



Specification of DATEX II v2.3 messages in conjunction with CAMs and DENMs in SCOOP

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Responsible, Entity: Émilie PETIT and Loïc BLAIVE, CEREMA Ile de France

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As illustration :

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0.10 > Del. Approved by SC Studies but not released

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1 Introduction

1.1 Purpose of the document

This document looks at the possibility of using DATEX II or not for each use case.

The referenced documents are:

- [1] DATEX II Documentation (on the site www.datex2.eu)
- [2] Safety related message sets - Selection of DATEX II Codes, TPEG2-TEC-Causes and TMC-Events for EC high level Categories
- [3] 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

1.2 DATEX II principle

(extracts from the guide [3] 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 have to be added (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>
    <situation>[parameters describing situation 2: type,
      location, direction ... E.g.:X vehicles in Y minutes]
    </situation>
    [n situations described one-by-one]
  </payloadPublication>
</d2LogicalModel>
```

The other DATEX II publications fit overall into the same scheme. It should be noted that the different types of publication cannot 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”).

Operating mode 3 is used for resynchronisation requests.

1.3 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 (version 1.3.2)
- DENM refers to the standard EN 302 637-3 (version 1.2.2)

The nomenclature for DATEX II messages is as follows:

- TE: Traffic element: this concerns an event on the network (e.g., D use cases)
- OA: Operator Action: this concerns an action initiated by the operator (e.g., B use cases)

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 “upload” case from Roadside Unit (RSU) to platform, the RSU is a sender, the platform can be a recipient and then a sender and the TICS is a recipient. The RSU is the message creator and the platform performs the exchange.

In this document, two terms appear that should 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 information and control system” (TICS) 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 TICS 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. This namespace can be explicitly defined in the <d2LogicalModel> tag using the XML parameter named “xmlns”. For this reason, as well as 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.

For example:

- Complete tag name with namespace: <D2LogicalModel:payloadPublication>
- 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 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 SCOOP project, several attributes or classes of a DATEX II message that could be completed by a TICS are not presented because, in general, there is no equivalent in DENM. However, it should be noted that the operator can send messages to several recipients at the same time. Some attributes or classes of the DATEX II message, not recommended in this SCOOP document, could therefore be entered by the operator.

1.4 Summary of SCOOP use-cases

Name	Covered in this doc
A - Data collection	
A1: traffic data (position, speed, direction)	Chapter 3
A2 and A3: event data produced by the vehicle	Chapter 4
A4: vehicles' consumption data	NOT SPECIFIED
B: Warning - roadwork	
B1: warning - scheduled roadwork (stationary and mobile)	Chapter 5
B2: Warning - work on lanes	Chapter 5
B3: warning - priority winter road maintenance vehicles	Chapter 5
C - On-board signalling - driving information	
C1: Stationary signalling	NOT SPECIFIED
C2: real-time speed signalling	NOT SPECIFIED
C3: On-board VMS	NOT SPECIFIED
D - On-board signalling - unexpected and dangerous events	
D1: warning - temporarily slippery road	Chapter 4
D2: Warning - animal or person on the road	Chapter 4
D3: Warning - obstacle on the road	Chapter 4
D4: warning - stationary vehicles, breakdown	Chapter 4
D5: warning - unprotected accident area	Chapter 4
D6: Warning - low visibility	Chapter 4
D7: warning - wrong way drivers	NOT SPECIFIED - Chapter 4
D8: Warning - unmanaged blockage of a road	Chapter 4
D10: warning - emergency braking	Chapter 4
D11: warning - end of queue	Chapter 4
E - Information on road traffic	
E1: traffic colour	NOT SPECIFIED
E2: Transit time	NOT SPECIFIED
E3: Recommended itinerary – rerouting related to traffic conditions	NOT SPECIFIED
E4: information on access to amenities	NOT SPECIFIED
E5: information on access to services	NOT SPECIFIED
E6 (formerly D9): Warning - exceptional weather conditions	Chapter 4
F - Relay fleets and multimodality	
F1: location and availability of relay parking sites - static information	NOT SPECIFIED
F2: Location and availability of relay parking sites - real-time information	NOT SPECIFIED
F3: timetable of next TC departures (fixed)	NOT SPECIFIED
F4: timetable of next TC departures (real-time)	NOT SPECIFIED

Table 1: SCOOP use cases

This document only addresses the use cases specified by SCOOP wave 1. But, where it seems useful, additions have been made for the use cases that could be useful for SCOOP wave 2 (this is specified in the document, where applicable).

1.5 Summary of DATEX II messages

There are five types of messages exchanged between the different SCOOP elements:

	Name	Details
TE01	A1: traffic data (position, speed, direction)	Chapter 3
OA01	B1: warning - scheduled roadwork (stationary and mobile)	Chapter 5
OA01	B2: Warning - work on lanes	Chapter 5
OA01	B3: warning - priority winter road maintenance vehicles	Chapter 5
TE02	A2 and A3: event data produced by the vehicle	Chapter 4
TE03	D1: warning - temporarily slippery road	Chapter 4
TE03	D2: Warning - animal or person on the road	Chapter 4
TE03	D3: Warning - obstacle on the road	Chapter 4
TE03	D4: warning - stationary vehicles, breakdown	Chapter 4
TE03	D5: warning - unprotected accident area	Chapter 4
TE03	D6: Warning - low visibility	Chapter 4
TE03	D8: Warning - unmanaged blockage of a road	Chapter 4
TE03	D10: warning - emergency braking	Chapter 4
TE03	D11: warning - end of queue	Chapter 4
TE03	E6 (formerly D9): Warning - exceptional weather conditions	Chapter 4
TE04	Traffic data issued by road operators' vehicles	Chapter 6
TE05	SOS activation notification on road operator's vehicles	Chapter 6
PA01	Configuration of the RSU	
PA02	Configuration of measurement points in the RSU	Chapter 3

Table 2: DATEX II message codes

2 Construction of any DATEX II message

This paragraph details the construction of each part of a DATEX II message according to the SCOOP 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 2.2]
...
[MESSAGE CONTENT see 2.3 ]
...
</d2LogicalModel>
```

NOTE 1: The prologue "<?xml version='1.0' coding='UTF-8'?>" is used only once, at the first file line. When used with the SOAP protocol, it's 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>SCOOP_ENTITE_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 paragraph "2.2. Definition of a publication envelop" in the situations guide [3].

The red parameters depend on the use case and are therefore addressed in the chapters hereafter.

For the **<protocol>** attribute, the protocol used is clarified in the detailed platform specifications, per use case.

For the **<nationalIdentifier>**, the following limitation is specified in the guide [3]: "no accents, no spaces, only ASCII characters, and only CAPITAL letters and digits."

In the context of the SCOOP project, the following convention is proposed: PROJECT_ENTITY_SOURCE where the parts are filled in as follows:

- PROJECT = SCOOP for the SCOOP project (Maybe CROADS or INTERCOR in the future.)
- 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...) for an RSU, PF for a platform, SAGT or TGBretagne or name of the TICS for a TICS ...

Example: `SCOOP_DIRIF_UBR12345`

NOTE: The guide [3] 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 (DGITM/GRT3). This convention may change in the future. In consequence, the entire <nationalIdentifier> must be configurable.

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

The **<response>** attribute indicates that this message is a response to another 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.

All version numbers begin at 1 according to the guide issued by the DGITM/GRT3 service of the Ministry of Sustainable Development.

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>
  <headerInformation>
    <confidentiality>noRestriction</confidentiality>
    <informationStatus>real</informationStatus>
  </headerInformation>
  [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. But in the case, for example, of a message created by an RSU and transmitted by the platform, the creator remains the RSU and the supplier the platform. Thus, there are also differences of date.*

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

In the case of a "cancellation" DENM, the **<Management>** class must specify that it is an end message.

The content of the situation must be described as described in the chapters below. The "cancel" and "end" attributes of the **<lifeCycleManagement>** class are used to know whether the situation has ended or been cancelled or neither.

Table 3: Example of information calculated based on CAMs

3.2 Construction of the DATEX II message PA02 Configuration of measurement points in the RSU

The platform and the RSU must know the description of the zones and the measurement classes. Consequently, this assumes that there is an exchange message between the TICS, the platform and the RSUs concerning the definition of these zones and classes. Here are some paths to explore, if these measurement points must be configured in DATEX II (see SCOOP deliverable “platform specifications”).

