeningTimes> Class

The POI "openingDaysHours" is optional.

It is a sequence of seven (one for each day) of four periods from opening till closing.

As the DATEX II message can be much more complex, some simplification are made for the French C-ITS

If only one of the <available24hours> or <openAllYear> attributes are set to "true", Then the "openingDaysHours" in the POI shall be set to (((0,1440)), ((0,1440)), ((0,1440)), ((0,1440)), ((0,1440)), ((0,1440)), ((0,1440))).

Example

```
<openingTimes>
  <available24hours >true</available24hours>
```

```
<openAllYear>true</openAllYear>
</openingTimes>
```

Only the recurring period set in a weekly view will be considered. See example.
The operator can send the data each week to update the opening hours for the week to go, and the precise the validity of the data in the <validityTimeSpecification>.

Example

```
<openingTimes>
  <validity>
    <validityStatus>definedByValidityTimeSpec</validityStatus>
    <validityTimeSpecification>
      <overallStartTime>2019-01-01T00:00:00+01:00 </overallStartTime>
      <overallEndTime>2019-01-07T00:00:00+01:00 </overallEndTime>
      <validPeriod>
        <periodName>
          <values>
            <value>WEEK_OPENING</value>
          </values>
        </periodName>
        <recurringTimePeriodOfDay xsi:type="TimePeriodByHour">
          <startTimeOfPeriod>08:00:00Z</startTimeOfPeriod>
          <endTimeOfPeriod>12:00:00Z</endTimeOfPeriod>
        </recurringTimePeriodOfDay>
        <recurringTimePeriodOfDay xsi:type="TimePeriodByHour">
          <startTimeOfPeriod>14:00:00Z</startTimeOfPeriod>
          <endTimeOfPeriod>18:00:00Z</endTimeOfPeriod>
        </recurringTimePeriodOfDay>
        <recurringDayWeekMonthPeriod>
          <applicableDay>monday</applicableDay>
          <applicableDay>tuesday</applicableDay>
          <applicableDay>wednesday</applicableDay>
          <applicableDay>thursday</applicableDay>
          <applicableDay>friday</applicableDay>
        </recurringDayWeekMonthPeriod>
      </validPeriod>
    </validityTimeSpecification>
  </validity>
</openingTimes>
```

This example will be translated in POI in the following values : (((480, 720),(840,1080)), ((480, 720),(840,1080)) , ((480, 720),(840,1080)) , ((480, 720),(840,1080)) , ((480, 720),(840,1080)), ((0,0)), ((0,0)))

7.2.2.1.2.5 The <tariffsAndPayment> class

This class is optional.
But if the class is present, the <freeOfCharge> attribute is made mandatory. It will be used by the R-ITS-S if the parking is not a truck Parking nor a Park and Ride.

tariffsAndPayment. freeOfCharge	poiType
true	ParkingLot
false	ParkingGarage
class not present and no relevant type in parkingUsageScenario	ParkingLot

Figure 22 : *Table between tariffsAndPayment and poiType*

Example

```
<tariffsAndPayment>
  <freeOfCharge>true</freeOfCharge>
</tariffsAndPayment>
```

Example

```
<tariffsAndPayment>
  <freeOfCharge>false</freeOfCharge>
</tariffsAndPayment>
```

7.2.2.1.2.6 The other classes

Other classes can be present, but will not be used by the R-ITS-S.

7.2.2.2 Enhancement of ParkingTablePublication DATEX II Message by the Platform

The platform, unlike the situationrecords, do not need to enhance the data from the TMS.

NOTE: There are no traces in the POI message.

NOTE : Deliverable 2.4.3.2 could present some rejectement rules.

7.2.2.3 Exemple of <parkingTablePublication>

```
<?xml version="1.0" encoding="UTF-8"?>
<payloadPublication type="GenericPublication" lang="fre">
  <publicationTime>2015-07-20T08:34:14+02:00</publicationTime>
  <publicationCreator>
    <country>fr</country>
    <nationalIdentifier>SEE 2.4.1.2_H</nationalIdentifier>
  </publicationCreator>
  <genericPublicationName>ParkingTablePublication</genericPublicationName>
  <genericPublicationExtension>
    <parkingTablePublication>
      <parkingTable id="PARKING_DE_LA_DIR" version="1">
        <parkingTableVersionTime>2019-01-01T00:00:00+01:00</parkingTableVersionTime>
        <parkingRecord id="4901" version="1" type="InterUrbanParkingSite">
          <parkingName>
            <values>
              <value lang="fr">Parking de l'aire_du_meleze</value>
            </values>
          </parkingName>
        </parkingRecord>
      </parkingTable>
    </parkingTablePublication>
  </genericPublicationExtension>
</payloadPublication>
```



```

        <parkingRecordVersionTime>2019-01-
01T00:00:00+01:00</parkingRecordVersionTime>
        <urlLinkAddress>www.monparking.fr</urlLinkAddress>
        <parkingNumberOfSpaces>1200</parkingNumberOfSpaces>
        <parkingLocation type="Point">
            <pointByCoordinates>...</pointByCoordinates>
        </parkingLocation>
        <owner id="Gestionnaire_du_parking_34003" version="1"
type="ContactDetails">
            <contactOrganisationName>
                <values>
                    <value lang="de">Les parkings du Haut Meleze</value>
                </values>
            </contactOrganisationName>
            <contactDetailsTelephoneNumber>+33
123456789</contactDetailsTelephoneNumber>
        </owner>
        <parkingSiteAddress id="ADRESSE_PARKING_7834" version="1"
type="ContactDetails">
            <contactDetailsAddress>3 rue de Berry, 75001,
Paris</contactDetailsAddress>
            <contactDetailsPostcode>75001</contactDetailsPostcode>
            <contactDetailsCity>
                <values>
                    <value lang="de">Paris</value>
                </values>
            </contactDetailsCity>
            <country>fr</country>
        </parkingSiteAddress>
        <parkingUsageScenario scenarioIndex="1">
            <parkingUsageScenario>
                <parkingUsageScenario>truckParking</parkingUsageScenario>
            </parkingUsageScenario>
        </parkingUsageScenario>
        <parkingUsageScenario scenarioIndex="2">
            <parkingUsageScenario>
                <parkingUsageScenario>ParkAndRide</parkingUsageScenario>
            </parkingUsageScenario>
        </parkingUsageScenario>
        <openingTimes>
            <available24hours>true</available24hours>
            <openAllYear>true</openAllYear>
        </openingTimes>
        <tariffsAndPayment>
            <freeOfCharge>true</freeOfCharge>
        </tariffsAndPayment>
    </parkingRecord>
</parkingTable>
</parkingTablePublication>

```

```
</genericPublicationExtension>
</payloadPublication>
```

7.3 Construction of <parkingStatusPublication>

This message will provide the dynamic data.

7.3.1 Exchange parameters: Choosing the distribution mode

Exactly the same as:

5.2.1 Exchange parameters: Choosing the distribution mode

7.3.2 Message Content

The publication shall be a genericPublication, specified in <ParkingStatusPublication>.

The <publicationTime> shall be present. It corresponds to the "timestamp" in the POI message.

The <publicationCreator> shall be present.

The R-ITS-S shall have a table to translate the PayloadaPublication. Publicationcreator. country into the country code. (« FR » into « 10110 01010 » (value in the 2412H(C3))).

PFro will send the <internationalIdentifier> in the <publicationcreator> as the issuerIdentifier format required by the table in the 2.4.1.2_H(F1).

NOTE: two fields « country » and two fields « InternationalIdentifier » are present in the DATEX II Message. PFro and R-ITS-S shall translate the appropriate ones.

Example:

```
<payloadPublication xsi:type="GenericPublication" lang="fre">
  <publicationTime>2015-07-20T08:34:14+02:00</publicationTime>
  <publicationCreator>
    <country>fr</country>
    <nationalIdentifier>SEE 2.4.1.2_H</nationalIdentifier>
  </publicationCreator>
  <genericPublicationName>ParkingStatusPublication</genericPublicationName>
  <genericPublicationExtension>
    <parkingStatusPublication>
      ...
    </parkingTablePublication>
  </genericPublicationExtension>
</payloadPublication>
```

7.3.2.1 The <ParkingStatusPublication> class

The <parkingTableReference> attribute shall be filled with reference to the parkingTable containing the static data of the same parking.

The R-ITS-S will use this attribute to make the link.

7.3.2.1.1 THE <PARKINGRECORDSTATUS> CLASS

The <parkingStatusPublication> contains 1 to n <parkingRecordStatus>.

The <parkingRecordStatus> can be instantiated as a <parkingSiteStatus>, or as a <groupOfParkingSiteStatus>. Each one has different attributes.

The <parkingRecordReference> shall be filled with reference to the parkingRecord containing the static data of the same parking.

The <parkingStatusOriginTime> attribute of the <parkingRecordStatus> is mandatory and shall corresponds to the date of the update of the data.

No other attributes is mandatory.

Exemple

```
<parkingRecordStatus xsi:type="ParkingSiteStatus">
  <parkingRecordReference id="4901" targetClass="ParkingRecord" version="1"/>
  <parkingStatusOriginTime>2019-01-02T00:00:00+01:00</parkingStatusOriginTime>
  ...
</parkingRecordStatus>
```

If the parking <parkingRecordStatus> is a <ParkingSiteStatus>, then their attributes can be used by the R-ITS-S.

The <parkingSiteStatus> attribute called <parkingSiteStatus> can give information for the “freeSpots” in the “statusData”:

If the value is “full” or “fullAtEntrance” or “almostFull” then “freeSpots” shall be set to “full(0)”.

If the value is spacesAvailable, and the classe occupancy is not present, then “freeSpots” shall be set to “freespaces(16382)”.

If the value is “unknown”, and the classe occupancy is not present, then “freeSpots” shall be set to unknown (16383).

The <parkingSiteStatus> attribute called <parkingSiteOpeningStatus> can give information for the “openingStatus”:

parkingSiteOpeningStatus	openingStatus
open	open (1)
Closed or closedAbnormal	closed (0)
openingTimesInForce	open or closed, depending on the <openingTimes> in the <parkingTablePublication> unknown if <openingTimes> is not present
statusUnknown or other or class not present	unknown (15)
the R-ITS-S shall check the <applicableForUser> attribute in the <ParkingAssignment>	subscriberonly

Figure 23 : Table between parkingSiteOpeningStatus and openingStatus

If the attribute is set to “openingTimesInForce”, the R-ITS-S shall check if the parking is open regarding the validity set in the chapter: 7.2.2.1.2.4 The <OpeningTimes> Class.

