



# Italian Motorways Operators DATEX II Profile and Extensions



## Controllo Documento

Oggetto	Technical reference for DATEX II node deployments for Italian Motorways Concessionaries TCC and TIC
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## PREFACE

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The DATEX II profile for Italian Motorway Operators comes after several years of operation of the DATEX1 exchange network, from the need for the Italian motorway sector to migrate to DATEX II data exchange system.

The requirements for timely, accurate and reliable data exchange were gradually refined and a working group was set in 2011 to define the issue of the exchange operating data for emergency management and its possible solutions. This group took origin from Mare Nostrum Italian team, for he needs of operating Variable Message Signs (VMS). These requirements are described in the Final document of the working group named “Prospettive dello Scambio Dati fra Centri di Controllo Traffico in Italia” and presented in AISCAT “ITS and Tolling” committee.

Some of the achievements of the Working Group have formed the basis of the presentation of operating modes of variable message signs through DATEX II in the presentation by Fabrizio Paoletti the DATEX User Forum 2012 in Stockholm

(Vd [http://www.datex2.eu/user-forum/2012/duf\\_2012\\_p4\\_vms\\_management.pdf](http://www.datex2.eu/user-forum/2012/duf_2012_p4_vms_management.pdf))

The objective of the reported profiling work is the need to reduce the set of managed information in DATEX, for better use in the various sections of the protocol to avoid ambiguities and differences in use, simplifying the DATEX II model for a shared management of information.

Information relevant to IT Motorways operation has been retailed from the DATEX II data model, specifying how to use relevant parameters and attributes to simplify the model and manage it to the best of its potential.

This way of cutting out information is called DATEX Profiling and is feasible with the methods and tools provided by the DATEX standard itself, which allows to create sub-schemes reduced by the overall scheme and compatible with the original scheme, in the sense that XML documents originated with the reduced schema validation maintain the validation with the wider standard scheme.

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## DATEX II MODEL ANALYSIS

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A “DATEX II Profile” was generated as base for italian sector DATEX II Guidelines.

The areas of analysis of the group being examined in the paper, were the following:

- 1) Understanding and agreement on general DATE II profiling methodology and tools.
- 2) Events: Situation Publication  
Which comprises
  - a. Methodology
  - b. Events general data
  - c. Locations
  - d. Events Specifications
    - i. Traffic
    - ii. Road Operations
    - iii. Non-Road Events
- 3) VMS
- 4) Sensors Measurements

## 5) Travel Times

### EXCHANGE

Additional requirements were about a minimum completion of data exchange specification that in DATEX II are not yet completely finalized.

For pure http and XML exchange specifications since version 1.0 the so-called Low Cost Profile (Simple HTTP Pull) is defined, that provides global information for a node through publication on the web of static files.

For Web Services (WS) based exchange, so-called Push mode, there are some lacks in the specifications that do not allow to be totally reliable and interoperable without any additional specification, for example the definition of minimum functionality of synchronization and error handling.

Furthermore, analysis carried out by the working group on emergency has highlighted the need to make available to the Supplier any information about the proper acquisition and processing of information client side. For these needs an Extension had been implemented that works even with Simple http model, a Feedback publication has been provided and included in TMP extension delivered on DATEX II website ( <http://www.datex2.eu/content/vms-operational-exchange-and-tmp-management> )

Beside this, a Delta Pull Extension has been developed to reduce bandwidth and deliver only incremental information in Pull Exchange, asynchronous or cycle polling or pushing.