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

- The geometric definition of a Zone in DATEX II is detailed in the “Location” paragraph: 6.5.1 Case of CAM aggregations. This 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 [3] 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="RSU12345-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.

3.3 Construction of the DATEX II message TE01 Reporting traffic data

3.3.1 Exchange parameters

3.3.1.1 Choosing the distribution mode

The OM2 mode, called "Push at a regular interval," is recommended for this use case. The RSU 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>
...
```

3.3.1.2 Data reporting period

In "OM2" mode, the reporting period must be configured for each RSU. Its value is in seconds.

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

3.3.2 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, this signifies that a DATEX II message between an RSU 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 table 3)

3.3.2.1 <measurementSiteTableReference> class

The identifier is used to identify the transmitting RSU or RSUs. The value proposed for the identifier is:

- SCOOP_ENTITE_UBRxx for the RSU number xx
- SCOOP_ENTITE_TOUTESUBR if the message concerns all the RSUs (e.g., between the platform and the traffic management system).

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

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

3.3.2.2 DATEX II <siteMeasurements> Class

First of all, the class type used has to be specified. For this type of information, the guide [3] 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 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: UBRxx_ZoneX_ClasseY

For example: « UBR12345-Zone01-Classe02»

NOTE: there is another option to identify a class: The solution described above is the preferred solution to identify a class, for "TE01" type 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 "PA02" message.

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.

3.3.2.2.1 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>
```

3.3.2.2.2 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 Part 2.