For the “subscriberonly”, the R-ITS-S shall check the <applicableForUser> attribute in the <ParkingAssignment> of the parking Record.

7.3.2.1.2 THE CLASSES LINKED TO THE <PARKINGRECORDSTATUS> CLASS

7.3.2.1.2.1 The < ParkingOccupancy> class

This class is mandatory.

The R-ITS-S shall translate the following attributes :

- parkingNotAllowed
In case of 'true', parking is not allowed (e.g. abnormal closure), and the R-ITS-S shall set the "openingStatus" to "closed".
- parkingNumberOfSpacesOverride
If this attribute is present, R-ITS-S shall used it instead of the static value 'parkingNumberOfSpaces' for "totalSpots".
- parkingNumberOfVacantSpaces
The total number of currently vacant parking spaces available in the specified parking site, group of parking sites or group of parking spaces.
If this attribute is present, R-ITS-S shall used it for the "freepot" number.
- parkingNumberOfOccupiedSpaces
The number of currently occupied spaces in the specified parking site, group of parking
If this attribute is present and < parkingNumberOfVacantSpaces> is not present, R-ITS-S shall used it to find the "freepot" number, by difference with the "TotalSpots".
- parkingNumberOfVehicles
The Number of vehicles (of specified type) on the parking site. This can be used if the parking is equipped with a vehicle counter at the entrance of the parking, but no automatic detection in each place.
If this attribute is present and < parkingNumberOfVacantSpaces> is not present, R-ITS-S shall used it to find the "freepot" number, by difference with the "TotalSpots"

The following attributes shall not be translated by the R-ITS-S. TMS shall send the available data in a class translated by the R-ITS-S, and so should not used the following attributes.

NOTE: This rule could change in the future.

- parkingNumberOfVacantSpacesGraded : The number of currently vacant parking spaces available in the specified parking, presented in a graded way (« lessThan10SpacesAvailable », « lessThan20SpacesAvailable »...)
- parkingNumberOfVacantSpacesHigherThan and parkingNumberOfVacantSpacesLowerThan: the number of vacant parking spaces is higher or lower than the given value (example: More than 10 spaces are free).
- parkingOccupancyGraded : occupied parking spaces by a percentage-grading (enumeration).
- parkingOccupancyTrend : the trend of the occupancy of the parking spaces in the specified parking site, group of parking sites or assigned parking.

7.3.2.2 Enhancement of ParkingStatusPublication DATEX II Message by the Platform

The platform, unlike the <situationPublications>, do not need to enhance the data from the TMS.

NOTE: There are no traces in the POI message.

NOTE : Deliverable 2.4.3.2 could present some rejectement rules.

7.3.2.3 Exemple of <parkingStatusPublication>

```
<?xml version="1.0" encoding="UTF-8"?>
```

```

<payloadPublication xsi:type="GenericPublication" lang="fre">
  <publicationTime>2015-07-20T08:34:14+02:00</publicationTime>
  <publicationCreator>
    <country>fr</country>
    <nationalIdentifier>SEE 2.4.1.2_H</nationalIdentifier>
  </publicationCreator>
  <genericPublicationName>ParkingStatusPublication</genericPublicationName>
  <genericPublicationExtension>
    <parkingStatusPublication>
      <parkingRecordStatus xsi:type="ParkingSiteStatus">
        <parkingRecordReference id="4901" targetClass="ParkingRecord" version="1" />
        <parkingStatusOriginTime>2019-01-02T00:00:00+01:00</parkingStatusOriginTime>
        <parkingOccupancy>
          <parkingNumberOfVacantSpaces>179</parkingNumberOfVacantSpaces>
        </parkingOccupancy>
        <parkingSiteStatus>spacesAvailable</parkingSiteStatus>
      </parkingRecordStatus>
      <parkingRecordStatus xsi:type="ParkingSiteStatus">
        <parkingRecordReference id="321" targetClass="ParkingRecord" version="1" />
        <parkingStatusOriginTime>2019-01-02T00:00:00+01:00</parkingStatusOriginTime>
        <parkingOccupancy>
          <parkingNumberOfVehicles>321</parkingNumberOfVehicles>
        </parkingOccupancy>
        <parkingSiteStatus>spacesAvailable</parkingSiteStatus>
      </parkingRecordStatus>
      <parkingRecordStatus xsi:type="ParkingSiteStatus">
        <parkingRecordReference id="4930" targetClass="ParkingRecord" version="1" />
        <parkingStatusOriginTime>2019-01-02T00:00:00+01:00</parkingStatusOriginTime>
        <parkingOccupancy>
          <parkingNumberOfOccupiedSpaces>93</parkingNumberOfOccupiedSpaces>
        </parkingOccupancy>
        <parkingSiteStatus>spacesAvailable</parkingSiteStatus>
      </parkingRecordStatus>
    </parkingStatusPublication>
  </genericPublicationExtension>
</payloadPublication>

```

8 Dynamic speed limit

This chapter is completed by :

- 2.4.1.4 Annex 7 : Translation of a Networkmessage Datex II message into an IVI.

8.1 Description of the use case

This use case is described by the deliverable 2.4.1.2_H – C2 Dynamic speed limit.

It is only in the downlink direction.

The purpose is to send a speed limit on a linear road to the users.

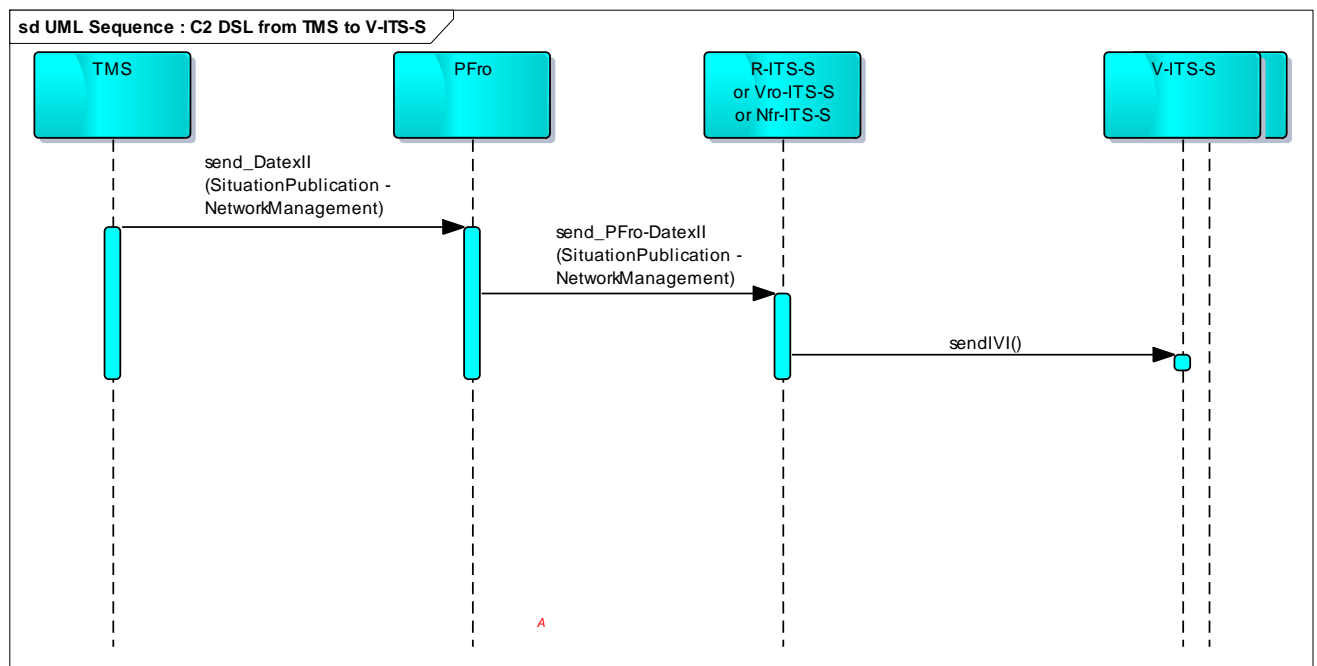


Figure 24 : UML sequence diagram for the speed limit management from TMS to V-ITS-S.