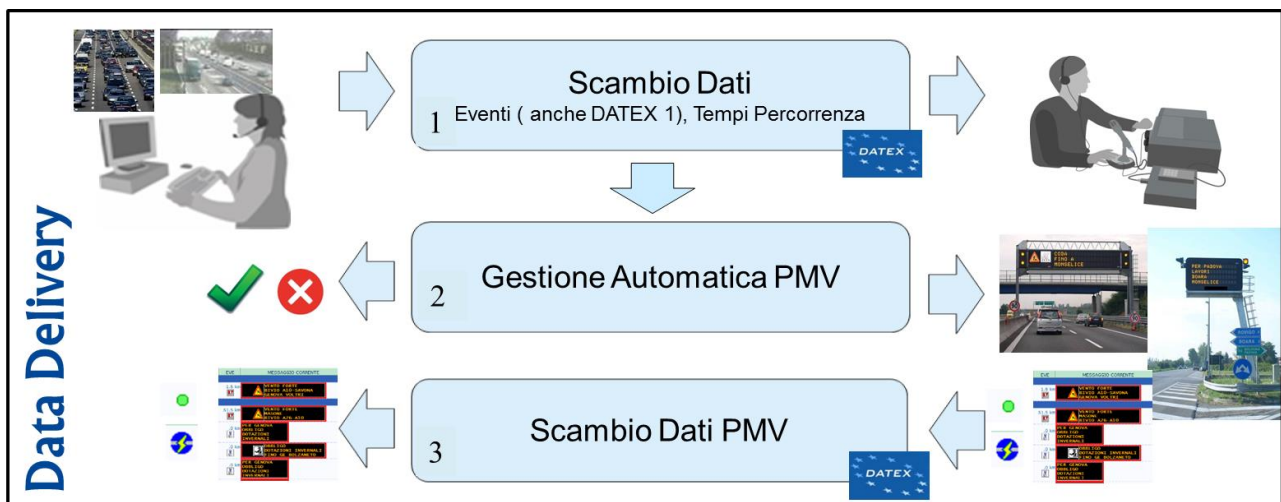
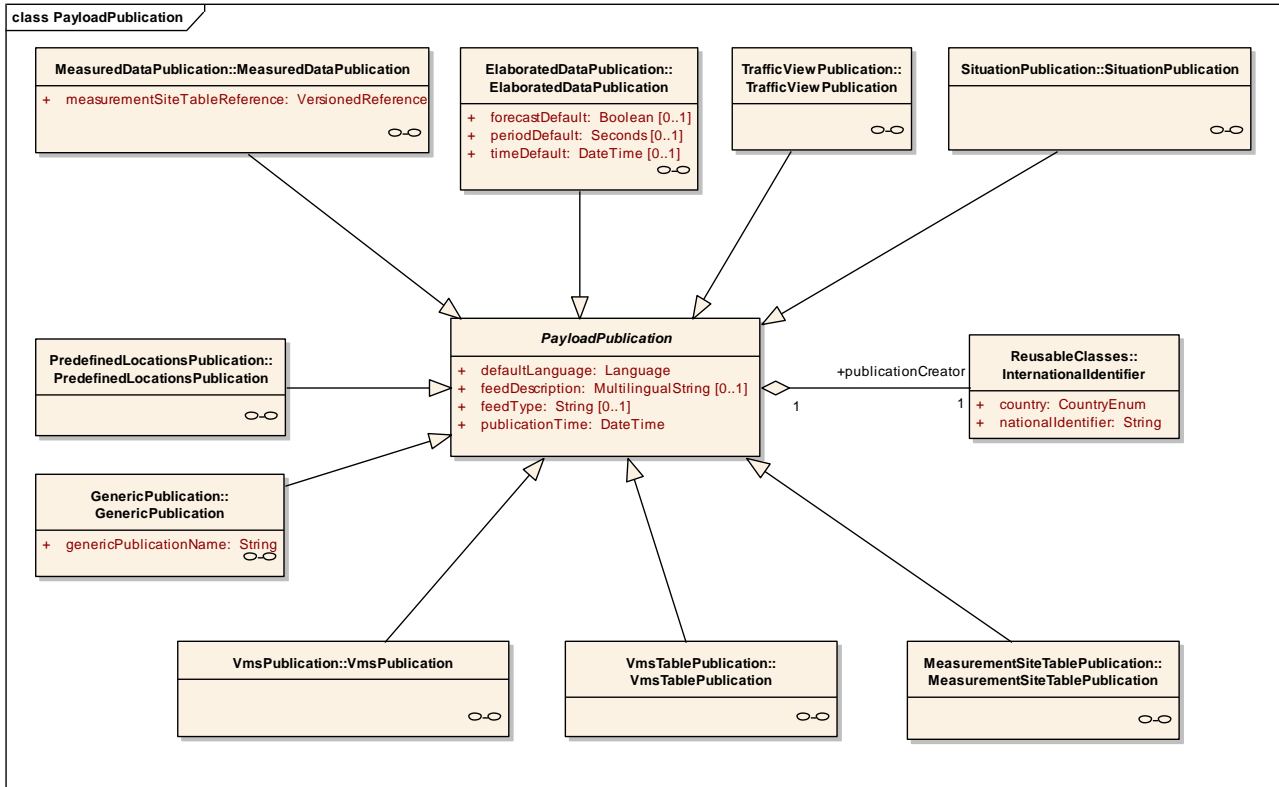


FIGURA 1 - SCHEMA LIVELLI SCAMBIO DATI CON FEEDBACK DELL'ELABORAZIONE NEL FLUSSO PMV

The completion of the real time exchange profile is in progress in the DATEX2 European study.

## PUBLICATIONS GENERALITY

DATEX publication are specialized in several payloads



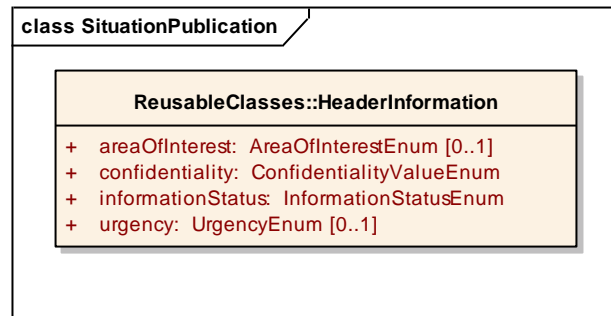
The work has taken into account the following Publications:

Information	Publication
Total Events	Situation
VMS Registry	VmsTable
VMS State and Messages	Vms
Sensors and Control Units Registry	MeasurementSites
Sensors Data and State	MeasuredData
Travel Times, Elaborated Data	ElaboratedData
Extensions	Generic

## HEADER

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Header class is found in some publications (Situation, Vms, MeasuredData) is a reusable class that contains some optional attributes and other required ones:



Some attributes (`areaOfInterest`, `confidentiality`, `urgency`) have a meaning that is generally understood semantically but the underlying concept is generic and their use is not precisely defined.

They are left as optional as it could be useful in some application contexts to manage this information, but in case of use the precise meaning and use of the attribute must be specified in detail in the class of application: for example, the attribute `areaOfInterest` (`regional`, `national`, `local`) that defines the geographical diffusion of information can be used in different ways depending on the medium or channel of publication, which may be either the VMS that the broadcast of TMC with intrinsically different extents.

**ISSUE.** It was decided to insert a message via Datex issue to notify the ambiguous and not specific use, asking for the inclusion of these attributes in packages suitable for application use, in such a way that they are not general attributes of the event but specific ones for individual data applications.