3.3.2.2.3 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>
```

3.3.2.2.4 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.

3.3.3 Example of a DATEX II message from an RSU to the platform.

For example, if the RSU, named RSU12345, 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 RSU12345

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.

3.3.4 Example of DATEX II message from the platform to TICS

There are two possibilities for this message:

1. the platform sends as many messages to the TICS as messages received from the RSU (The platform modifies the exchange parameters, but it keeps the content unchanged):
 - this solution does not optimise the traffic between the platform and the TICS; and
 - the platform has a very reduced role.
2. the platform aggregates the data from the RSU 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 TICS, solution 2 is recommended.

In the "download" direction, the TICS sends the information to the platform, which sends it to the RSU. The RSU stores the information and sends DENMs based on the parameters received.

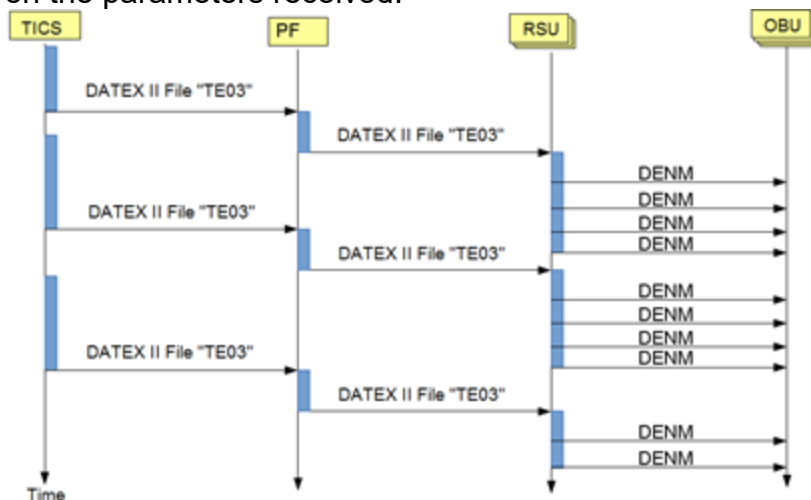


Figure 3: Information download from the platform

From the point of view of DATEX II, all the following use cases are treated in the same manner in terms of content format (**<payload>** class and class attributes).

- D1: temporarily slippery road and A2-D1: temporarily slippery road
- D2a: Animal on the road and A3-D2a: animal on the road
- D2b: People on the road and A3-D2b: people on the road People on the road
- D3: Obstacle on the road and A3-D3: Obstacle on the road
- D4a: Warning - stationary vehicle and A2-D4a: stationary vehicle
- D4b: Warning - vehicle breakdown and A2-D4b: vehicle breakdown
- D5: Unprotected accident area and A2-D5: Unprotected accident area and A3-D5: Unprotected accident area
- D6: Warning - reduced visibility and A2-D6: Warning - reduced visibility
- D7: Wrong way vehicle and A2-D7: Wrong way vehicle (SCOOP Part 2)
- D8: Unmanaged blockage of a road and A3-D8: unmanaged blockage of a road
- E6: Warning - exceptional weather conditions

The recommendations of this document are based, in part, on 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. And consequently the version of the DENM standard adopted in SCOOP presents variances from this document. This will be specified below, where applicable.

4.2 Construction of TE02 upload messages of event data and TE03 download messages of event data

4.2.1 Exchange parameters

4.2.1.1 Choosing the distribution mode

The "Push on occurrence" mode is recommended 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 (RSU=>PF for the TE02s, PF=>RSU for the TE03s). The publication receives a unique situation: it concerns the "case-by-case" publication.

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

4.2.1.2 The DATEX II <Validity> class

If the end date is not filled in by TICS (e.g., case of a TE03 (download messages)), 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 (e.g., TE02 cases (uploads)), 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 SCOOP project and in all use cases, the **<overallStartTime>** and **<overallEndTime>** must be filled in. These two attributes will be used to construct the **<validityDuration>** data element of the DENM.

For messages coming from TICS 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.

NOTE: DATEX II can be used to describe a validity in a more complex way using the DATEX II <Period> class (connected to <validPeriod>). This ability was not retained for these cases in SCOOP@F part I. For example: "message valid every Monday and Tuesday, from midnight to 8:00 am".

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

A message in DATEX II (for the publication) contains at least one situation (= one event), but 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 of times and dates of a situation.

4.2.2.1 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.

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

4.2.2.2 The DATEX II <Situation> class

For the SCOOP project a situation publication only contains one situation that is “versionIdentifiable”. The creation rules for identifier and version are the following:

- In case of download (use cases Dx): the identifier and version are defined by the platform depending on what is sent by TICS;
- In case of upload (use cases A2Dx and A3Dx): the identifier is created by concatenating:
 - The “actionID” DENM attribute;
 - The RSU “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 incremented (starting from 1) and is updated for each new DENM version based on the “referenceTime” DENM attribute.

NOTE: the chapter 0 details the exact structure of the identifier.

4.2.2.3 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. In SCOOP, it has been decided that a situation, for cases A and D, shall only contain a single situation record (it is told of “mono-record situation”).

NOTE: this will not be the case for the roadwork situations (see Roadwork cases).

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

- Comment
- Impact
- Source
- Validity (Mandatory)
- UriLink
- Cause
- GroupOfLocations") (see above); (Mandatory)

4.2.2.3.1 THE <SITUATIONRECORD> CLASS ATTRIBUTES

The class identifier

The class identifier is mandatory (“versionedIdentifiable”):

- In case of download (use cases D); the identifier is defined by platform from what is provided by the traffic information and control system;
- In case of upload (use cases A2Dx and A3Dx): the identifier is equal to the value of the “situationRecordCreationReference” (see below).

The “situationRecordCreationReference” attribute

In SCOOP, 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 [3].

Particularity for the download 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).

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

The RSU 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 upload 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 RSU constructs the DATEX II **<situationRecordCreationReference>** attribute by concatenating the following information (all the elements in hexadecimal format – see above):

- “actionID” attribute of the DENM (keeping the “stationID” of generating OBU makes possible for the platform to verify if the same DENM is uploaded from two different RSUs)¹
- followed by the “stationID” of the RSU
- followed by a sequence number in each situation starting from 1² (this last point in order to make the identifier unique³)

Time attributes

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:
<situationRecordFirstSupplierVersionTime>.

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

¹ Note 1: This implies that the <situationRecordCreationReference> can be different from the “stationID” in the “actionID” (Forward by vehicles before the treatment by RSU).

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.

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	RSU=>PF message	TICS=>PF and PF=>RSU message
PayloadPublication::publicationTime	Y	Message creation time by the RSU	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 RSU.	Fill in (because mandatory) but not used by the RSU except in case "situationRecordObservationTime" is void..
SituationRecord::situationRecordFirstSupplier-VersionTime	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 RSU.
SituationRecord::situationRecordObservation-Time	N	Time contained in the "detectionTime" data element of DENM where the current version of the situation record came from.	Time used by the RSU to construct the "detectionTime" data element of DENM. If this attribute is not present "detectionTime" is filled in using the other "SituationRecordCreationTime" attribute.
SituationRecord::situationRecordVersionTime	Y	This is the time of the current version of the situation record via the current relay (for an RSU, it is the same piece of data as that contained in <situationRecordFirstSupplierVersionTime>)	Time used to fill in the DENM "referenceTime" data element.

Table 5: Dates and times of a situation

NOTE: there are two possible formats: 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").

“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 SCOOP, a DENM can be transmitted with 3 quality levels (“InformationQuality” attribute of a DENM). The correspondence is presented in table 6:

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

Table 6: Correspondence between “SCOOP Level of Quality” and “probabilityOfOccurrence”

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 SCOOP Level of Quality used here.

The other attributes

<confidentialityOverride> and <severity> are not retained in the context of the SCOOP project. They are not mandatory in DATEX II and do not have an equivalent in DENM.

4.2.2.3.2 THE CLASSES LINKED TO THE <SITUATIONRECORD> CLASS

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, it is strongly recommended to create two situation elements, one per direction. 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 SCOOP 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. Note: according to the capacities of the OBU, the DENM could be more complete. The RSU 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).
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 7: Attributes for UC “D8” & “A3-D8”

*NOTE: For SCOOP part I, 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”).*

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 concerning the version in question of the “sourceName” / 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 must be kept).
- “sourceIdentification”: Coded information of the organisation or active equipment that produced the information concerning the version in question

of the “sourceIdentification”. Example: number of the OBU (in the case where the publication is relayed, the identification of the source of the original publication must be kept). For example, “sourceIdentification” could keep the “stationID” data element of the DENM which corresponds to the “transmitterID”.

Particularity for messages created by TICS or PF

Since there is no equivalent in a DENM, the RSU 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.

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.

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 [3] WG guide.

4.2.2.3.3 THE CLASSES INHERITED FROM THE <SITUATIONRECORD> CLASS: <ACCIDENT>, <GENERALOBSTRUCTION>, ETC.

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 SCOOP project between the DATEX II messages and the DENMs. This table describes:

- the messages sent by the RSU to the PF
- the messages sent by the PF to the RSU

- the messages sent by the PF to the TICS

Concerning the messages sent by the TICS to the PF, it is recommended to use this table. However, TICS 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 SCOOP 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 France” column indicates whether the correspondence proposed for the case is present in the guide [3].

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 message signalling “black ice” in DATEX, implies that the road is slippery).

SCOOP Name	CC / subC		TISA	DATEX 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 = UnprotectedAccident Area	This attribute value is not recommended by the DATEX 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 = accidentInvolvingHazardous Materials	
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 = UnprotectedAccident Area	This attribute value is not recommended by the DATEX 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	
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 = roadBlocked	The trafficConstrictionType = roadBlocked attribute should be specified. See 4.2.2.2.1 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 4.2.2.2.1 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 4.2.2.2.1 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 4.2.2.2.1 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 4.2.2.2.2.1 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".
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 RSU 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 RSU direction. Today there is no exact correspondence in DATEX nor in TPEG. The DENM 11/3 will not be sent by an RSU but the RSU 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 (see 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 [3].
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 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 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 dangerousSlowMovingVehic le	= Note, there is no exact correspondence in DATEX. The DATEX value signifies "slow moving vehicles", while the DENM value signifies "Brake lights on."
D7: Wrong way vehicle			yes		VehicleObstruction	vehicleObstructionType vehicleOnWrongCarriagewa y	= SCOOP Part 2. We can add the vehicle's characteristics.

Table 8: correspondence between the DATEX II messages and the DENM
messages

4.2.2.3.4 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.

4.2.2.3.5 SPECIAL CASES FOR ACCIDENTS

The **<Accident>** class can be linked to the **<Vehicle>** class, which makes it possible to send information about the vehicles involved.

The common attributes with a DENM include:

- Vehicle::vehicleCharacteristics::loadType can be used to specify the type of goods carried (especially related to the data element "CarryingDangerousGoods")
- Vehicle::vehicleIdentifier (related to the data element "VehicleIdentification")

It should be noted that the length of the two fields is not the same. In the download direction, the RSU truncates the DATEX II attribute to fill in the DENM. In the upload direction, it inserts the 9 characters of the DENM in the DATEX II attribute without complying with the semantic rule. Since there are no model-related constraints, the platform will not reject the information. TICSSs have to verify that they accept this "altered form".

- Vehicle::vehicleManufacturer (related to the data element "VehicleIdentification")
- Vehicle::vehicleCharacteristics :: fuelType (related to the data element "EnergyStorageType")

4.2.2.3.6 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 download direction, the message must include the precise queue length. In order to construct the DENM "EventPosition" attribute for this use case, the RSU will use the secondary point of the DATEX II message (i.e., "LinearWithinLinearElement::fromPoint" or "AlertCMethod4SecondaryPointLocation"). The "queueLength" attribute should be ignored because it does not represent the real position of the end of queue.

5 SCOOP use case B: Warning - roadwork

5.1 Description of the SCOOP use cases

5.1.1 General exchanges

This use case includes several exchanges involving DATEX II messages:

1. The roadwork information (start or end) is scheduled by the operator and then broadcast to users.

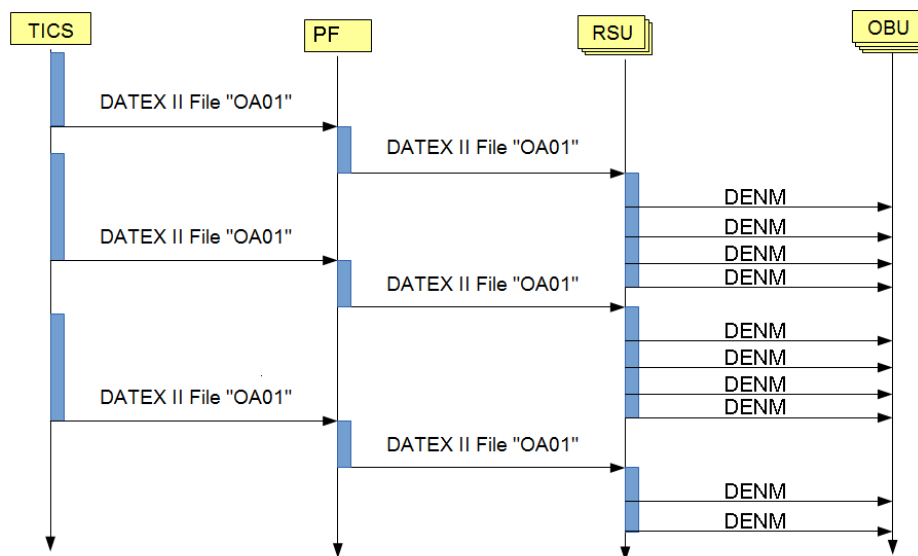


Figure 4: case of scheduled road works

2. The operator vehicle broadcasts its position to indicate the roadwork (in the case where this roadwork has not been signalled yet):

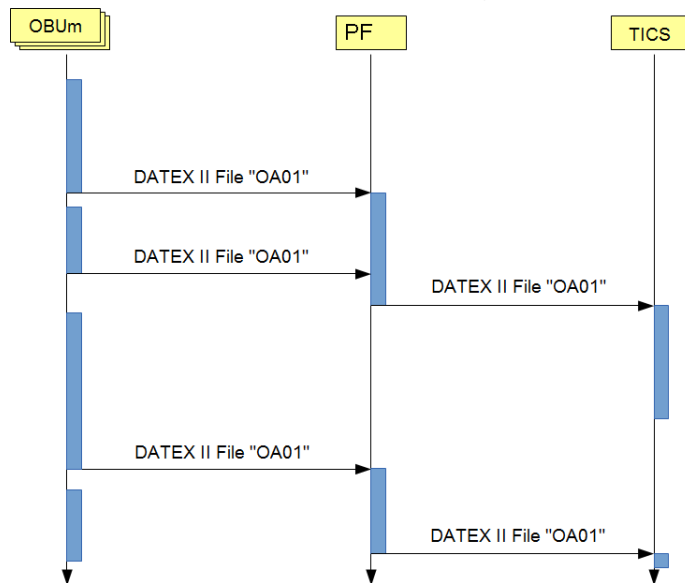


Figure 5: case of not scheduled road works

3. The operator vehicle broadcasts its position to specify the information (especially the position or the end) on the roadwork already sent to users in case 1 (same diagram as in case 2)

5.2 Construction of the message in DATEX II: declaration of roadwork

This message is very close to the publication of TE03 situations. The paragraphs, which have not changed, are not explained here, but a reference is inserted to the corresponding paragraph in chapter 4.

5.2.1 Exchange parameters

5.2.1.1 Choosing the distribution mode

The "Push on occurrence" OM1 mode is recommended for this use case.
See 4.2.1.1 Choosing the distribution mode

5.2.1.2 The DATEX II <Validity> class

The end date can be known (e.g., roadwork from TICS) or unknown (e.g., case of messages from an operator OBU).

See 0

The DATEX II <Validity> class

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

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 are recommended in SCOOP:

- 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.

The DATEX II <SituationPublication> class, describing a roadwork warning in SCOOP, will therefore contain several classes of one or the other type, which will each describe an aspect of the warning.

5.2.2.1 The attributes

5.2.2.1.1 THE <SITUATIONRECORD> CLASS ATTRIBUTES

The “situationRecordCreationReference” attribute

See 0 The “situationRecordCreationReference” attribute

Time attributes

See Table 5: Dates and times of a situation

“probabilityOfOccurence” attribute

See 0

“probabilityOfOccurrence” attribute

5.2.2.1.2 THE <OPERATORACTION> CLASS ATTRIBUTES

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 SCOOP 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).

5.2.2.2 The classes linked to the <SituationRecord> class

5.2.2.2.1 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.

See 0 The DATEX II <Impact> class.

Concerning divided roads, it is recommended to create two situation elements, one per direction. The two attributes, “capacityRemaining” and “originalNumberOfLanes”, are to be used as recommended. 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”.

5.2.2.2.2 THE DATEX II <SOURCE> CLASS

Since there is no equivalent in a DENM, the RSU will not use its content in preparing the messages.

See 0 The DATEX II <Source> class

5.2.2.2.3 THE DATEX II <COMMENT> CLASS

Since there is no equivalent in a DENM, the RSU will not use its content in preparing the messages.

See 0 The DATEX II <Comment> class.

5.2.2.3the <RoadWorks> class

5.2.2.3.1 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 RSU will not use these two attributes in preparing the messages.

5.2.2.3.2 THE CLASSES LINKED TO THE <ROADWORKS> CLASS

The DATEX II <Mobility> class

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

- “mobilityType” can be “stationary”, “mobile” or “unknown”.

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.

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.

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 RSU will not use its content in

preparing the messages.

5.2.2.3.3 THE INHERITED CLASSES OF THE <ROADWORKS> CLASS

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

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 RSU will not use its content in preparing the messages.

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.

5.2.2.4The <NetworkManagement> class

5.2.2.4.1 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.

In case of uploaded messages from DENM that do not include the “closedLanes” or “restriction” attributes, the RSU 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”. In case of downloaded messages, the platform will fill in the attribute depending on what is sent by TICS.

5.2.2.4.2 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”

5.2.2.4.3 THE INHERITED CLASSES OF THE <NETWORKMANAGEMENT> CLASS

In the SCOOP project, the <NetworkManagement> class can be instantiated by one of the following classes:

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.

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.

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.

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.

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.

5.2.2.5 Correspondence between DENM and the DATEX II <Roadworks> class

Name	CC/ SCC	MaintenanceWorks RoadMaintenanceType =	Mobilit yType =	MaintenanceVehicl eActions =
B1 Roadwork Warning - planned roadwork - stationary	3/0	roadworks	stationary	<i>Absent</i>
B1 Roadwork Warning - planned roadwork - mobile	3/3	roadworks	mobile	<i>Absent</i>
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	maintenanceVehicle sMergingIntoTraffic Flow
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

Some other values may be transmitted by TICS in case of downloaded 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.

6 The TE04 and TE05 messages

6.1 Description of the SCOOP use case “Transmission of road operators’ vehicle position”

The corresponding message is created by OBU of the road operator based on the position determined by GNSS receiver. It is sent directly to the platform without using any RSU.

The message allows for static or mobile OBU 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 RSU-generated message by CAM aggregation (from end-user vehicles). However, it has some specificities that are detailed below.

6.2 Construction of the TE04 message

6.2.1 Exchange parameters

6.2.1.1 Choosing the distribution mode

Cf. paragraph **Erreur ! Source du renvoi introuvable.** “**Erreur ! Source du renvoi introuvable.**”.

6.2.1.2 Data reporting period

The paragraph 3.3.1.2 “Data reporting period” defines this parameter. To accommodate different needs and situations this parameter is defined in OBU according to Table 9.

6.2.2 Message content

6.2.2.1 The DATEX II <MeasuredDataPublication> class

Besides the attributes defined in chapter **Erreur ! Source du renvoi introuvable.** “**Erreur ! Source du renvoi introuvable.**” 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 OBU (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 OBU positions.

6.2.2.2 The DATEX II <SiteMeasurements> class

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