8.2 Overview of the DATEX II Model

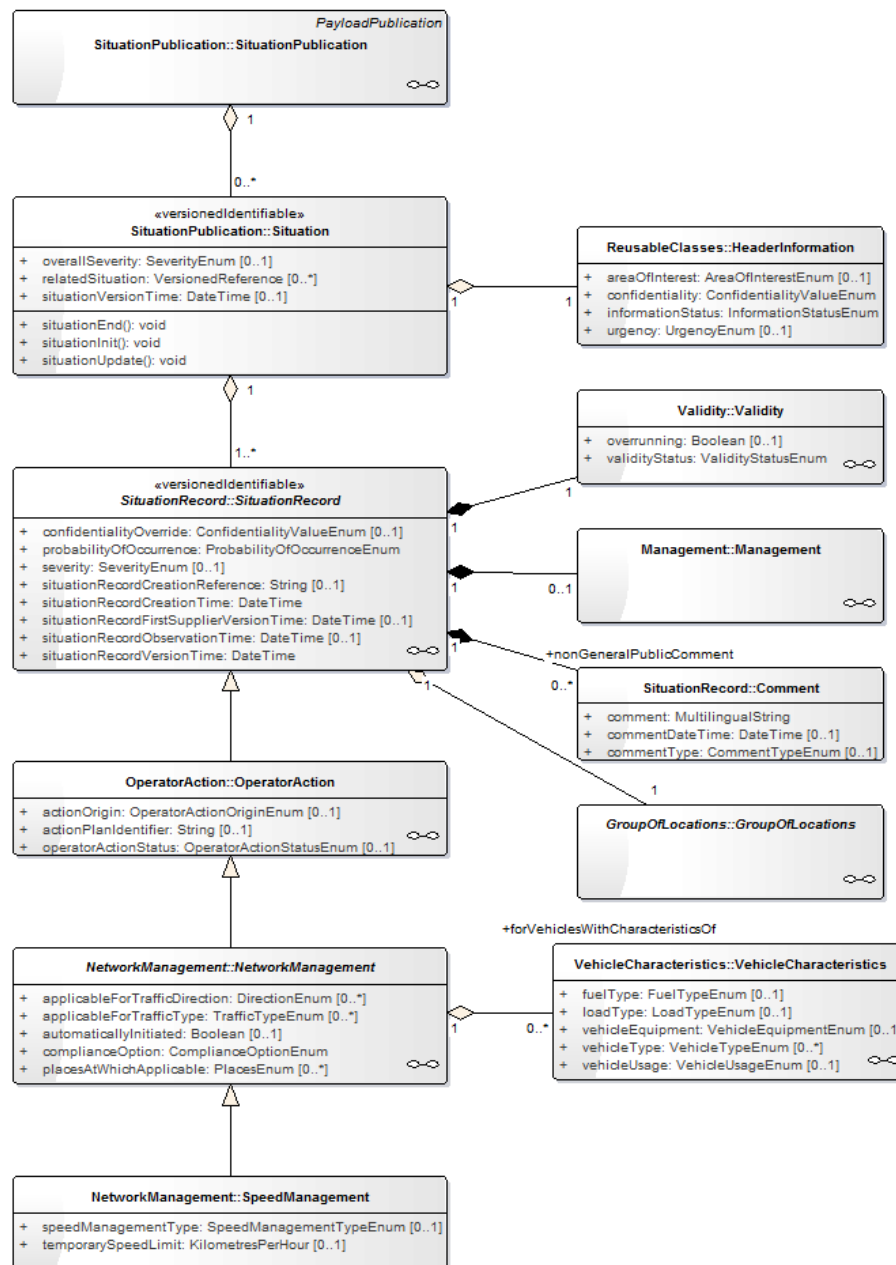


Figure 25 : Overview of the DATEX II model about SpeedManagement

NOTE: This is only an extract; the entire model is available on the datex2.eu website.

8.3 Construction of DATEX II messages of speed limit management

This message is very similar to the ones translated in DENM. So the structure of this chapter is based on the chapter 5 Traffic Events and Operator Actions Messages.

8.3.1 Exchange parameters: Choosing the distribution mode

Exactly the same as: 5.2.1 Exchange parameters: Choosing the distribution mode

8.3.2 Message content (<PayloadPublication> and <SituationPublication>)

Exactly the same as: 5.2.2 Message content (<PayloadPublication> and <SituationPublication>)

R-ITS-S shall have a table to translate the country code in « publicationCreator » into the IVI country code. (« FR » into « 10110 01010 » (value given in the 2412H)).

R-ITS-S shall use payloadpublication.publicationcreator.internationalidentifier into the IVI issuerIdentifier.

NOTE: PFro provides the relevant internationalidentifier, in the relevant format.

The situation which first situationrecord is a <speedLimitManagement>, shall be translated in an IVI, with respect to the deliverable 2.4.1.2_H – C2 Dynamic speed limit.

NOTE: “first” means the situationrecordcreationreference ends with 1.

8.3.2.1 The DATEX II <HeaderInformation> class

Exactly the same as: 5.2.2.1 The DATEX II <HeaderInformation> class

8.3.2.2 The DATEX II <Situation> class

8.3.2.2.1 IDENTIFIER OF THE CLASS

Exactly the same as: 5.2.2.2.1 Identifier of the class

NOTE: this chapter concerns a downlink use case.

A situation shall be translated in 1 IVI by the R-ITS-S.

8.3.2.2.2 TWO OR MORE SITUATIONS LINK

This use case shall not use the attribute “relatedSituation”.

8.3.2.3 The DATEX II <SituationRecord> class

The introduction in the chapter 5.2.2.3 The DATEX II <SituationRecord> class, does apply here and is completed with the following elements.

For this specific use case, a situation will be translated in an IVI.

For the R-ITS-S, all the situationrecords present inside the same situation shall be translated in the same IVI message, provided that the groupOflocations of each situationrecord are the same.

NOTE: According to the deliverable 2.4.3.1, the TMS should not send a situation for this use case with different groupOflocations in the same situation.

NOTE: According to the deliverable 2.4.3.2 and 2.4.2.2, the PFro and R-ITS-S should not spread an improper situation for this use case.

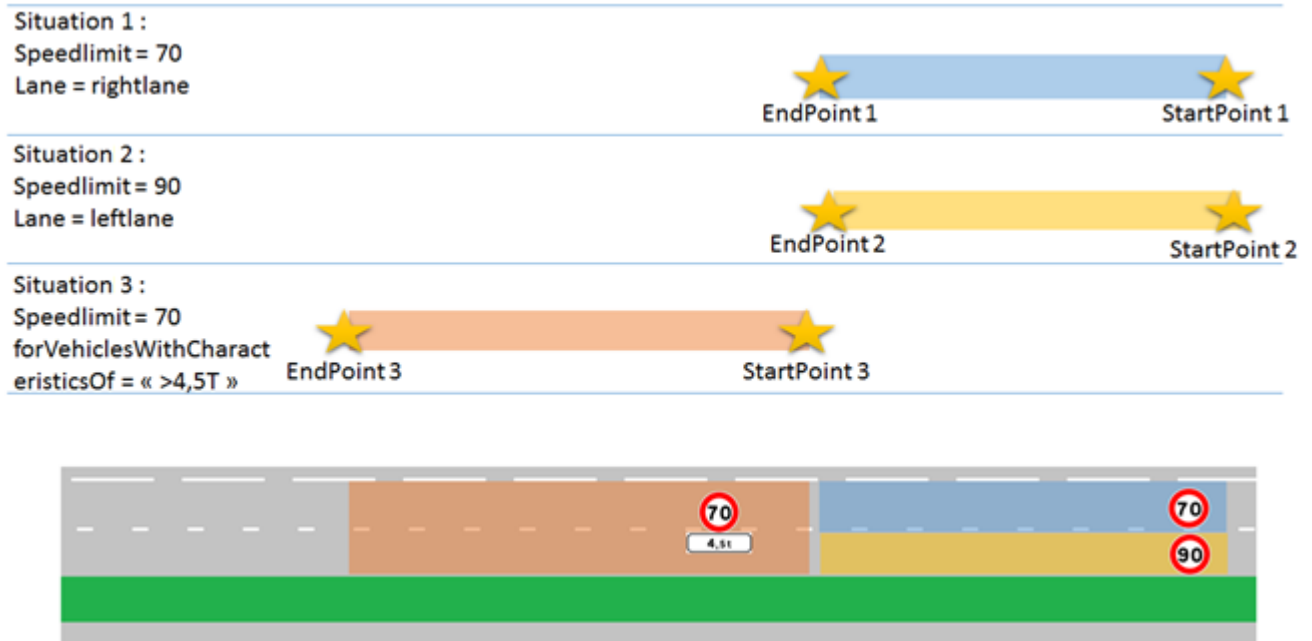


Figure 26 : Illustration of three situations sent by the TMS, to be translated in three IVI.

The regulated area shall be divided by the TMS depending on:

- the location: start and end points of each zone, called « canton » in french:
 - on the figure 21, there are 2 « cantons »
- the lanes:
 - on the figure 21, the first « canton » shall be divided in the 2 lanes.
- the vehicles concerned:
 - on the figure 21, the second « canton » only concerns certain vehicles (another speed limit could applied, in another situationrecord for the same location).

8.3.2.3.1 THE <SITUATIONRECORD> CLASS ATTRIBUTES

8.3.2.3.1.1 The class identifier

Exactly the same as: 5.2.2.3.1 The class identifier.

NOTE: this chapter concerns a downlink use case.

8.3.2.3.1.2 The "situationRecordCreationReference" attribute

In the French C-ITS Projects, the attribute of the situation record, called **<situationRecordCreationReference>** becomes mandatory. This attribute contains a unique alphanumeric reference (external or GUID) of the first **<SituationRecord>** class occurrence version when created by the original supplier.

NOTE: it is not mandatory in the standard or in the guide [4].

Particularity for the downlink cases

This reference, in the form of a text chain, may therefore not be provided by the traffic information and control system. In any case, the platform creates it because it is used for defining the IVI "ivildnetificationNumber" data frame.

The platform creates the "situationRecordCreationReference" attribute by concatenating the following information:

- its “stationID” (32-bit integer in hexadecimal format left padded with 0),
- followed by an incremental number (16-bit integer in hexadecimal format left padded with 0),
- followed by a sequence number in each situation starting from 1 (0 is allocated for the situation itself) (4-bits integer in hexadecimal format left padded with 0).

One number in the hexadecimal base corresponds exactly 4 numbers in binary base.

The SituationRecordCreationReference is on 13 hexadecimal characters.

Example of a “SRCR” from PFro	0	0	D	5	E	1	5	6	0	0	E	7	1
Meaning for an R-ITS-S:	Not used by the R-ITS-S								To use to fill the iviIdentificationNumber				
Value in DENM	14016854								231				Nothing

Figure 27 : *example of translation of the SituationRecordCreationReference in the downlink cases.*

There is no need for a separation character between the different concatenated elements due to the fix format.

The R-ITS-S that receives this message recovers the incremental number and the “stationID” from the platform (considered as the “originatingStationID” to fill in the “actionID” attribute of the DENM to transmit.

NOTE: this chapter concerns a downlink use case.

8.3.2.3.1.3 Time attributes

The rules presented in the following chapter applies: 5.2.2.3.1.3Time attributes.
Except for the table 5 which is different:

Class::attribute	Mand.	TMS=>PF and PFro=>R-ITS-S message
PayloadPublication:: publicationTime	Y	Message creation time by the platform. Not used to generate the IVI.
Situation:: situationVersionTime	N	Not used
SituationRecord:: situationRecordCreationTime	Y	Fill in (because mandatory) but not used by the R-ITS-S to create IVI.
SituationRecord:: situationRecordFirstSupplierVersionTime	Y	Fill in (because mandatory) but not used by the R-ITS-S to create IVI.
SituationRecord:: situationRecordObservationTime	Y	Time used by the R-ITS-S to construct the "timestamps" data element of IVI
SituationRecord:: situationRecordVersionTime	Y	Fill in (because mandatory) but not used by the R-ITS-S to create IVI.
validity.overallStartTime	Y	Time used by the R-ITS-S to construct the "validFrom" data element of IVI
validity.overallEndTime	Y	Time used by the R-ITS-S to construct the "validTo" data element of IVI

Table 13 : *Dates and times of a situation for the C2 use case, based on IVI*

8.3.2.3.1.4 “probabilityOfOccurrence” attribute

This attribute is not used in IVI.