The `informationStatus` is unquestionably necessary and it can be:

- `real`                                    the case of real information for the production use
- `securityExcercise`                    the case of security training (simulation)
- `technicalExcercise`                  the case of technical test of false information
- `test`                                        the case of tests

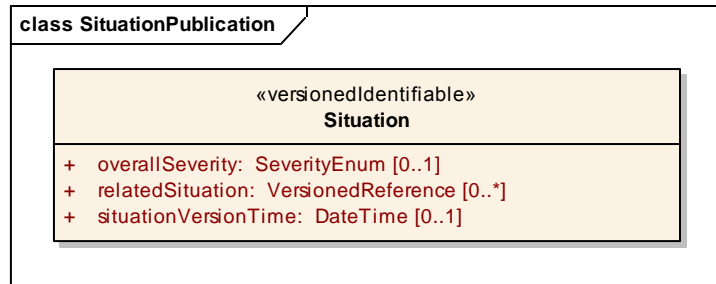
The use of meanings different from 'real' allows transferring information indicating that the data is not true for the expected uses and purposes (tests, simulations).



## EVENTS / ROAD SITUATIONS

### SITUATION PUBLICATION: GENERAL EVENTS DATA

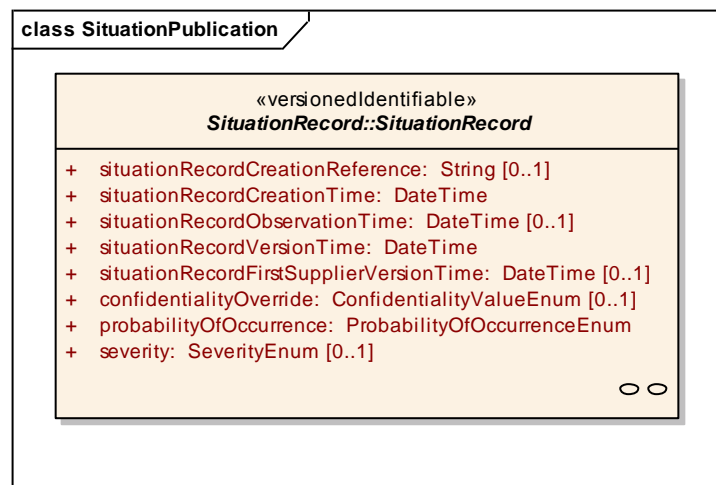
#### SITUATION



**overallSeverity:** also this attribute is understandable in general but has no immediate clarity of application and is left for possible future options.

ISSUE. Decision to signal by Datex site.

#### SITUATION RECORD



Creation and both Supplier and Client DB insertion timestamps appear, the use is left to individual users, the important fact is the **situationRecordVersionTime** that is the timestamp of the version reference, **situationRecordObservationTime** is generally unknown.

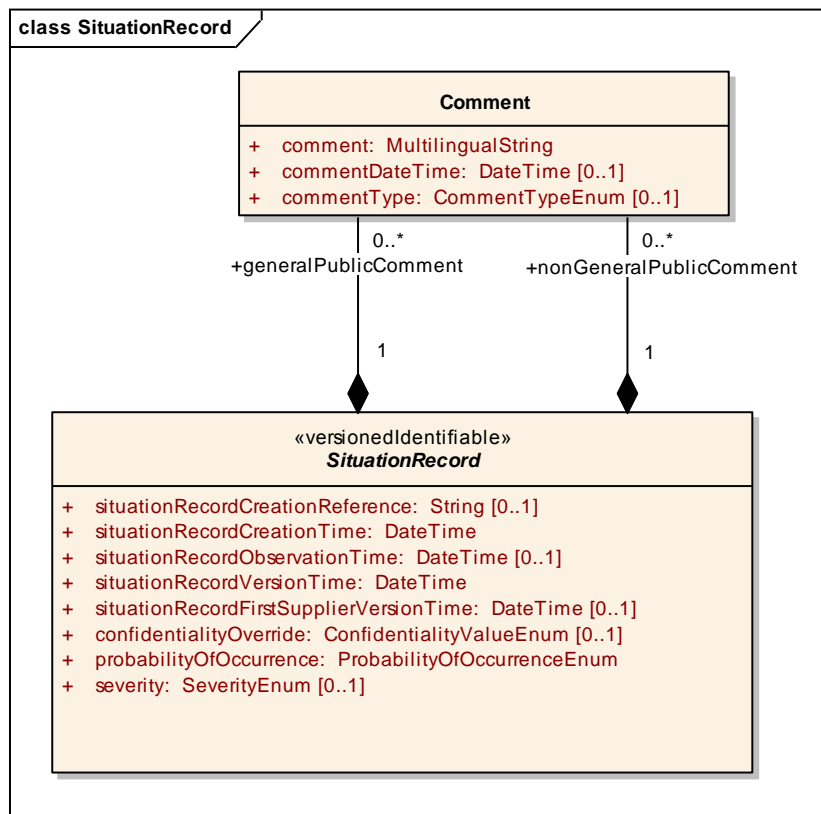
**severity:** it is left as unspecified optional qualitative attribute.

**confidentialityOverride:** it overwrites for the individual record the confidentiality value of the header.

**probabilityOfOccurrence:** it is important and can be:

- **certain:** applies to certain events that have been certified to be in place by the sources of information, can be different for non-certified signals and for prediction probable events (traffic and weather)
- **probable:** applies to events that are not certain but that have a probability of occurrence different from zero (which can be further specified by the appropriate attribute probabilityOfOccurrence)
- **risk of:** it means “danger of”, a signal of an event that is very likely but not certain to happen, for example the formation of ice due to which an operation is running with dedicated vehicles, or dangers from non-certified sources. The “risk of” non-overt event is inserted in order to warn road users with information of "REPORTED" obstacle or danger.