```
...  
<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 geopositions. They are distinguished through their timestamp.

The <MeasuredValue> class includes an optional "measurementEquipmentTypeUsed" attribute (about operator's OBU 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.

6.2.2.3 The DATEX II <BasicData> 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 OBU is in a static vehicle or trailer;
- "speed" is set to 10 if the OBU 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</D2LogicalModel:bearing>
            <pointCoordinates>
              <latitude>48.98318</latitude>
              <longitude>2.49709</longitude>
            </pointCoordinates>
          </pointByCoordinates>
        </pertinentLocation>
        <individualVehicleSpeed>
          <speed>10</speed>
        </individualVehicleSpeed>
      </basicData>
    </measuredValue>
  </measuredValue>
</siteMeasurements>
```

6.3 Construction of the TE05 messages

6.3.1 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 OBU. It is directly transmitted to the platform without using any RSU. 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 OBU. 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:

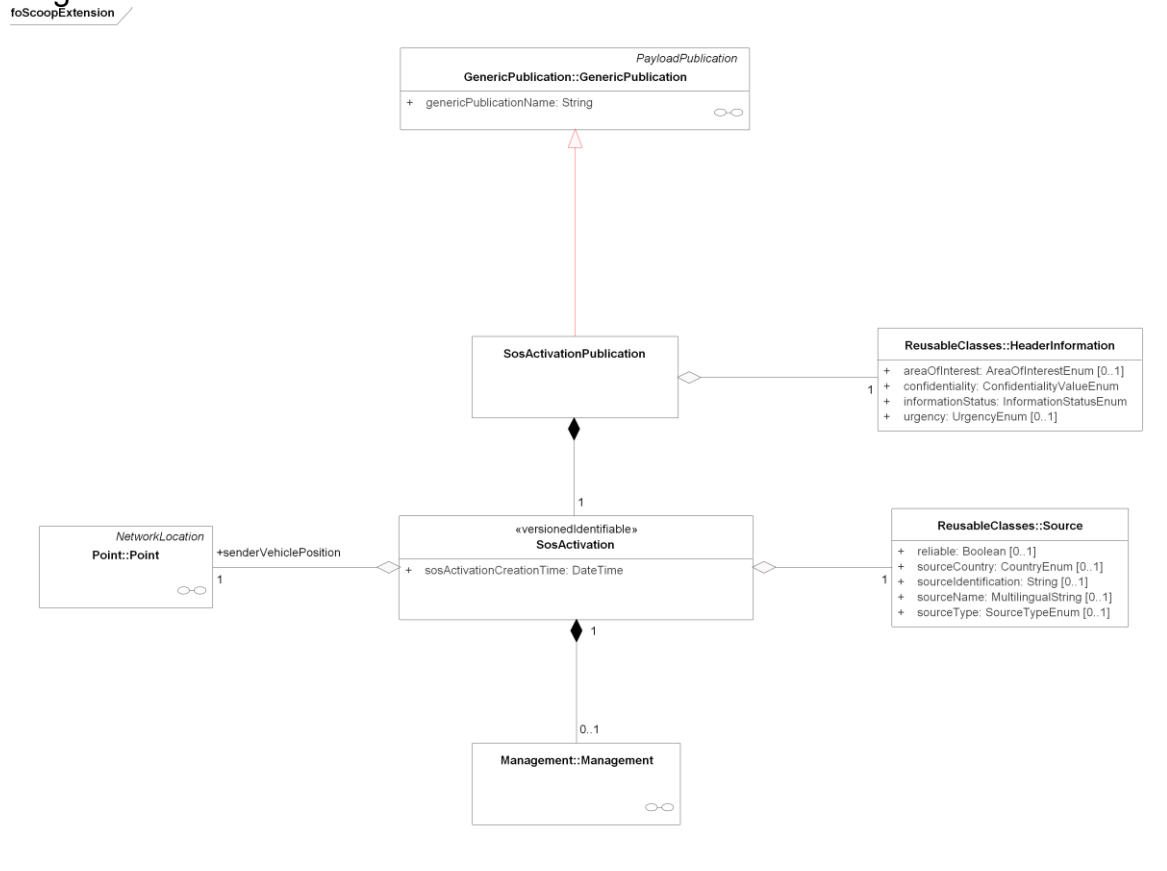


Figure 6: The *SosActivationPublication* class diagram

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.

6.3.2 Exchange parameters

6.3.2.1 Choosing the distribution mode

Cf. paragraph 4.2.1.1 “Choosing the distribution mode” (attribute value: “operatingMode1”).

6.3.2.2 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>
...
```

6.3.3 Message content

6.3.3.1 The DATEX II <SosNotification> class

This class is “identifiable”, which means a unique identifier is added to the class definition. For definition of such an identifier see § 0.