8.3.2.3.1.5 The <OperatorAction> class attributes

This class is not used in IVI.

Exactly the same as: 5.2.2.3.1.5 The <OperatorAction> class attributes (roadworks only)

8.3.2.3.1.6 The other attributes

This class is not used in IVI.

Exactly the same as: 5.2.2.3.1.6 The other attributes.

8.3.2.3.2 THE CLASSES LINKED TO THE <SITUATIONRECORD> CLASS

8.3.2.3.2.1 The DATEX II <Impact> class

This class is not used in IVI.

8.3.2.3.2.2 The DATEX II <Source> class

This class is not used in IVI.

8.3.2.3.2.3 The DATEX II <Comment> class

This class is not used in IVI.

Exactly the same as: 5.2.2.3.2.3 The DATEX II <Comment> class.

8.3.2.3.2.4 The DATEX II <Cause> class

This class is not used in IVI.

8.3.2.3.2.5 The DATEX II <Validity> class

In the French C-ITS Projects and in all use cases, the <overallStartTime> shall be filled in for all messages.

If the end date is unknown, the DATEX II <Validity> class is instantiated as follows:

```
...
<validity>
  <validityStatus>active</validityStatus>
  <validityTimeSpecification>
    <overallStartTime>2015-01-01T17:13:39+01:00</overallStartTime>
  </validityTimeSpecification>
</validity>
...
```

If the end date is known, the DATEX II <Validity> class should be instantiated as follows:

```
...
<validity>
  <validityStatus>definedByValidityTimeSpec</validityStatus>
  <validityTimeSpecification>
    <overallStartTime>2015-01-01T17:13:39+01:00</overallStartTime>
    <overallEndTime>2015-05-25T19:13:39+01:00 </overallEndTime>
  </validityTimeSpecification>
</validity>
```

In the French C-ITS Projects, the **<overallEndTime>** shall be filled in for the messages from the Platform to the R-ITS-S, Nfr-ITS-S or Vro-ITS-S. These two attributes will be used to fill in “validFrom” and “validTo” data element of the IVI.

Consequently, for messages coming from TMS, if the end date is not filled in, the platform shall follow the following processus:

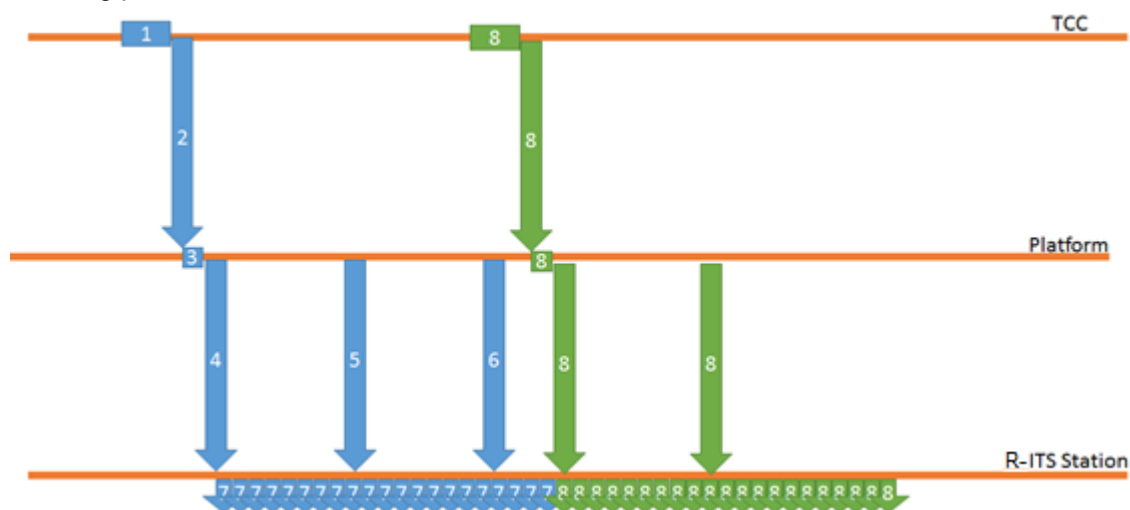


Figure 28 : *Processus for validity management*

- 1-2: TMS prepares and sends a message.
- 3: Platform modifies the validity definition of the original DATEX II message such that the “validityStatus” attribute is made as “definedByValidityTimeSpec”, and the “overallEndTime” is filled in from the “overallStartTime” value and adding a duration of 12 minutes
- 4: Platform sends the messages to R-ITS-S.
- 5: If, 10 minutes after the previous sending, no new message is received, the previous message is updated by the platform: the overallEndTime is filled in from the previous “overallEndTime” value and adding a duration of 10 minutes, and then the platform sends the updated message.
- 6: If, 10 minutes after the previous sending, no new message is received, the previous message is updated by the platform: the overallEndTime is filled in from the previous “overallEndTime” value and adding a duration of 10 minutes, and then the platform sends the updated message.
- 7: The R-ITS-S sends regularly the valid IVI messages, based on the DATEX II received messages from the platform.
- 8: If a new message concerning the same regulated zone is send, the platform completes the message, sends it to the R-ITS-S which update and send their messages.

These elements are presented in the Table 13 :

NOTE: The platform receive scheduled events sent from TMS. See the deliverable 2.4.3..2_H for details.

8.3.2.3.2.6 The DATEX II <groupOfLocations> class

The use case concerns a linear, with differents roads leading to the event.

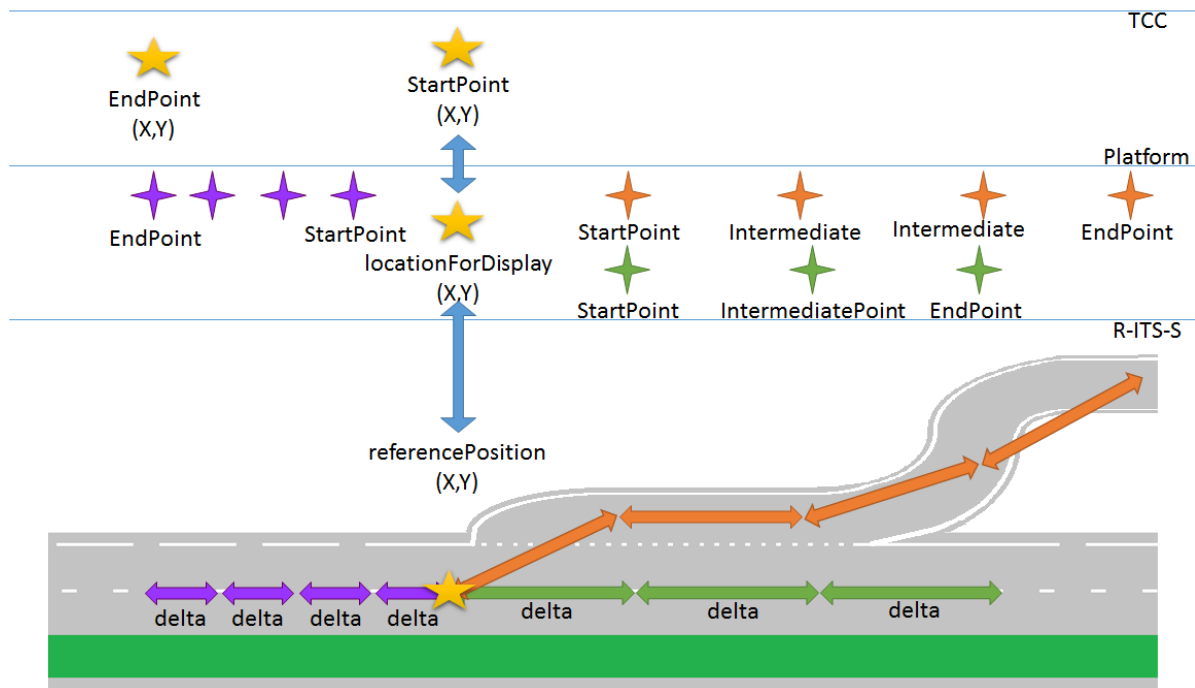


Figure 29 : Illustration of the groupOfLocations in one situationrecord

Platform shall apply the process described in the 3.7 Case of the linearly located events, for each groupOfLocations present in the situation.

R-ITS-S will then use the data to translate each groupOfLocations in the corresponding IVI data frame: referencePosition, and zones.

NOTE: As explain in the Deliverable 2.4.1.2, the "direction" attribute in IVI, is set to "samedirection". Contrary to the DENM direction, there is no upstream or downstream consideration.

The fact than "One situation = One IVI", implies that all the groupoflocations inside the situationrecords of the same situation, shall exactly be the same, including lanes, and so on.

NOTE: According to the deliverable 2.4.3.1, the TMS should not send a situation for this use case with differents groupOflocations in the same situation.

NOTE: According to the deliverable 2.4.3.2 and 2.4.2.2, the PFro and R-ITS-S should not spread an improper situation for this use case.

NOTE: as the situation shall be trasblated in an IVI, the external referecing shall be set to "RELEVANCEZONE" and "DETECTIONZONE".

8.3.2.3.3 THE <NETWORKMANAGEMENT> CLASS

8.3.2.3.3.1 The class attributes

The attributes are not used in IVI.

The description can be found in: 5.2.2.3.4.4.1 The class attributes.

8.3.2.3.3.2 The classes linked to the <NetworkManagement> class

The DATEX II <VehicleCharacteristics> class used to describe the characteristics of the concerned vehicles is linked to the **<NetworkManagement>** class by the “forVehiclesWithCharacteristicsOf” association. This reusable class contains the description of the vehicle categories that the operating applications apply to.

This class shall be used to fill in the “VehicleCharacteristics” data element of the IVI. The deliverable 2.4.1.2_H_Master sets that the only characteristics to be considered is the weight of the vehicle.

NOTE: The operator shall be aware that the vehicle uses this attribute to determine if it is concerned and if the message will be displayed. See Deliverable 2.4.2.3.

If relevant, the <GrossWeightCharacteristic> will be used and the attributes of GrossVehicleWeight and comparisonOperator can be combined, once or twice for the same situation record.