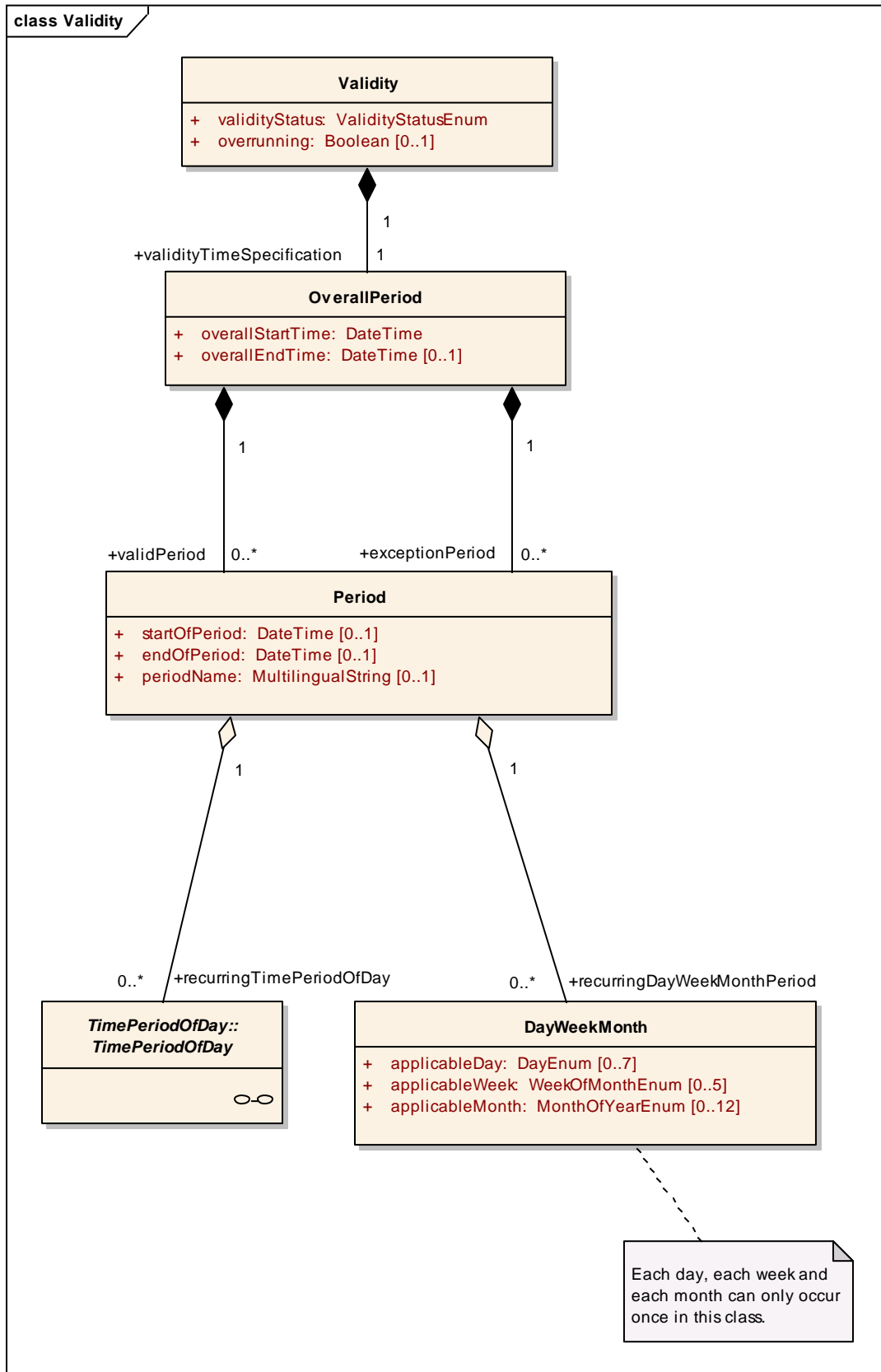
## NOTES



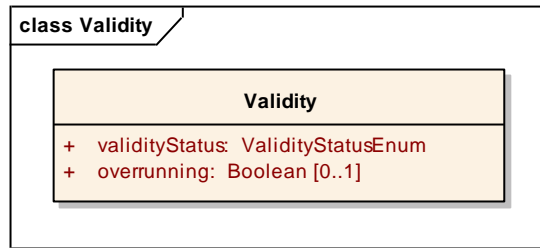
Free texts are associated to situations versions: they are distinguished between Public comments (`generalPublicComment`) for the external broadcasting and Reserved comments for the internal use between centers (`nonGeneralPublicComment`) and therefore not diffusible as external information.

These texts can be expressed in different languages via the comment field of type `MultilingualString` that allows to specify a text for every available language, but it is of course possible to use it even in a single language. They are intended to clarify in natural language the individual events information detail and the situations, in order to improve the additional information in a non-encoded way.

## VALIDITY



Validity is a complex information. In general, the information is taken into account of classes Validity and OverallPeriod, that have a start date (observed for in-place events or future for forecast events) and an expected end date of the event.



In Validity class, the mandatory attribute validityStatus must be set to the conditions explicated:

- **active**: information is valid and active, the event is active.
- **suspended**: information is not valid or suspended, the event is temporarily suspended in case of closure measures and road works.
- **overrunning**: the event has a validity normally defined by the values of the beginning and end that goes beyond the scheduled end time, but that has not yet been terminated or modified due to lack of information.