However, as there is no DENM input in this case the generation process is different:

- The identifier is created by a GUID creation process that guaranties its unicity. It is kept for new versions;
- The version number is an integer starting with 1 and incremented for each new version of the same event.

For defining the “sosActivationCreationTime” attribute see § 0.

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 OBU clock.

6.3.3.2 The DATEX II <HeaderInformation> class

To fill in the attributes of this class see § 4.2.2.1. However, the attribute “confidentiality” is filled in with the value “internalUse”.

6.3.3.3 The DATEX II <Source> class

To fill in the attributes of this class see §5.2.2.2.2. However, the attribute “sourceType” is filled in with the value “roadOperatorPatrol” whereas the attribute “reliable” is set to “True”.

This definition is static and independent from any stationType definition.

6.3.3.4 The Point location description

For general information on Point location description, see chapter 7.1.

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.

6.3.4 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>
```


6.4 Setting the static OBU parameters

No static data exchange is planned for OBU 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 OBU	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 9: Setting the static OBU 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 OBU).

For example: “UEVG-EC301” (OBU installed in the EC301-coded vehicle).

The “nationalIdentifier” attribute is inferred from the previous one by adding “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 RSU and OBU. Therefore, no confusion is possible between the data issued by CAM aggregation and the data issued by vehicle positions (OBU). In the future if road operator’s OBU are used as mobile RSU and aggregate CAM data they are identified as such including virtual loop location.

7 Location of events in DATEX II

For all messages transmitted, one should specify the location of the event. The range of location systems recognised by DATEX II is broad. Furthermore, it 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).

Finally, it should be noted that the location systems used by DATEX II 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.

NOTE: paragraphs 7.1 to 7.4 use the definitions of the DATEX II technical specification.

7.1 Point location

7.1.1 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 the point is on.

7.1.2 A point location defined linearly

This is the location using reference markers (also named "PR" or "PLO" in French⁴) commonly used by operators on a defined road. They are named "Referent" in DATEX II. The following 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

⁴ 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

- identifier of the marker (which must be unique for the road in question), information contained in the **<referentIdentifier>** attribute of the **<Referent>** class
- the relative abscissa (in metres) in relation to the PR in question, 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.

*NOTE: the information below can also be completed, but it would not be used in creating the DENM and cannot be completed by and RSU from a DENM:
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 that the event is located on.*

7.1.3 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.

This description cannot be used for exchanges between the platform and the SCOOP RSUs.

This description can be used for the exchanges between the platform and the TICSs in SCOOP. Consequently, the platform must convert the ALERT-C into geographic coordinate points (see deliverables: platform specifications)

7.1.4 A point identified in TPEG-LOC

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. It presents certain similarities with the case of § 7.1.1 .

7.2 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. Refer to § 7.1.2 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 (see § 7.1.4) 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.

7.3 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 – "tppegAreaLocationType" 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)

7.4 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" = BAU, "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 DATEX II **<SupplementaryPositionalDescription>** and **<AffectedCarriagewayAndLanes>** classes are used for this purpose.

7.5 Application in SCOOP

7.5.1 Case of CAM aggregations

As explained in paragraph § 3.3. Construction of the DATEX II message: TE01 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.

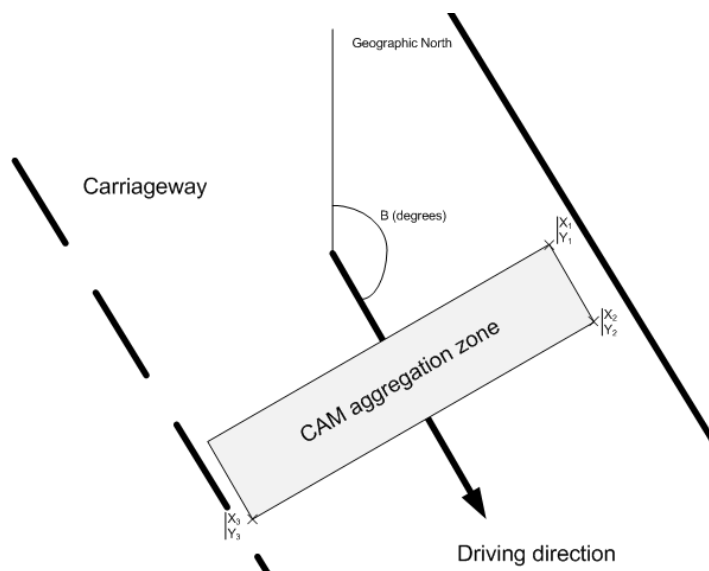


Figure 7: Defining the CAM aggregation area

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>
...
```

7.5.2 Summary for all DENM locations

In the case of point locations (No EventHistory in DENM message) :

- If there is no trace
 - Use **<GroupOfLocations>** of type "point"
 - pointByCoordinates (= eventPosition)
 - See : DENM report without EventPosition, without Traces

Note: for the case of an event positioned manually on the SCOOP application: the bearing will probably not be filled in.

- If there is 1 trace:
 - Use **<GroupOfLocations>** of type "point"
 - <PointAlongLinearElement> (= "trace")
 - pointByCoordinates (= "eventPosition")
 - See: DENM report without EventPosition, with 1 Trace and DENM creation without EventPosition, with only 1 Trace
- If there are 2 traces or more:
 - Use **<GroupOfLocations>** of type "NonOrderedLocationByList" 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 : DENM creation without EventPosition, with more than 1 Trace

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 : (=eventPosition = end of the EventHistory)
 - linearWithinLinearElement : index = 2 (Trace 1)
 - linearWithinLinearElement : index = 3 (Trace 2)
 - etc.
 - See : DENM report with EventPosition, with Traces and DENM creation with EventPosition, with Traces

7.5.3 Case of DENM reports (AxDy use cases)

7.5.3.1 Case of point-located events for DENM reports

7.5.3.1.1 EXPLANATION OF THE CHOICES

The platform does the work of reconciling the different messages sent by the RSU related to the event to signal. The DENM sent by an OBU can include the following geographic type information:

- the actual location of the event (“eventPosition”) (defined by the standard as the vehicle's position at the time of detection).
- the user's minimum information distance (“relevanceDistance”)
- the direction in which it is relevant to take into account a displayed event (“relevanceTrafficDirection”)
- the approach location (in the form of “traces”) that provide the routing to the event position.
- the history of the event (“eventHistory”), which is “the list of positions that a plain event has been detected prior to the eventPosition”.
- the destination zone (“destinationArea”) linked to the dissemination in terms of communication. Linked to message communications, it is not taken into account in the interpretation of the location.

The range covers the two notions (distinct) of applicable distance (range of the broadcast event) as well as the warning distance. The distinction takes place by the enumeration value given to the data element “relevanceTrafficDirection”.

According to ETSI EN 302 637-3, a trace “contains a list of well-ordered waypoints that forms an itinerary approaching the event position”. This standard does not specify the rules for using intermediary points or traces. There can be several (up to seven) traces leading to the same event location if there are several possible itineraries. It should be noted that the order of the waypoints is opposite to the direction of the route, the first point being nearest the event position and the following being defined relatively.

An event history is defined quite similarly to how a trace is defined. The difference is that in this case it is a question of event points whereas in the case of a trace it is the trace of the vehicle that reports the information.

According to the definition of the event position (DF “ReferencePosition”) whose ASN.1 structure is as follows:

```
ReferencePosition ::= SEQUENCE {
    latitude Latitude,
    longitude Longitude,
    positionConfidenceEllipse PosConfidenceEllipse,
    altitude Altitude
}
```

the useful information is given by the two DENM data elements, “latitude” and “longitude”.