Example for restriction only for the lorries which weight is comprised between 3,5T and 7,5T:

```
<forVehiclesWithCharacteristicsOf>
  <vehicleType>lorry</vehicleType>
  <grossWeightCharacteristic>
    <comparisonOperator>greaterThan</comparisonOperator>
    <grossVehicleWeight>3.5</grossVehicleWeight>
  </grossWeightCharacteristic>
  <grossWeightCharacteristic>
    <comparisonOperator>lessThan</comparisonOperator>
    <grossVehicleWeight>7.5</grossVehicleWeight>
  </grossWeightCharacteristic>
</forVehiclesWithCharacteristicsOf>
```

The vehicle type will be used by the R-ITS-S to find in the type of IVI VehicleCharacteristics, which can described a tractor, a trailer or a train.

The speedlimit always concerns the entire vehicle, so the weights will always concern the train in IVI, except for the following Datex II type trailer, which shall be translated in the trailer IVI attribute.

8.3.2.3.3.3 The DATEX II <SpeedManagement> class

This class is used to provide the speed limit for the dynamic speed management.

The attributes are as follows:

- “speedManagementType”: Type of action on the speed. Only the following shall be considered as a C2 use case by the R-ITS-S:
 - ActiveSpeedControlInOperation
 - speedRestrictionInOperation
 - reduceYourSpeed
 - policeSpeedChecksInOperation
 - or the type is not present.
- “temporarySpeedLimit”: Temporary speed that shall correspond to the mandatory speed (expressed in km/h).
 - This attribute will be used to fill in the “spm” attribute of the pictogram in the IVI.

9 Lane management

9.1 Description of use-cases

These use cases are described by the following deliverables:

- 2.4.1.2_H – H2 Dynamic Traffic ban to specific vehicle (I2V),
 - Type 1 : storage on a road or a parking area for some vehicles,
 - Type 2 : u-turn and go back for some vehicles,
 - Type 3 : road closed to all types of vehicles,
- 2.4.1.2_H – H4 Dynamic Lane management – reserved lane (I2V) :
 - Type 1 : High Occupancy Vehicle (HOV) lane
 - Type 2 : Bus and Taxi reserved lane
- 2.4.1.2_H – H6 HGV overtaking ban (lanes forbidden to heavy goods vehicle)

NOTE: 2.4.1.2_H – H4 Eco-friendly vehicle reserved lane (e.g. Crit'Air) is not covered by this version.

They are only in the downlink direction.

The purpose is to send a lane information on a linear road to the users.

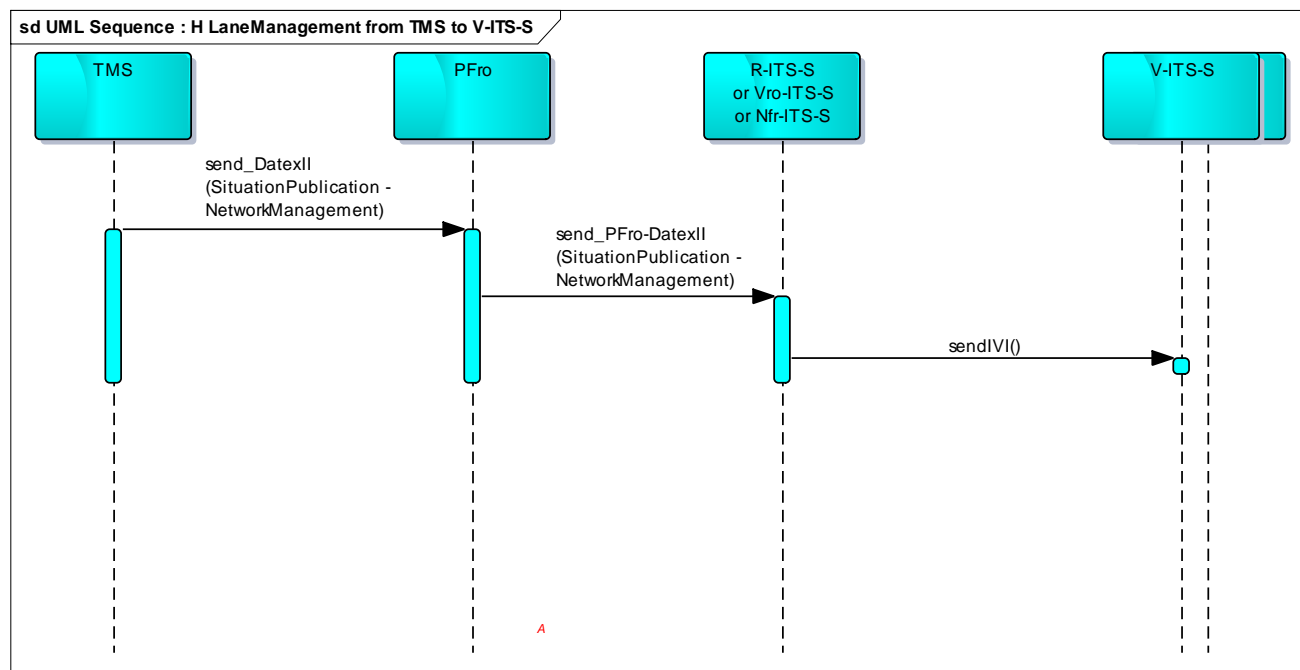


Figure 30 : UML sequence diagram for the lane management from TMS to V-ITS-S.

9.2 Overview of the DATEX II Model

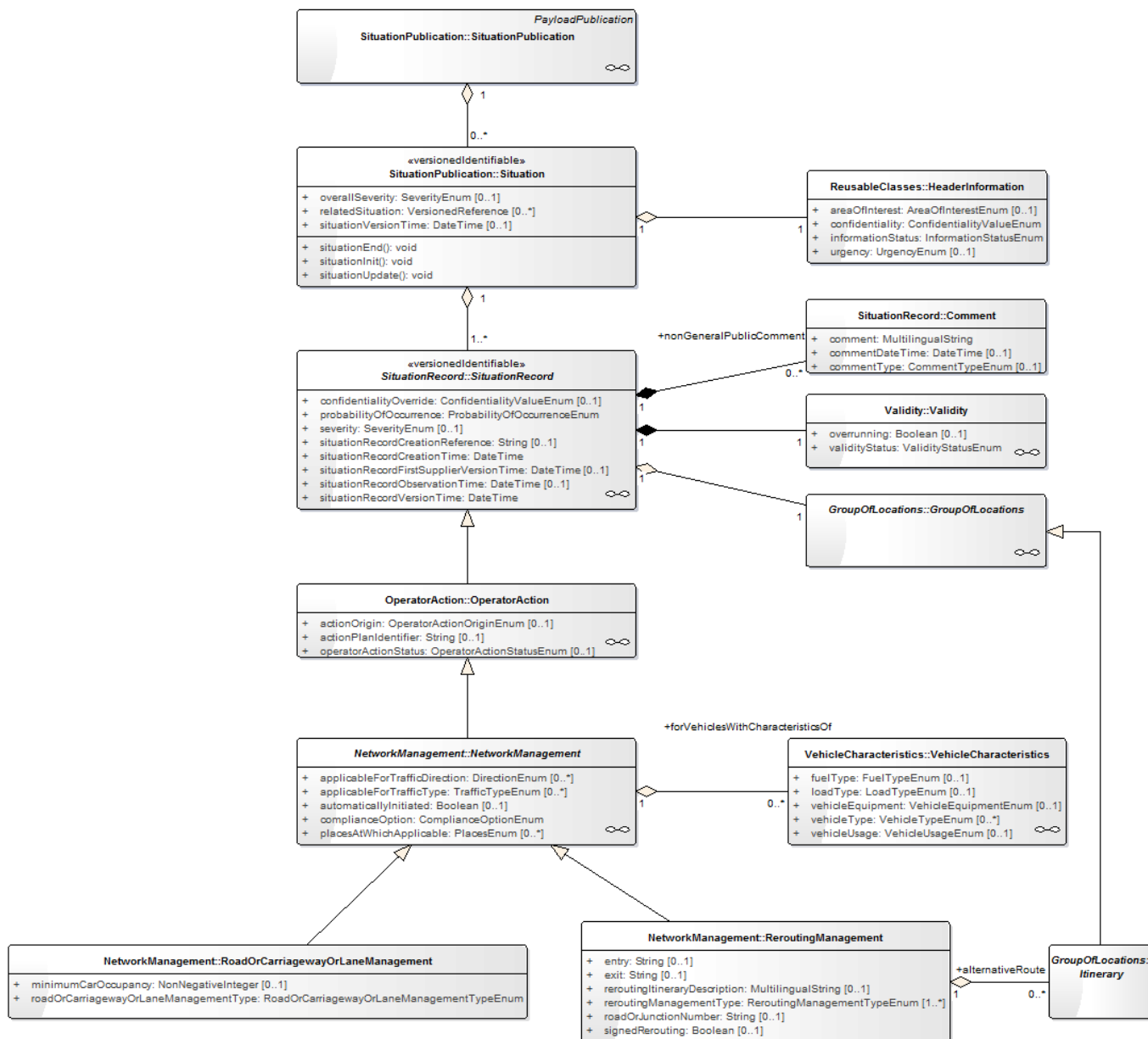


Figure 31 : Overview of the DATEX II model about LaneManagement

NOTE: This is only an extract; the entire model is available on the datex2.eu website.

9.3 Construction of DATEX II messages of lane management

This message is very similar to the ones translated in DENM and to the speed limit management. So the structure of this chapter is based on the chapter 5 Traffic Events and Operator Actions Messages.

9.3.1 Exchange parameters: Choosing the distribution mode

Exactly the same as : 5.2.1 Exchange parameters: Choosing the distribution mode.

9.3.2 Message content (<PayloadPublication> and <SituationPublication>)

Exactly the same as : 5.2.2 Message content (<PayloadPublication> and <SituationPublication>).

R-ITS-S shall have a table to translate the country code in « publicationCreator » into the IVI country code. (« FR » into « 10110 01010 » (value given in the 2412H)).

R-ITS-S shall use payloadpublication.publicationcreator.internationalidentifier into the IVI issuerIdentifier.

NOTE: PFro provides the relevant internationalidentifier, in the relevant format.

The situation which first situationrecord is a <RoadOrCarriagewayOrLaneManagement>, shall be translated in an IVI, with respect to the deliverable 2.4.1.2_H – H2 lane management.