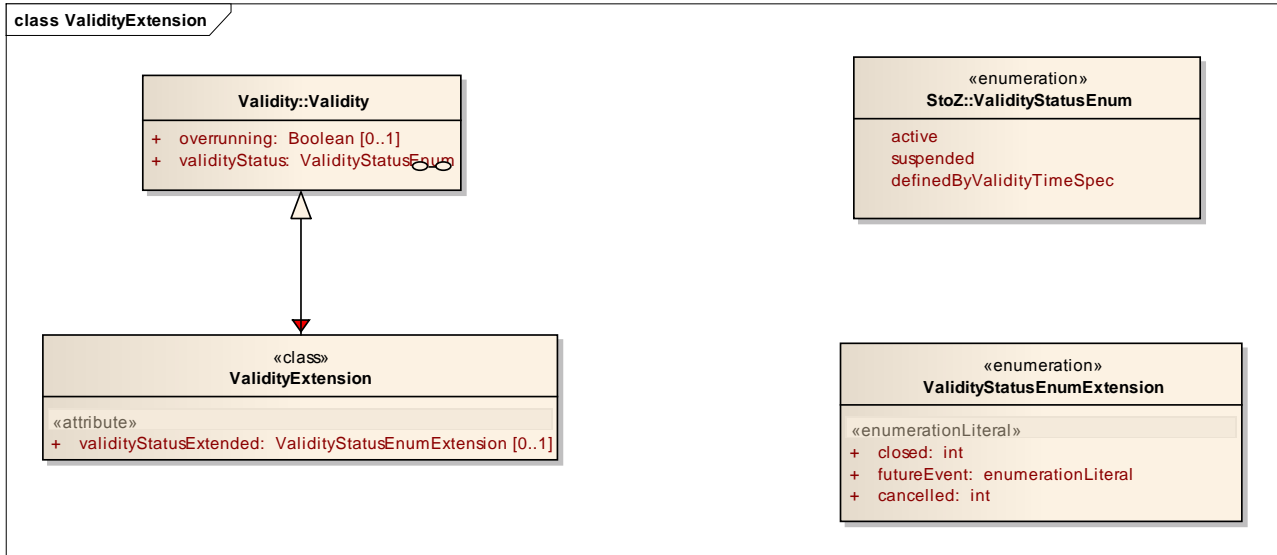
ISSUE + EXTENSION: it is observed that in this present management a clear indication is missing for planned events and confirmed ones. In case of planned constructions and closures that are not implemented the record has initially a start date in the future (future event) but when the start date has passed it is not possible to distinguish a scheduled event from a confirmed on-road event. It is considered necessary to make this request and manage at this time an extension for the validity field that indicates the futureEvent value for scheduled events so that it is possible to distinguish forecast events from confirmed ones.

In the overall scheme it is agreed that a single period of validity will be used for the event, reducing to one the numerosity of the validity periods with possible exceptions for one or more periods of invalidity, this to avoid having multiple periods of validity and invalidity partially overlapping.

ISSUE. Evaluate whether to report an ISSUE to datex2 reporting the problem of the plurality of possibilities of use of validity and invalidity periods, with a possible temporal heterogeneity between different implementations.

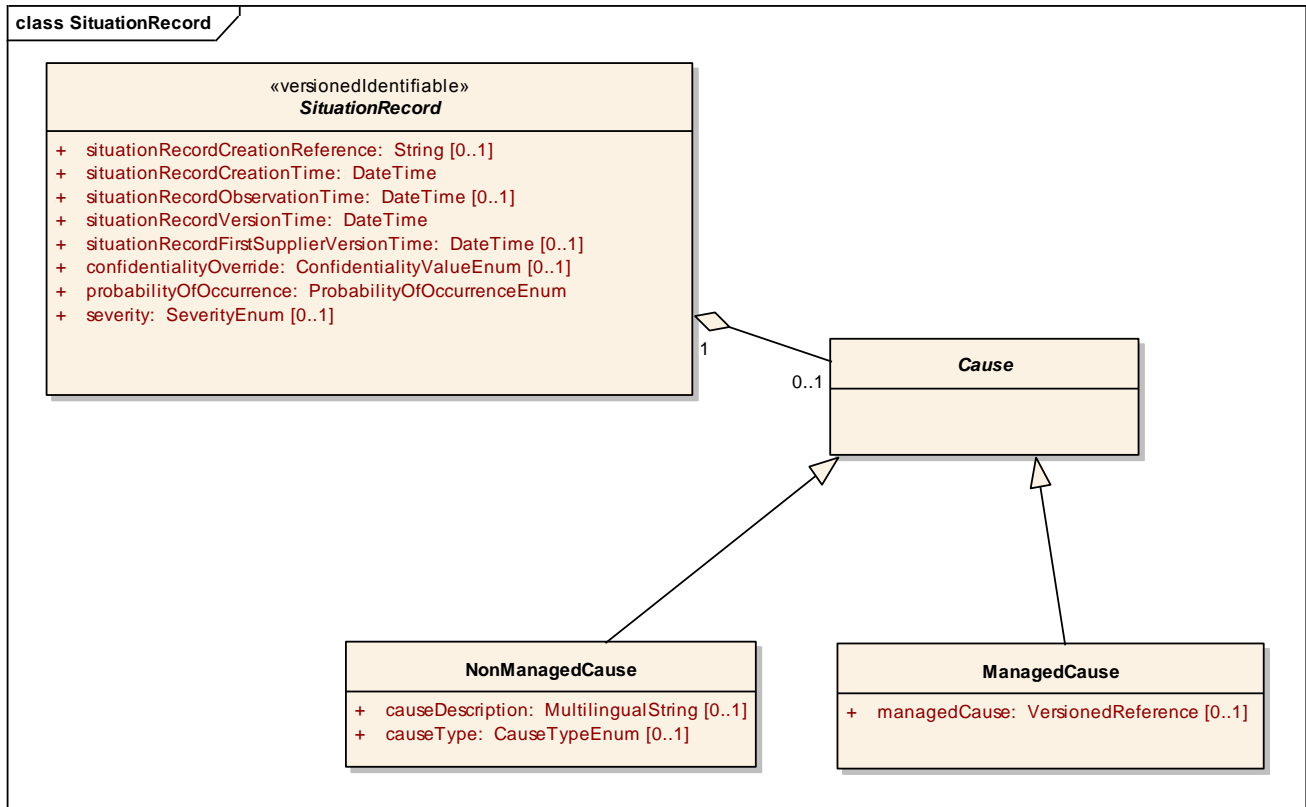
## ITALIAN VALIDITY EXTENSION

The following extension has been designed for the management of planned and confirmed events, events closing and canceled events.