Caution 1: the units used are different (tenth of a micro-degree for DENM, decimal degree for DATEX II). On the other hand, these geodetic systems can be considered as equivalent for these applications (WGS84 for DENM and ETRS89 for DATEX II, better adapted for positioning in Europe).

Caution 2: Whereas the different geographic locations, which are part of a trace or an event history, are defined in DENM by difference with the previous location (“deltas”), DATEX II defines point locations by geodetic coordinates (latitude and longitude) separately. The conversion rules (operated by RSUs) are defined below.

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.

7.5.3.1.2 DENM REPORT WITHOUT EVENTPOSITION, WITHOUT TRACES

The “eventPositionHeading” information in the LocationContainer (DENM) will be used to define the “bearing” attribute of the DATEX II class **<PointByCoordinates>** (caution: the units are not the same but the zero corresponds to North of the reference ellipsoid). The other DENM attributes are not used. 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.

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

NOTE: The coordinates of a “PointByCoordinates” object can be easily calculated based on the information present, but in the case of an RSU → PF exchange, the decoding by TICS will be uncertain because it does not contain any adjustment information.

It should be noted that a convention has been introduced in the deliverable 2.4.1 to process the location like DATEX II: the type of location is preassigned to a type of event according to the SCOOP use case.

7.5.3.1.3 DENM REPORT WITHOUT EVENTPOSITION, WITH 1 TRACE

When an ad hoc location normally expected by TICS regarding the event has to be managed so as to improve the overall precision vis-à-vis the platform's geographic repository, the first trace included in the DENM can be used based on the following rules:

- the location managed this way will be specialised with the DATEX II **<PointAlongLinearElement>** class. No attribute of this class will be filled in other than the “directionRelativeAtPoint” attribute.
- 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)
- the point defined in the DENM by the data element “eventPosition” will be the last point in the series of referents (“endPointOfLinearElement”)
- the last trace position will be used as the first point of the series (“startPointOfLinearElement”)
- the other trace positions will be used as intermediary points (at least one) (“intemediatePointOfLinearElement”). They will be ordered in the route direction.
- each point defined this way will include geographic coordinates (DATEX II **<PointCoordinates>** class). For all points (except the last one), the coordinates will be calculated based on the next position in the sequence by applying the values included in the DENM data structure, “DeltaReferencePosition” (“deltaLatitude” and “deltaLongitude” elements)

Rule:

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

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

- 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 1 of the points entering into the definition of the linear element.
- 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 following diagram details the coding procedure:

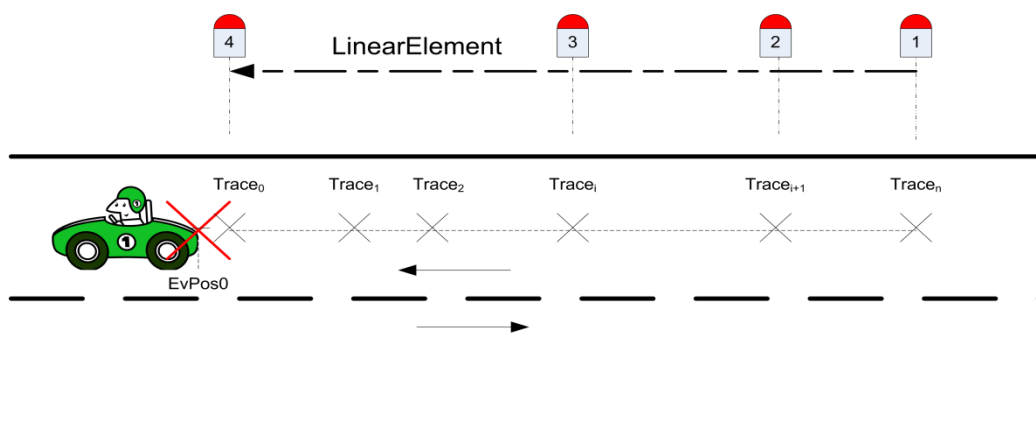


Figure 8: coding procedure for Traces

Hence the corresponding XML coding:

```
...
<groupOfLocations xsi:type="Point">
  <!-- In this case, the point is defined linearly based on the trace
  of the transmitting vehicle (via DENM).-->
  <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>
    <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>
...

```

7.5.3.1.4 DENM REPORT WITHOUT EVENT POSITION, WITH TRACES

This case is not present in SCOOP Part 1.

7.5.3.2 Case of the linearly located events for DENM reports

For the following 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 which consist of the ordered list (until 23 positions) of the positions along the event. The first position is defined by an offset delta position with regards to the previous event position (for the first one it is about the event position). This data frame is very analogous to the “*Traces*” data frame.

7.5.3.2.1 DENM REPORT WITH EVENTPOSITION, WITHOUT TRACES

This case is not present in SCOOP Part 1.

7.5.3.2.2 DENM REPORT WITH EVENTPOSITION, WITH TRACES

In DATEX II, a linear location of the event is used to carry this information using the **<LinearWithinLinearElement>** class instantiated from the positions defined in « eventHistory » according to the following rules:

- The generated location is specialised with the DATEX II **<LinearAlongLinearElement>** class. No attribute of this class is filled in except the “directionRelativeAtPoint” attribute.
- The DATEX II **<linearElement>** class is specialised as **<LinearElementByPoints>** and is instantiated as follows:
 - All the attributes are kept void but the “roadName” attribute;
 - The “roadName” attribute 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), if the “eventHistory” data frame at least contains two offset positions;
- The point defined by the DENM data frame “eventPosition” is the last point of the referent list (« endPointOfLinearElement »);
- The last position recorded in the “eventHistory” data frame is used as first position of the referent list (“startPointOfLinearElement”);
- The other positions recorded in the “eventHistory” data frame are used as intermediate points if at least one is provided (“intemediatePointOfLinearElement”). They are ordered using the driving direction.
- Every defined point includes geographic coordinates (DATEX II **<PointCoordinates>** class). For each of them (except the last one) the coordinates are calculated with the subsequent position in the ordered list by using the values in the DENM “DeltaReferencePosition” data frame (data elements “deltaLatitude” et “deltaLongitude”).

Rule :

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

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

- 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.
- 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.

- 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.
- 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.

7.5.4 Case of messages from the infrastructure (Bx and Dx use cases)

A situation element generated by an operator and transmitted by the platform includes a location part. To generate a DENM, we have to choose to simplify the description, initially only retaining simple locations.

7.5.4.1 Case of point locations

In this case (between the platform and the RSU), the location of the situation element should preferably 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 Element	Information
PointByCoordinates:: bearing	In whole degrees (integer number) <i>(optional but made mandatory for SCOOP)</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)
---			eventPosition.altitude.altitudeConfidence	15 (i.e. unavailable)
(PointWithRoadType)	(DATEX extension)	II	roadType	Filled in by rule based on the operator's map database (see § 7.5.4.2)
AffectedCarriage wayAndLanes:: lengthAffected	Fill in for roadworks		eventHistory	Specific type of trace used for linear events.
(1)			relevanceDistance	Enumeration (management rule based on the use case)
(2)			relevanceTrafficDirection	Enumeration (definition by use case – see 2.4.1.2)

(1) DATEX II does not know the concept of warning distance. In the case of a point event, the range would be length nil. This solution, which would only work for a range, is excluded by SCOOP.

(2) 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 in defined in the deliverable 2.4.1.2 (depending on the use cases).

Table 10: Table of location parameters

For the locations defined by other localisation systems but without the DATEX II **<PointByCoordinates>** class, direct geocoding should be performed by the platform.

7.5.4.1.1 DENM CREATION WITHOUT EVENTPOSITION, WITHOUT TRACE

This case is not present in SCOOP Part 1.

7.5.4.1.2 DENM CREATION WITHOUT EVENTPOSITION, WITH ONLY 1 TRACE

To generate the "Trace" element, a similar solution to the one presented in § 7.5.2 is usable, if the location part of the situation element contains a **<PointAlongLinearElement>** type object.