NOTE: “first” means the situationrecordcreationreference ends with 1.

9.3.2.1 The DATEX II <HeaderInformation> class

Exactly the same as: 5.2.2.1 The DATEX II <HeaderInformation> class.

9.3.2.2 The DATEX II <Situation> class

9.3.2.2.1 IDENTIFIER OF THE CLASS

Exactly the same as: 5.2.2.2.1 Identifier of the class.

NOTE: this chapter concerns a downlink use case.

A situation shall be translated in 1 IVI by the R-ITS-S.

9.3.2.2.2 TWO OR MORE SITUATIONS LINK

This use case shall not use the attribute “relatedSituation”.

9.3.2.3 The DATEX II <SituationRecord> class

Exactly the same as: 5.2.2.3 The DATEX II <SituationRecord> class.

For this specific use case, a situation will be translated in an IVI. For the R-ITS-S, all the situationrecords present in a situation shall be translated in the same IVI message.

9.3.2.3.1 THE <SITUATIONRECORD> CLASS ATTRIBUTES

9.3.2.3.1.1 The class identifier

Exactly the same as: 5.2.2.3.1.1 The class identifier.

NOTE: this chapter concerns a downlink use case.

9.3.2.3.1.2 The “situationRecordCreationReference” attribute

The principle of the : 8.3.2.3.1.2 The “situationRecordCreationReference” attribute apply here.

NOTE: this chapter concerns a downlink use case.

9.3.2.3.1.3 Time attributes

The rules presented in the following chapter applies: 8.3.2.3.1.3 Time attributes.

9.3.2.3.1.4 “probabilityOfOccurrence” attribute

This attribute is not used in IVI.

9.3.2.3.1.5 The <OperatorAction> class attributes

This class is not used in IVI.

Exactly the same as: 5.2.2.3.1.5 The <OperatorAction> class attributes (roadworks only).

9.3.2.3.1.6 The other attributes

This class is not used in IVI.

Exactly the same as: 5.2.2.3.1.6 The other attributes.

9.3.2.3.2 THE CLASSES LINKED TO THE <SITUATIONRECORD> CLASS

9.3.2.3.2.1 The DATEX II <Impact> class

This class is not used in IVI.

9.3.2.3.2.2 The DATEX II <Source> class

This class is not used in IVI.

9.3.2.3.2.3 The DATEX II <Comment> class

This class is not used in IVI.

Exactly the same as: 5.2.2.3.2.3 The DATEX II <Comment> class.

9.3.2.3.2.4 The DATEX II <Cause> class

This class is not used in IVI.

9.3.2.3.2.5 The DATEX II <Validity> class

The rules presented in the following chapter apply: 8.3.2.3.2.5 The DATEX II <Validity> class.

9.3.2.3.2.6 The DATEX II <groupOfLocations> class

The rules presented in the following chapter apply: 8.3.2.3.2.6 The DATEX II <groupOfLocations> class.

The description of the relevant lanes is mandatory for H4 and H6, so the affected lanes shall be described through the 3.8.3 Lane and carriageway positioning.

9.3.2.3.3 THE <NETWORKMANAGEMENT> CLASS

9.3.2.3.3.1 The class attributes

The attributes are not used in IVI.

The description can be found in: 5.2.2.3.4.4.1 The class attributes.

9.3.2.3.3.2 The classes linked to the <NetworkManagement> class

The rules for <VehicleCharacteristics> presented in the following chapter apply: 8.3.2.3.3.2 The classes linked to the <NetworkManagement> class.

For the H2 use case, at least the maximum “GrossVehicleWeight” shall be present in the DATEX II message, and the R-ITS-S shall translate it into the “wei” mandatory IVI attribute.

Note for the R-ITS-S: the DATEX II VehicleCharacteristics class is used for the pictogram information, and not for the IVI <VehicleCharacteristic>.

9.3.2.3.3.3 The DATEX II <RoadOrCarriagewayOrLaneManagement> class

This class is used to provide the useful information for the following usecases:

- H2 use case type 1, storage on a road or a parking area for some vehicles,
- H2 use case type 2, u-turn and go back for some vehicles,
- H2 use case type 3, road closed to all types of vehicles,
- H4, reserved lanes to some vehicles,
- H6, no overtaking ban.

This class has two attributes.

The first, roadOrCarriagewayOrLaneManagementType, can have different values.

Value of roadOrCarriagewayOrLaneManagementType	Translation in the use case :
vehicleStorageInOperation	H2 use case type 1
turnAroundInOperation	H2 use case type 2
carriagewayClosures	H2 use case type 3 (*)
roadClosed	H2 use case type 3 (*)
doNotUseSpecifiedLanesOrCarriageways	H4 – for bus lane
carPoolLaneInOperation	H4 – HOV : carpool restriction.
laneClosures	H4 and H6 – see <vehiclecharacteristics>
clearALaneForEmergencyVehicles	NOT TO BE TRANSLATED
clearALaneForSnowploughsAndGrittingVehicles	NOT TO BE TRANSLATED
closedPermanentlyForTheWinter	NOT TO BE TRANSLATED
contraflow	NOT TO BE TRANSLATED
hardShoulderRunningInOperation	NOT TO BE TRANSLATED
heightRestrictionInOperation	NOT TO BE TRANSLATED
intermittentShortTermClosures	NOT TO BE TRANSLATED
lanesDeviated	NOT TO BE TRANSLATED
narrowLanes	NOT TO BE TRANSLATED
newRoadworksLayout	NOT TO BE TRANSLATED
other	NOT TO BE TRANSLATED
overnightClosures	NOT TO BE TRANSLATED
roadCleared	NOT TO BE TRANSLATED
rollingRoadBlock	NOT TO BE TRANSLATED
rushHourLaneInOperation	NOT TO BE TRANSLATED
singleAlternateLineTraffic	NOT TO BE TRANSLATED
tidalFlowLaneInOperation	NOT TO BE TRANSLATED
useOfSpecifiedLanesOrCarriagewaysAllowed	NOT TO BE TRANSLATED
useSpecifiedLanesOrCarriageways	NOT TO BE TRANSLATED

weightRestrictionInOperation	NOT TO BE TRANSLATED
keepToTheLeft	NOT TO BE TRANSLATED(*)
keepToTheRight	NOT TO BE TRANSLATED(*)

Table 14 : List of lane management type available in DATEX II

(*) For these values, the translation apply only if the situationrecord is the first in the situation, otherwise it shall be used to complete the DENM according to chapter 5.

The second attribute is minimumCarOccupancy, which corresponds to the minimum number of persons required in a vehicle in order for it to be allowed to transit the specified road section.

This attribute shall be filled for the H4 – HOV : carpool restriction.

10 V-ITS-S specific DATEX II messages

10.1 Transmission of road operators' vehicle position

10.1.1 Description

The corresponding message is created by V-ITS-S of the road operator based on the position determined by GNSS receiver. It is sent directly to the platform without using any R-ITS-S.
The message allows for static or mobile V-ITS-S during message sending.

The DATEX II publication named "MeasuredDataPublication" is used for this use case with the ancillary publication named "MeasurementSiteTablePublication" for the corresponding static elements. This message can be considered as similar to the R-ITS-S-generated message by CAM aggregation (from end-user vehicles). However, it has some specificities that are detailed below.

10.1.2 Construction of the message

10.1.2.1 Exchange parameters

10.1.2.1.1 CHOOSING THE DISTRIBUTION MODE

See chapter 5.2.1 Choosing the distribution mode.

10.1.2.1.2 DATA REPORTING PERIOD

The chapter 4.3.2.1 Data reporting period defines this parameter. To accommodate different needs and situations this parameter is defined in V-ITS-S according to Table 10, see chapter 10.3 Setting the static V-ITS-S parameters.

10.1.2.2 Message content

10.1.2.2.1 THE DATEX II <MEASUREDDATAPUBLICATION> CLASS

Besides the attributes defined in chapter 4.3.2.2 Message content the DATEX II <MeasuredDataPublication> class contains the following attributes:

- The "measurementSiteTableReference" attribute which provides a reference to the associated static element definition of the road operator V-ITS-S (i.e. the versioned identifier of the <MeasurementSiteTable> class instance already defined through the <MeasurementSiteTable> publication;
- As many instances of the DATEX II <SiteMeasurements> class as V-ITS-S positions.

10.1.2.2.2 THE DATEX II <SITE MEASUREMENTS> CLASS

The DATEX II **<MeasurementSiteRecord>** class allows identifying the V-ITS-S of a road operator the position of which is uploaded (a reference for the road operator's V-ITS-S):

```
...
<measurementSiteReference id="UEVG-EC301" targetClass="MeasurementSiteRecord"
version="1"/>
...
```

The version number is incremented every time one of the instance attributed is updated.

The **<SiteMeasurements>** class contains an only instance of the **<MeasuredValue>** class that represents vehicle position to transmit. Each instance of **<SiteMeasurements>** is timestamped through the "measurementTimeDefault" attribute. In case several positions are to upload in once, as many **<SiteMeasurements>** instances are created as positions. They are distinguished through their timestamp.

The **<MeasuredValue>** class includes an optional "measurementEquipmentTypeUsed" attribute (about operator's V-ITS-S type) which is not used for exchanging dynamic data. It can be defined in the static data publication (DATEX II **<MeasurementSiteTablePublication>** class). The other optional classes linked to this class are not used.

10.1.2.2.3 THE DATEX II <BASIC DATA> CLASS

The abstract **<basicData>** class is realised using the concrete **<IndividualVehicleDataValues>** class. It is linked to the abstract **<groupOfLocations>** class that is realised using the **<Point>** (indeed using the **<PointByCoordinates>** class with the "bearing" attribute filled in with the heading of vehicle or trailer).