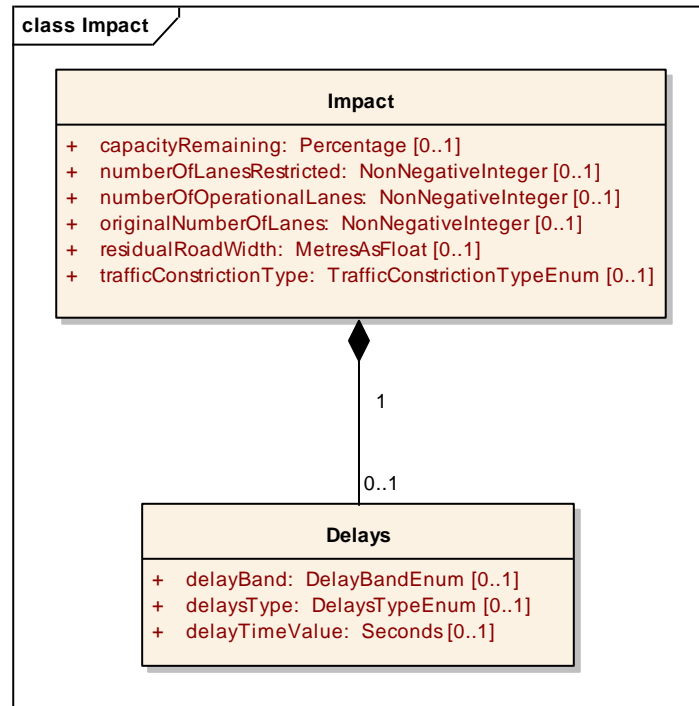
The extension involves the construction of a **ValidityExtension** class that according to the extension rule defined for the Datex model allows to extend validity values.

## CAUSES



The cause is distinguished in **ManagedCause** for events managed within the same system (reference to the key of the version of element of situation **SituationRecord**) or causes that are outside of the system or that are not managed by the system that are documented with a general typology and a description mapped as in attached table (a).

## IMPACT



A SituationRecord can have an Impact.

From the point of view of the typical use of the events in the sector, the Impact has an unclear use and responds to a logic that is primarily derived from previous requirements of some countries, requirements that have subsequently evolved.

This class is used to explicitly declare the number of lanes closed by event and operational, as well as the original section of the road prior to the event or construction site, and allows to specify the residual passable width of the road. In fact, the lane occupied by the event are to be indicated in location fields (GroupsOfLocation Supplementary Position Description and Lanes) and the data reported here is partially redundant.

`trafficConstrictionType` is an attribute that specifies the Impact. In version 1.0, the use of this attribute was the only way to report a Traffic Block by entering an AbnormalTraffic "stationary Traffic" event with added impact "blocked road" / "blocked roadway". Since version 2.0 this modality is excluded to be used, bringing the block information directly in the AbnormalTraffic class with the `TrafficFlowCharacteristic` attribute as "trafficBlocked".

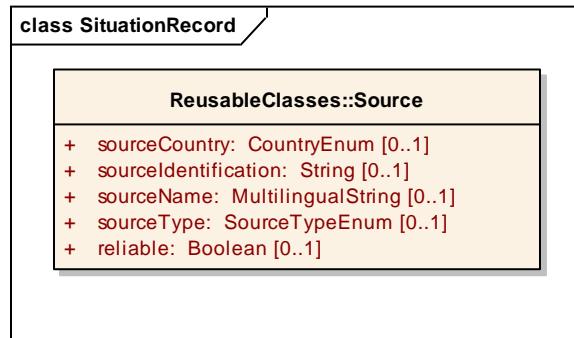
**ISSUE.** Report redundancy of information between AbnormalTraffic and Impact for the indication of blocked traffic for a better definition of use.

Delays information of Delays class remains useful and can be used as a value expressed in seconds: `delayTimeValue`. Sending delays with `delayBand` or `delaysType` is excluded.

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## SOURCE

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Source class indicates the source of information, is defined by a type and can be specified as an encoded provider of information (country, identifier); the name field is open for a better identification of the source with respect to the type (i.e. Type = Police, Name = Carabinieri, COA, etc.).

**reliable:** indicates whether the source is reliable, and therefore that the information is certified, or the source is not totally reliable. It must be considered that the most suitable attribute for this purpose is probabilityOfOccurrence in the SituationRecord class.

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## SITUATION RECORD TYPES

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The analysis of the different types of elements divided into several sub-types is defined in annex (a) and in the documentation of the file for the selection of classes and attributes produced by this work.

At the moment there are no tools that allow us to make graphically classes and selected attributes if not the tool types definition tool itself, that allows a graphical display of the selected items.

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## SITUATION RECORD MANAGEMENT: MAPPING FROM DATEX1

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Based on the list of events from DATEX1 Glossary agreed by the IT Motorways DATEX group in 2005 and subsequent extensions in 2009, a check was made on the DATEX II classes and attributes to elaborate the profile.

The information related to events and attributes of interest was selected using the DATEX II "XML Schema tool" which was then used for the generation of XML sub-schemes.

The tool itself allows for navigation of the model and all of its classes, the selection of classes and attributes to be used in the profile and the choice of values used by the enumeration list in order to reduce complexity and ensure consistency of use in different applications.