The following diagram illustrates the principle of coding by the platform:

- the "eventPosition" element is either filled in directly based on the information in the instantiation of the DATEX II **<PointCoordinates>** class, if present, or obtained by geocoding the information contained in the instantiation of the DATEX II **<PointAlongLinearElement>** class;
- the Trace element itself is coded by the RSU based on coding for the **<LinearElement>** object:
 - The first point of this Trace is positioned at a distance d (configurable) from the event position. This point is then geocoded similarly to the event position, but taking a relative abscissa equal to $absrel + d$;
 - the other points are determined by taking the different referents used to define the **<LinearElement>** type object. If the coordinates of the referents are attached to these referents via the DATEX II **<PointCoordinates>** class, they will be used directly, otherwise the platform will calculate them by direct geocoding and add them to the definition of the instantiation of the DATEX II **<LinearElement>** class.
 - the values of the entities defining each waypoint of the trace will be defined by the RSU relatively based on the preceding point. For the first trace point, these values are defined in relation to the event position:

Rule:

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

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

- The other values are filled in consistent with the previous Table 10: Table of location parameters.
- The DATEX II **<ExternalReferencing>** class will be instantiated as follows (indications added by the platform):
 - The "externalReferencingSystem" attribute will contain the "TRACE" string;
 - The "externalReferencingCode" attribute will contain any string.

NOTE: Even if DATEX II does not define any rule to fill in this attribute, the following convention can be adopted, which consists in allocating the value "1" for the first string and then incrementing for the subsequent strings.

- The "roadName" and "roadNumber" attributes will be ignored by the RSU;
- The "directionRelativeAtPoint" attribute will be used to fill in the DENM data element "relevanceTrafficDirection" (see below);
- No history will be created.

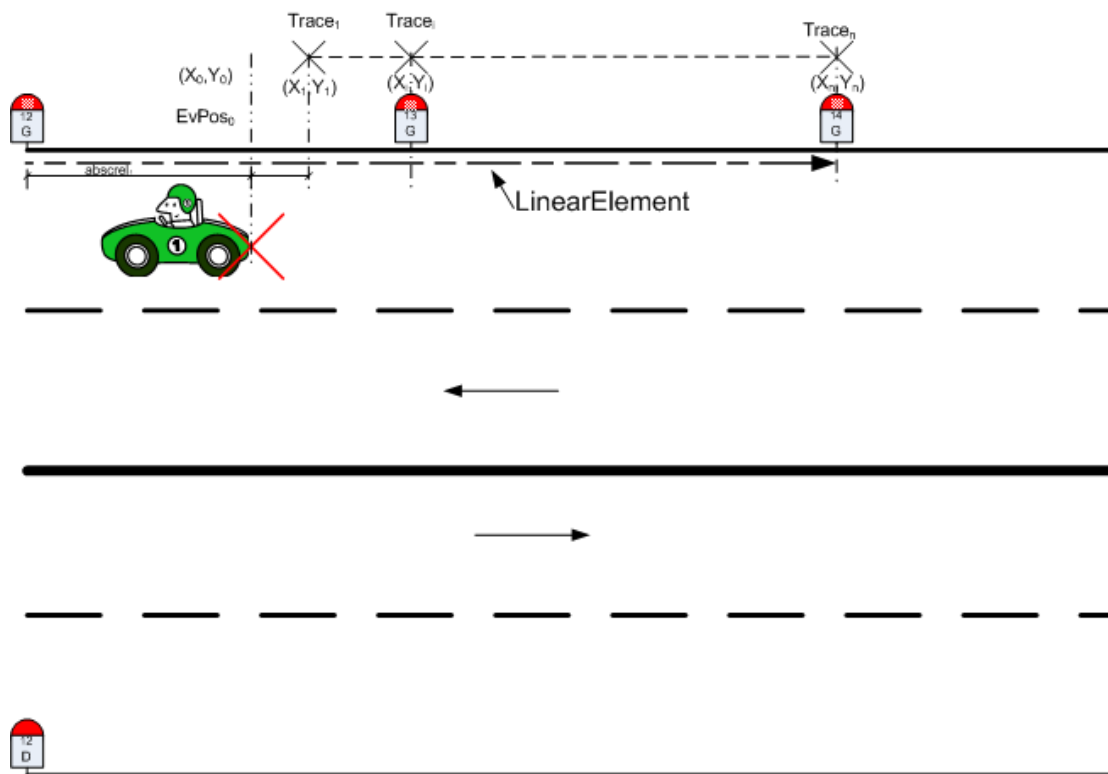


Figure 9: Defining Traces for an infrastructure-originated event

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

```
...
<groupOfLocations xsi:type="Point">
  <externalReferencing>
    <externalLocationCode>1</externalLocationCode>
    <externalReferencingSystem>TRACE</externalReferencingSystem>
  </externalReferencing>
  <pointAlongLinearElement>
    <directionRelativeAtPoint>opposite</directionRelativeAtPoint>
    <linearElement xsi:type="LinearElementByPoints">
      <roadNumber>A1</roadNumber>
      <linearElementReferenceModel>RIU V2 2015
    </linearElementReferenceModel>
    <startPointOfLinearElement>
      <referentIdentifier>93PR12G</referentIdentifier>
      <referentType>referenceMarker</referentType>
      <pointCoordinates>
        <latitude>48.96060</latitude>
        <longitude>2.46806</longitude>
      </pointCoordinates>
    </startPointOfLinearElement>
    <intermediatePointOnLinearElement index="1">
      <referent>
        <referentIdentifier>93PR13G</referentIdentifier>
      </referent>
    </intermediatePointOnLinearElement>
  </pointAlongLinearElement>
</groupOfLocations>
```

```

        <referentType>referenceMarker </referentType>
        <pointCoordinates>
            <latitude>48.96695</latitude>
            <longitude>2.47769</longitude>
        </pointCoordinates>
    </referent>
</intermediatePointOnLinearElement>
<endPointOfLinearElement>
    <referentIdentifier>95PR14G</referentIdentifier>
    <referentType>referenceMarker</referentType>
    <pointCoordinates>
        <latitude>48.97318</latitude>
        <longitude>2.48709</longitude>
    </pointCoordinates>
</endPointOfLinearElement>
</linearElement>
<distanceAlongLinearElement
xsi:type="DistanceFromLinearElementReferent">
    <distanceAlong>350</distanceAlong>
    <fromReferent>
        <referentIdentifier>93PR12G</referentIdentifier>
        <referentType>referenceMarker</referentType>
    </fromReferent>
</distanceAlongLinearElement>
</pointAlongLinearElement>
<pointByCoordinates>
    <bearing>214</bearing>
    <pointCoordinates>
        <latitude>48.96237</latitude>
        <longitude>2.47197</longitude>
    </pointCoordinates>
</pointByCoordinates>
</groupOfLocations>
...

```

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., impacting both directions of traffic). Consequently, SCOOP 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°).

7.5.4.1.3 DENM CREATION WITHOUT EVENTPOSITION, WITH MORE THAN 1 TRACE

See : DENM with EventPosition, with Traces

7.5.4.2 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 TICS. 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:

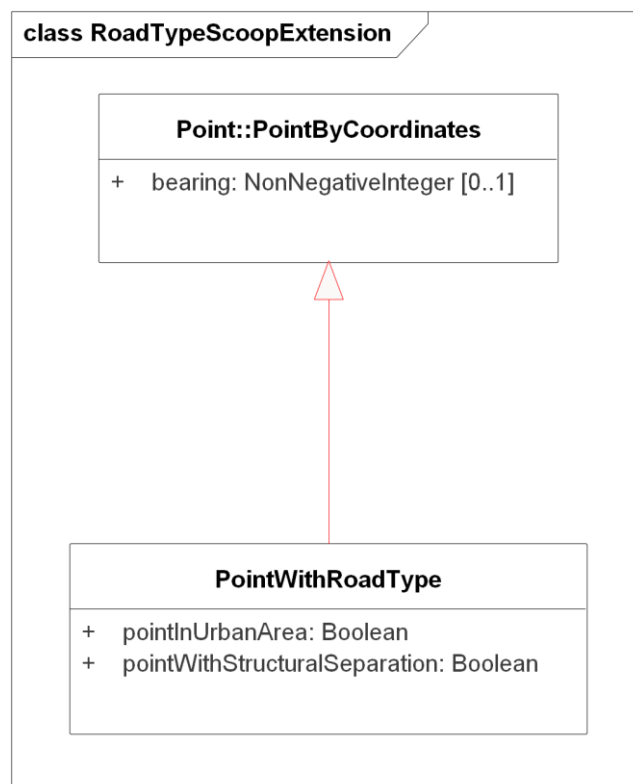


Figure 10: Extension for the “roadType” definition

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>
...
```

7.5.4.3 Case of linear locations

For the DENM norm, there is no real localisation system to represent linear type topological objects, whereas DATEX II does it natively and this is certainly the most common localisation mode. It is possible to circumvent the problem by using either the “relevanceDistance” data element or the “eventHistory” entities (in fact a succession of “eventPoint” entities - 23 at most).

Apart from the ALERT-C localisation system that can also use predefined linear objects, all the other systems proposed in DATEX II define a linear as a dual point. However, the order of the points defining the linear is not the same between ALERT-C⁵ and the other localisation systems.

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.

7.5.4.3.1 DENM CREATION WITH EVENTPOSITION, WITHOUT TRACE

This case is not present in SCOOP Part 1.

7.5.4.3.2 DENM CREATION WITH EVENTPOSITION, WITH TRACES

The two locations representing respectively the trace and the history will be grouped into an instance of the DATEX II “NonOrderedLocationGroupByList” class. The order is not important. To generate the “Trace” element, the solution presented in § 7.5.4.1 can be used, by considering the point encountered first in relation to the direction of traffic impacted by the event. For the definition of the “eventHistory” entity, the method retained involves creating a location that

⁵In the ALERT-C localisation system, the first point is the downstream point in relation to the traffic direction (by analogy with the traffic jams, this corresponds to the head of queue) and the second point is the upstream point (by analogy with the traffic jams, this corresponds to the end of queue) in relation to the direction impacted by the event. For the other systems, this runs from the upstream point to the downstream point in relation to the direction of traffic affected.

instantiates the DATEX II “LinearWithinLinearElement” class.

- If the situation element received by the platform from the TICS already contains a location of this type (based on reference points), it will be kept, but enriched by the coordinates (obtained by direct geocoding) of the referents that describe the “LinearElement” object.
- If the situation element does not contain the instantiated location as in the preceding point, but contains locations that instantiates the DATEX II “TpegLinearLocation” class, it will be possible to easily generate the instance of the DATEX II “LinearWithinLinearElement” class based on the definitions of the “from” and “to” points.
- In one or the other preceding cases, if the relative direction (“directionRelativeOnLinearSection” or “tpegDirection”) is defined as the “opposite” value, the role of the “from” and “to” points should be changed.
- If the situation element only contains one location instantiating the DATEX II “AlertCMethod4Linear” class, this location should be transformed, starting with the so-called secondary point (“AlertCMethod4SecondaryPointLocation”), which will constitute the “from” point, while the “to” point will be obtained from the so-called primary point (“AlertCMethod4PrimaryPointLocation” also using the relative distances (“OffsetDistance”)).
- In this latter case, if the value of the “alertCDirectionCoded” attribute is coded as “negative”, the role of the primary and secondary points should be exchanged.

The following diagram illustrates the principle of coding by the platform:

- the “eventHistory” entity will contain two “eventPosition” type elements defined by their coordinates, the other attributes being unavailable;
- the first element “<locationContainedInGroup xsi:type=“Linear”>” shall be the one for the “eventhistory”, the following elements shall be the ones for the traces;
- the class <locationForDisplay> is made mandatory in this case, and gives the precise values of “eventhistory”,
- the first element of the “eventHistory” entity will either be filled in based on the information in the instantiation of the DATEX II <PointCoordinates> class of the “from” point, if present, or obtained by geocoding the information contained in the “from” object of the DATEX II “LinearWithinLinearElement” or “TpegLinearLocation” class;
- the second element of the “eventHistory” entity will either be filled in based on the information in the instantiation of the DATEX II <PointCoordinates> class of the “to” point, if present, or obtained by geocoding the information contained in the “to” object of the DATEX II “LinearWithinLinearElement” or “TpegLinearLocation” class;
- the values of the entities defining each waypoint of the history will be defined by the RSU relatively based on the preceding point. For the first history point, these values are defined in relation to the “from” position of the event:

Rule:

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

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

-

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

9 - SCOOP 2.4.1.4 Specification of DATEX II-2.3 messages V2.00

```

    <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>
                <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>
</linearWithinLinearElement>
</locationContainedInGroup>

```

```

        </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>
...

```

In the case of roadwork, the localisation part will be completed by the transverse positioning information as follows:

```

...
<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.

The information will be used to generate the DENM entity “RoadWorksContainerExtended”.

7.5.4.4 Case of location on slip roads and auxiliary lanes

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 TICS. In such cases, the corresponding location is projected on the main carriageway using the location referencing suitable for the corresponding carriageway. The platform shall transform such a location into a location usable by RSU for creating DENM. There is no specific rule in this document for such a transformation.

7.5.4.5 Special case of Speed limit positions for road works (UC B1)

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

As for any situation record a location reference shall be attached to the **<SpeedManagement>** class. From TICS 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 RSU using the DATEX II **<PointByCoordinates>** class. Bearing may be omitted.

At the RSU the DENM data frame is calculate as coordinates differences according to the following rule:

Rule:

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

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

7.5.4.6 Area locations

At present, only the ALERT-C and TPEG-LOC localisation systems of DATEX II can use area locations. This type of topological object is interesting for weather-related events or for certain operating actions. Since DENM cannot use this type of location directly, a topological intersection operation between the area so described and the road network content (or part of it) should be used on the platform to obtain all the linear sections impacted. The operator's sections should also be filtered.

8 Configuration of the RSU

At present, DATEX II cannot be used to exchange this type of configuration. Discuss with the RSU and platform suppliers.

The RSU configuration, apart from measurement points, will not be done in DATEX II and therefore is not described in this document.

9 Resynchronisation information and snapshot

In some cases, RSU or the Platform needs to synchronise all information with the other stations. This is not specific to the SCOOP project. 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" must be implemented to access the attribute "updateMethod" which can have three values:

- "snapshot" is used for snapshots, which means for a photo containing all situations and situationRecords without any link with their previous status

- "singleElementUpdate" is used when only the updated SituationRecord is transmitted on occurrence

- "allElementUpdate" is used when all the SituationRecords of a situation are transmitted on occurrence, even if only one situation record is updated. To be transmitted, the situation must at least have one updated situationRecord.

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

If the updateMethod is allElementUpdate, that means that all previous SituationRecords received from the same supplier must be deleted and replaced by the new one. If a SituationRecord is no longer in the new XML File, that means that the event was ended during the time between the two publications and after the mapping, and all these events must 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.

10 Appendices

10.1 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
Wrong way driver	VehicleObstruction	vehicleOnWrongCarriageway	14	0	vehicle on wrong carriageway

Road blocked	<SituationRecord>: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 ⁶	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 11: Correspondence DATEX II attributes and cause codes used by DENMS

⁶ 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 TICS.

10.2 Comparison of how use cases are processed by SCOOP and by SCOREF

Name	Processing in SCOOP	Processing by SCORE@F
A1: traffic data (position, speed, direction)	CAM chapter	GT01 - Collect traffic info and report to PCE
A2 and A3: event data produced by the vehicle	"Situation" chapter	GT01 - Collect traffic info and report to PCE
B1: warning - scheduled roadwork (stationary and mobile)	"Roadwork" chapter	SR01/SR09 - Information and work warning (Work)
C1: Stationary signalling	NOT SPECIFIED	MC01 - Embedded signage
C2: real-time speed signalling	NOT SPECIFIED	GT02 - Regulatory and contextual speed limit
D1: warning - temporarily slippery road	"Situation" chapter	SR08 - Weather information - Low stability
D10: warning - emergency braking	"Situation" chapter	SR10 - Warning emergency braking
D2: Warning - animal or person on the road	"Situation" chapter	SR05 - Information human presence on the road
D3: Warning - obstacle on the road	"Situation" chapter	SR04 - Information obstacle on the road
D4: warning - stationary vehicles, breakdown	"Situation" chapter	SR03/SR12 - Information and stationary vehicle warning
D6: Warning - low visibility	"Situation" chapter	SR07 - Weather warning - Low visibility
D7: warning - wrong way drivers	NOT SPECIFIED "Situation" Paragraph	SR14 - Warning wrong-way vehicle
E1: traffic colour	NOT SPECIFIED	GT03 - Traffic info and recommended itinerary
E2: Transit time	NOT SPECIFIED	GT03 - Traffic info and recommended itinerary
E3: Recommended itinerary – rerouting related to traffic conditions	NOT SPECIFIED	GT03 - Traffic info and recommended itinerary
E6 (formerly D9): Warning - exceptional weather conditions	"Situation" chapter	SR07/SR08 - Weather warning

Table 12: Correspondence between SCOOP and SCORE@F use cases