The instance of the **<IndividualVehicleDataValues>** class is linked to an instance of the **<SpeedValue>** class the speed » attribute is conventionally defined depending on whether it is static or not when its position is defined. The conventional values are defined as follows:

- "speed" is set to 0 if the V-ITS-S is in a static vehicle or trailer;
- "speed" is set to 10 if the V-ITS-S is in a moving vehicle or trailer;

```

<siteMeasurements>
  <measurementSiteReference id="UEVG-EC301" targetClass="MeasurementSiteRecord"
version="1"/>
  <measurementTimeDefault>2015-07-05T00:10:05.10+02:00</measurementTimeDefault>
  < measuredValue index="1">
    < measuredValue>
      <basicData xsi:type="IndividualVehicleDataValues">
        <pertinentLocation xsi:type="Point">
          <pointByCoordinates>
            <bearing>108</:bearing>
            <pointCoordinates>
              <latitude>48.98318</latitude>
              <longitude>2.49709</longitude>
            </pointCoordinates>
          </pointByCoordinates>
        </pertinentLocation>
        <individualVehicleSpeed>
          <speed>10</speed>
        </individualVehicleSpeed>
      </basicData>
    </measuredValue>
  </measuredValue>
</siteMeasurements>

```

10.2 V-ITS-S Sos Notification Publication

10.2.1 The use case description and the UML description

The created message is transmitted every time the corresponding SOS icon is tapped on the HMI notepad in road operator's vehicle and it is based on the GNSS-positioning of V-ITS-S. It is directly transmitted to the platform without using any R-ITS-S. Some actions can be defined by the road operator when receiving this message but they do not influence the content of the message.

The considered message is a specific event message using a DATEX II extension. Some commonalities can be seen with a DENM broadcast by any V-ITS-S. To do this a specific publication (**<SosNotificationPublication>**) has been created. It is a level B extension, which means the corresponding XML schema file can validate any message created using the normal plain DATEX II schema and this latter can validate any message created using this level B extended XML schema (without being able to decode the specific extension content).

The corresponding publication can be described using the following class diagram:

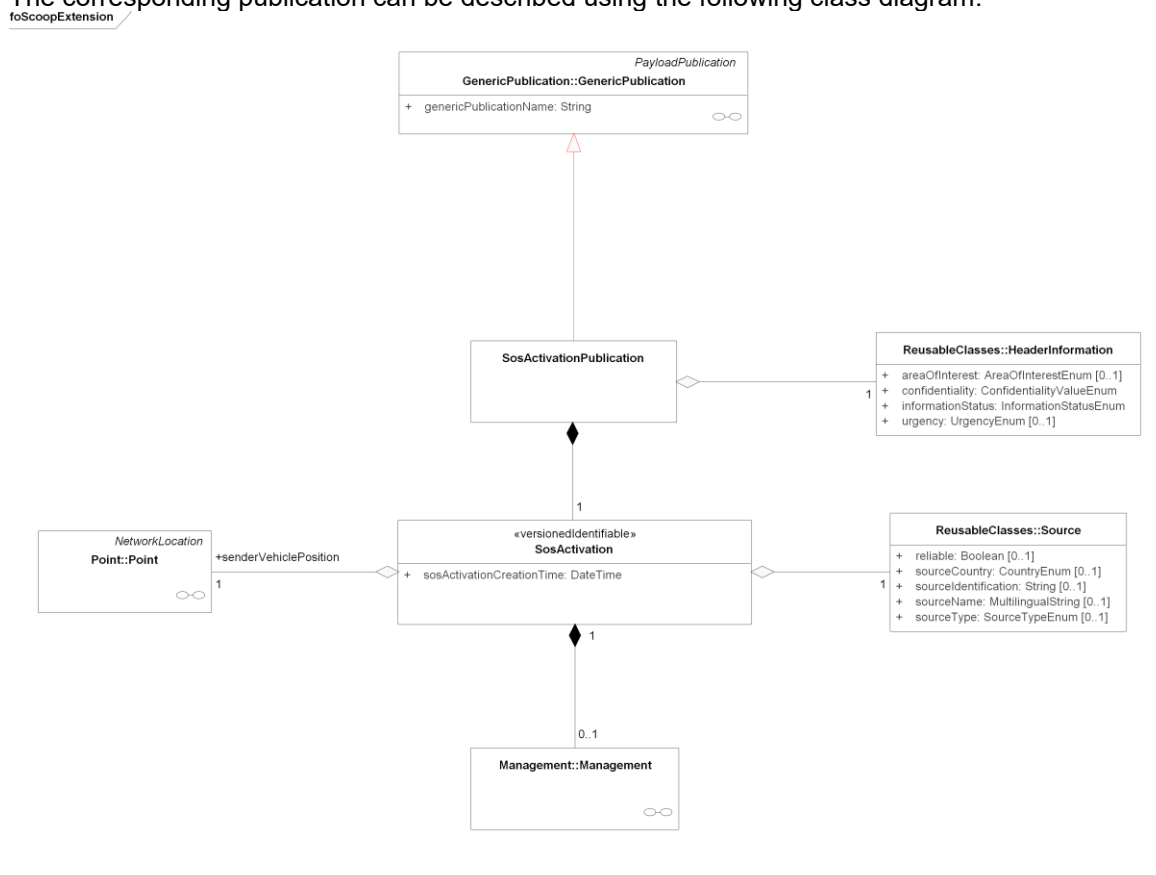


Figure 32 : The *SosActivationPublication* class diagram

This publication is derived of the DATEX II <GenericPublication> by inheritance. Such a publication only contains one <**SosActivation**> class defined internally.

NOTE: The DATEX II classes <Point>, <HeaderInformation> and <Source> are already defined for the TE01 to TE03 messages. However, their attributes are not filled in identically.

10.2.2 Construction of the message

10.2.2.1 Exchange parameters

10.2.2.1.1 CHOOSING THE DISTRIBUTION MODE

See chapter 5.2.1 Choosing the distribution mode (attribute value: “operatingMode1”).

10.2.2.1.2 NOTIFYING THE SOS ACTIVATION END

When the activation ends (through the SOS button) a new version of the corresponding publication is sent having the same classes instantiated and the attributes filled in. The only differences are:

- The version number is updated
- The DATEX II <LifeCycleManagement> class instance (in package Management) is updated with “end” = “True”.
- The location is the current vehicle position.

Thus the following XML content:


```

...
<sosActivation id="GUID3322530C-D452-4ae8-B942-993BC2923D13" version="2" >
  <sosActivationCreationTime>2015-07-05T00:00:00+02:00</sosActivationCreationTime>
  ...
  <management>
    <lifeCycleManagement>
      <end>true</end>
    </lifeCycleManagement>
  </management>
</sosActivation>
...

```

10.2.2.2 Message content

10.2.2.2.1 THE DATEX II <SOSNOTIFICATION> CLASS

This class is “identifiable”, which means a unique identifier is added to the class definition. As there is no DENM input in this case the generation process is different from the other situationPublication of this document :

- The identifier is created by a GUID creation process that guaranties its unicity. It is kept for new versions.

For defining the “sosActivationCreationTime” attribute see chapter 5.2.2.3.1.3 Time attributes.

NOTE: The definition of the “sosActivationCreationTime” is identical to the one of “situationRecordCreationTime”. However, as there is no DENM input the corresponding time stems from the V-ITS-S clock.

10.2.2.2.2 THE DATEX II <HEADERINFORMATION> CLASS

To fill in the attributes of this class see chapter 5.2.2.1 The DATEX II <HeaderInformation> class. However, the attribute “confidentiality” is filled in with the value “internalUse”.

10.2.2.2.3 THE DATEX II <SOURCE> CLASS

To fill in the attributes of this class see chapter 5.2.2.3.2.2 The DATEX II <Source> class. However, the attribute “sourceType” is filled in with the value “roadOperatorPatrol” whereas the attribute “reliable” is set to “True”.

NOTE : This definition is static and independent from any stationType definition.

10.2.2.2.4 THE POINT LOCATION DESCRIPTION

For details on this point location description, see chapter 3.4 Case of point-located event, without Traces.

In this case, the Point location will be realised using the DATEX II <PointByCoordinates> class. The “bearing” attribute is filled in with the heading of the vehicle where the SOS message is activated.

10.2.2.3 Example of produced message

An example of TE05 message content can be found below (payload part):

```

<payloadPublication xsi:type="GenericPublication" lang="fre">
  ...
  <genericPublicationName>SosActivationPublication</genericPublicationName>
  <genericPublicationExtension>

```

```

<sosActivationPublication>
  <headerInformation>
    <confidentiality>internalUse</confidentiality>
    <informationStatus>real</informationStatus>
  </headerInformation>
  <sosActivation id="GUID3322530C-D452-4ae8-B942-993BC2923D13">
    <sosActivationCreationTime>2015-07-05T00:00:00+02:00
</sosActivationCreationTime>
    <senderVehiclePosition>
      <pointByCoordinates>
        <bearing>210</bearing>
        <pointCoordinates>
          <latitude>50.12345</latitude>
          <longitude>1.23456</longitude>
        </pointCoordinates>
      </pointByCoordinates>
    </senderVehiclePosition>
    <source>
      <sourceIdentification>SCOOP_DIRIF_EC301</sourceIdentification>
      <sourceType>roadOperatorPatrol</sourceType>
      <reliable>true</reliable>
    </source>
  </sosActivation>
</sosActivationPublication>
</genericPublicationExtension>
</payloadPublication>

```

10.3 Setting the static V-ITS-S parameters

No static data exchange is planned for V-ITS-S in the wave 1, including identifiers. However, such information needs to be defined through static parameters, such that the mandatory publication attributes can be filled in.

The following table helps define these parameters:

DATEX II Parameters for V-ITS-S	Default values
nationalIdentifier	To be defined (e.g. <i>SCOOP_DIRIF_UEVG_EC301</i>)
measurementSiteTableReference	To be defined (e.g. <i>SCOOP_DIRIF_UEVG</i>)
measurementSiteReference	To be defined (e.g. <i>UEVG_EC301</i>)
sourceIdentification	To be defined (e.g. <i>SCOOP_DIRIF_EC301</i>)
Period	30 (in seconds)

Table 15: Setting the static V-ITS-S parameters

The naming rule for referencing the measurement is proposed as follows: “UEVG” + Inventory code (attributed by the road operator to the vehicle or the trailer where is installed V-ITS-S).

For example: “UEVG-EC301” (V-ITS-S installed in the EC301-coded vehicle).

The “nationalIdentifier” attribute is inferred from the previous one by adding the name of the project, for example “SCOOP”, and the road operator’s name (as here: DIRIF). The reference table identifier (implemented in the platform) is inferred from the previous one by removing the last element (here: “EC301”).

NOTE: it is advised to create separate publications for the measurement sites of R-ITS-S and V-ITS-S. Therefore, no confusion is possible between the data issued by CAM aggregation and the data issued by vehicle positions (V-ITS-S). In the future if road operator’s V-ITS-S are used as mobile R-ITS-S and aggregate CAM data they are identified as such including virtual loop location.