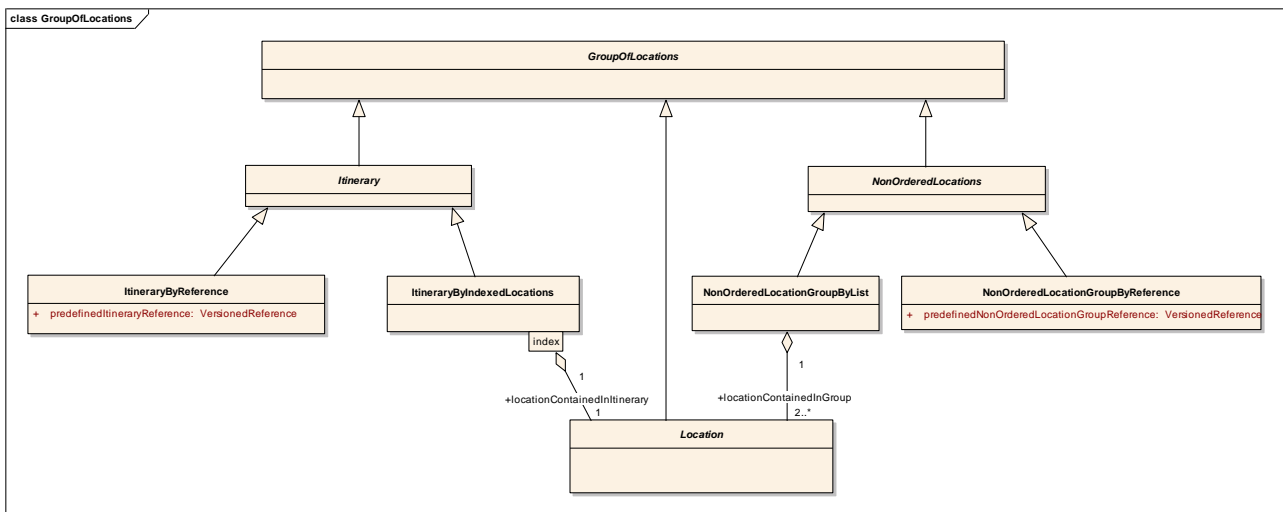


## LOCATION

### GENERALITY

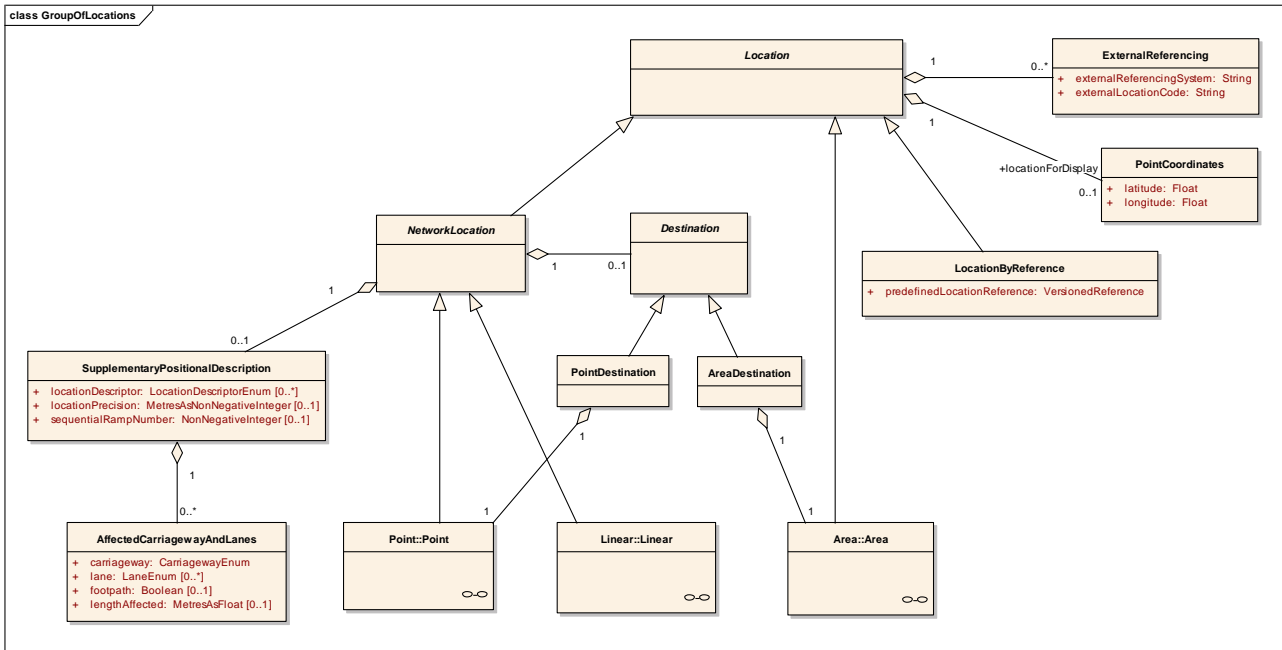
The DATEX II provides sending of location through a plurality of encoding options to overcome the rigidity of DATEX1, which provided only sending by Alert C encoding. However, using this encoding does not allow the sending of an event in lack of definition of the section of road affected within the so-called domestic location DB for the use of the RDS-TMC.

The location is part of a Location Diagram Group that allows the definition of heterogeneous places as paths or unordered sets of locations even for the detection of relevant information on a variety of points.



Itineraries are used in particular for the description of the alternative routes that will be subsequently through.

Regarding locations related to events and devices positions (sensors and VMS control units) the concept of Single Location is being thorough.