11 Appendices

11.1 Extract from the TISA guide proposing a correspondence between the DENM CauseCode and the DATEX II classes

Use case of the European Directive	DATEX		DENM		
	Class	Type	Cause code	Sub Cause Code	Text
Unprotected accident	GeneralObstruction	unprotectedAccidentArea	2	7	unsecured accident
Animal/People/Debris on the road	Environmental obstruction	avalanches	5	2	danger of avalanches
Animal/People/Debris on the road	Environmental obstruction	landslips	5	4	landslips
Animal/People/Debris on the road	Environmental obstruction	rockfalls	9	1	rockfalls
Animal/People/Debris on the road	GeneralObstruction	objectOnTheRoad	10	0	objects on the road
Animal/People/Debris on the road	GeneralObstruction	shedLoad	10	1	shed load
Animal/People/Debris on the road	Environmental obstruction	fallenTrees	10	5	fallen trees
Animal/People/Debris on the road	AnimalsPresenceObstruction	animalsOnTheRoad	11	0	animals on roadway
Animal/People/Debris on the road	AnimalsPresenceObstruction	herdOfAnimalsOnTheRoad	11	2	herd of animals
Animal/People/Debris on the road	AnimalsPresenceObstruction	largeAnimalsOnTheRoad	11	4	large animals
Animal/People/Debris on the road	GeneralObstruction	peopleOnRoadway	12	0	people on roadway
Animal/People/Debris on the road	GeneralObstruction	childrenOnRoadway	12	1	children on roadway
Animal/People/Debris on the road	GeneralObstruction	cyclistsOnRoadway	12	2	cyclists on roadway
Animal/People/Debris on the road	VehicleObstruction	brokenDownVehicle	13	0	broken down vehicles
Animal/People/Debris on the road	DisturbanceActivity	attackOnVehicle	20	3	stone throwing persons
Exceptional weather conditions	poorEnvironmentConditions	stormForceWinds	17	1	strong winds
Exceptional weather conditions	poorEnvironmentConditions	strongWinds	17	1	strong winds
Exceptional weather conditions	poorEnvironmentConditions	crosswinds	17	1	strong winds
Exceptional weather conditions	poorEnvironmentConditions	strongWinds	17	1	strong winds
Exceptional weather conditions	poorEnvironmentConditions	heavyRain	19	1	heavy rain
Exceptional weather conditions	poorEnvironmentConditions	heavySnowfall	19	2	heavy snowfall

2.4.1.4_H_SPECIFICATION OF DATEX II V2.3 MESSAGES IN CONJUNCTION WITH C-ITS MESSAGES

Use case of the European Directive	DATEX		DENM		
	Class	Type	Cause code	Sub Cause Code	Text
Wrong way driver	VehicleObstruction	vehicleOnWrongCarriageway	14	0 ⁴	vehicle on wrong carriageway
Road blocked	impact:trafficConstrictionType	roadBlocked	5	0	impassability
Slippery road	EnvironmentalObstruction	flooding	5	1	flooding
Slippery road	WeatherRelatedRoadConditions	slipperyRoad	6	0	slippery road
Slippery road	NonWeatherRelatedRoadConditions	petrolOnRoad	6	2	fuel on road
Slippery road	NonWeatherRelatedRoadConditions	mudOnRoad	6	3	mud on road
Slippery road	WeatherRelatedRoadConditions	Ice	6	5	ice on road
Slippery road	WeatherRelatedRoadConditions	icyPatches	6	5	ice on road
Slippery road	WeatherRelatedRoadConditions	blackIce	6	6	black ice on road
Slippery road	NonWeatherRelatedRoadConditions	oilOnRoad	6	7	oil on road
Slippery road	NonWeatherRelatedRoadConditions	looseChippings	6	8	loose chippings
Slippery road	WeatherRelatedRoadCondition	surfaceWater	7	0	aquaplaning
Slippery road	WeatherRelatedRoadConditions	snowDrifts	9	5	snow drifts
Roadworks	MaintenanceWorks	maintanceWork	3	0	Roadworks
Roadworks	MaintenanceWorks	RoadMarkingWork	3	2	road marking work
Roadworks	GeneralObstruction	rescueAndRecoveryWork	15	0	rescue and recovery work in progress
Roadworks	VehicleObstruction	SlowMovingMaintenanceVehicle	26	1	slow moving maintenance vehicle
Low visibility	poorEnvironmentConditions	visibilityReduced	18	0	visibility reduced
Low visibility	poorEnvironmentConditions	denseFog ⁵	18	1	visibility reduced due to fog
Low visibility	poorEnvironmentConditions	patchyFog	18	1	visibility reduced due to fog
Low visibility	poorEnvironmentConditions	smokeHazard	18	2	visibility reduced due to smoke
Low visibility	poorEnvironmentConditions	heavySnowfall	18	3	visibility reduced due to heavy snowfall
Low visibility	poorEnvironmentConditions	lowSunGlare	18	6	visibility reduced due to low sun glare

Table 16 : Correspondence DATEX II attributes and cause codes used by DENMs

⁴ There is a difference between the french deliverable 2.4.1.2.H_WrongWayDriving (14/2) and this TISA document (14/0).

⁵ Editor's note: there is a difference between TISA's correspondence table and the DATEX II France group. Taking into account national practices this latter does not make difference between "fog" and "denseFog" and therefore recommends using "fog" in TMS.

11.2 Available location descriptions in DATEX II

This chapter presents the descriptions of the location available in the TS 16157.

DATEX II can use the aggregations of locations in the form of non-ordered groups (DATEX II `<NonOrderedLocations>` class) or itineraries (DATEX II `<Itinerary>` class).

Considering the possibilities offered by this technical specification, it should be noted that DATEX II considers each basic topological object (point - dimension 0, linear - dimension 1 and zone - dimension 2) as a container of a group of values. This means, for example, that a point type object representing a specific point in space can be represented by means of one or more location systems (e.g. with an ALERT-C location and a TPEG-LOC location).

11.2.1 Point location

11.2.1.1 A point location in coordinates

This point is represented by:

- its longitude and latitude coordinates (only mandatory information)
- the “bearing” attribute: bearing in relation to geographic North in degrees, indicating the traffic direction of the lane on which the point is.

11.2.1.2 A point location defined linearly

The linear is the location using reference markers (also named “PR” or “PLO” in French⁶) commonly used by operators on a defined road. They are named “Referent” in DATEX II. The following elements must be specified:

- the section of road or slip road, described via an ordered series of `<Referent>` objects (e.g., the marker (PR) or a representation of the road's geometric axis),
- a road number (`<roadNumber>`) type identifier in the usual sense or a road name (or street name, especially in urban settings; `<roadName>`), corresponding to the section of road or slip road
- identifier of the marker (which must be unique for the road considered), information contained in the `<referentIdentifier>` attribute of the `<Referent>` class
- the relative abscissa (in metres) in relation to the PR considered, information contained in the `<distanceAlong>` attribute in the `<DistanceFromLinearElementReferent>` class
- the `<directionRelativeAtPoint>` attribute, which is used to specify whether the direction of traffic in question is the same as that defined by the order of the markers used (“aligned”) or opposed (“opposite”). There are also the “both” and “unknown” values.
- the general direction of the road: `<directionBoundAtPoint>` (values of geographical directions: N, NE, E, SE, S, SW, W, NW plus “bothWays” and “opposite”). This is the general destination of the traffic direction on the lane on which the event is located.

11.2.1.3 A point identified in ALERT-C

This description is related to the frame of reference for ALERT-C locations (approximately 100,000 km of road covered in France for the last version of the table). This method, used initially by the RDS/TMC road information services, is subject to European and international standards.

11.2.1.4 A point identified in TPEG-LOC

⁶ Note: PR means “point of reference”, it is also sometimes called kilometre-post (KP) even if in reality the distance between two points is not always equal to 1,000 metres

This description uses the TPEG-LOC method (point defined in geographic coordinates, including the name of the road concerned) such as it is implemented in the DATEX II model.

11.2.2 Linear location

DATEX II can be used to describe linear locations using two points, by means of the following methods:

- linear method: defined from a “fromPoint” and to a “toPoint”, to which one adds information, including the name of the road. See chapter “11.2.1. Point location”, for the basic definition of each point.
- ALERT-C method: defined by two ALERT-C points (which define an implicit direction) + one direction confirming or modifying the implicit direction (DATEX II classes **<AlertCMethod2Linear>** or **<AlertCMethod4Linear>**).
- TPEG-LOC method: defined by two points (“segment”) defined by the TPEG-LOC location method associated with a geographic or relative traffic direction (DATEX II class **<TpegLinearLoc>**).

It should be noted that the ALERT-C location system is the only one that includes natively linear type locations, which can be used directly to localise operating events or actions. Nevertheless, the precision is not as high as in the three methods above, using two points.

11.2.3 Area location

DATEX II can be used to describe areas using the following methods:

- ALERT-C area (DATEX II **<AlertCArea>** class, which contains the reference to a predefined area in the table of ALERT-C locations (a few towns, former districts, regions, etc.): approximately 3,000 area locations));
- TPEG-LOC area (in addition to the type – “tpgAreaLocationType” attribute, or by an area defined by its name and its type – DATEX II **<TpegNamedOnlyArea>** class, or geometrically by a circle (**<TpegGeometricArea>** class: a point defining the centre and the radius)

11.2.4 Transverse positioning

Moreover, DATEX II can be used to define additional elements to the preceding elements. It is possible to add:

- textual descriptive information (e.g., “in the curve”, “on the exit ramp”); and
- transverse positioning information (carriageways and lanes):
 - the carriageway concerned (corresponding to the attribute value “mainCarriageway”) or the opposite carriageway (value “oppositeCarriageway”), etc.)
 - its position on the lane, for the considered carriageway (“hard shoulder” = the lane for emergency stopping out of the road, “lane 1” = first lane numbered from nearest the hard shoulder to central reservation (i.e. in France from the right), “lane 3” = third lane from the hard shoulder; “middleLane” for the lane in the middle of the road in case of a single carriageway road, etc.)

The **<SupplementaryPositionalDescription>** and **<AffectedCarriagewayAndLanes>** classes are used for this purpose.