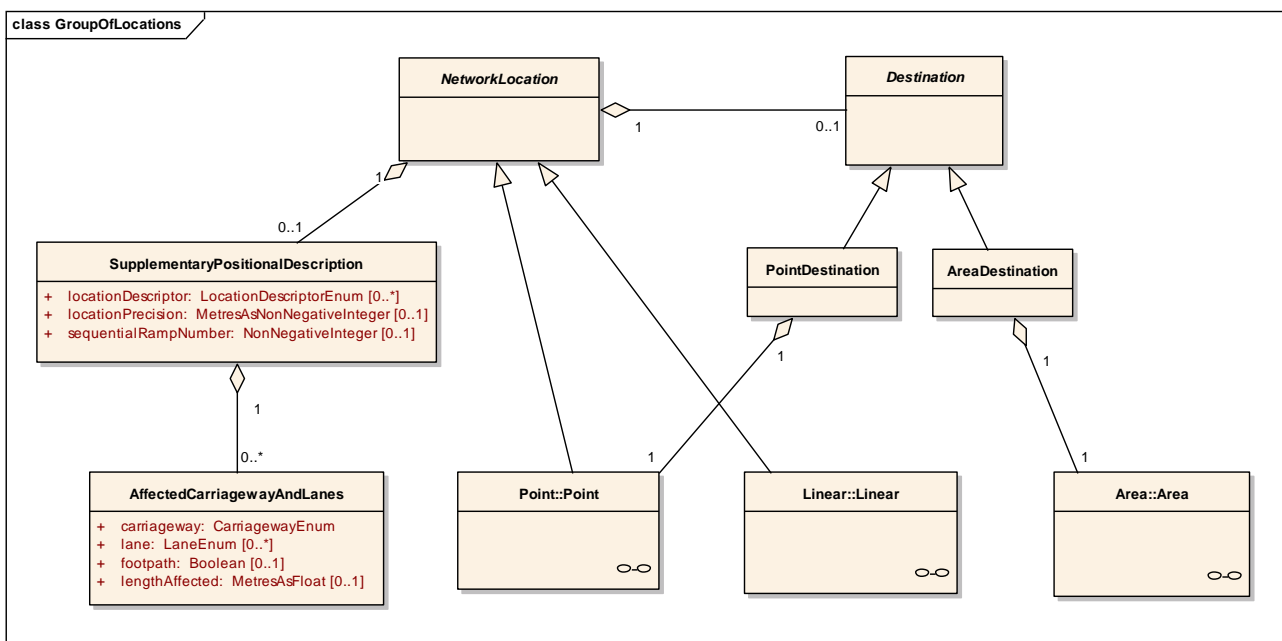


**Location** is first and foremost a place of a **Network (NetworkLocation)** or an **Area (Area)**.

Location could also be indicated by the use of LocationByReference class, referring to a predefined set of locations to be exchanged via PredefinedLocationPublication. This option is excluded for Events, but it could have its validity to be explored in the future for Control Units, Sensors and VMS.

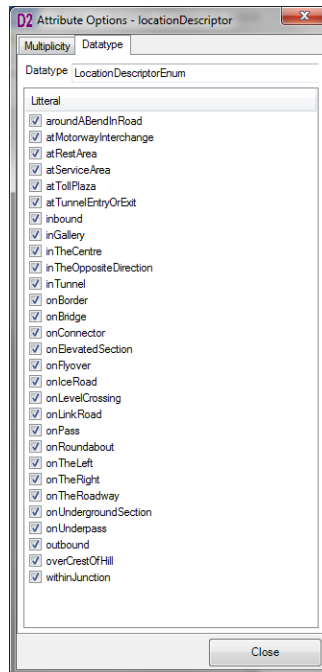
The use of Location as Area would be usable for extended weather events but is never used in the sector as we always refer to the operational conditions of a road and then weather or traffic events are normally expressed as conditions on the road sections.

Please note the following classes of general use



### SupplementaryPositionalDescription

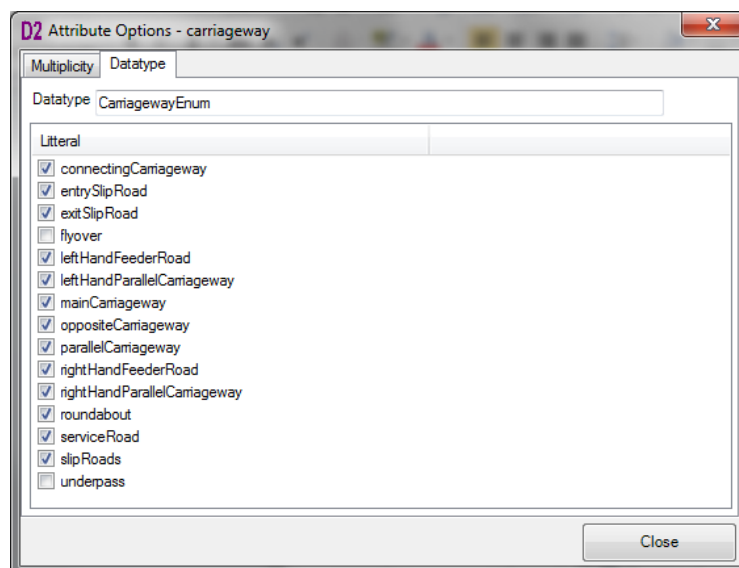
**locationDescriptor:** characterizes the geographical position (Tunnel, Viaduct, Service Area, Parking, etc.).



AffectedCarriagewayAndLanes

**carriageway:** mostly used to specify the track or the entry, exit or node junction (or other artifact: roundabout, service road, etc. slightly used).

- **connectingCarriageway:** used for Node junction
- **entrySlipRoad:** used for Entry junction
- **exitSlipRoad:** used for Exit junction





**lane:** allows indicating the occupation of the lanes (1, 2, 3, hardshoulder for emergency)

**affectedLenght:** length of the event for extended events.

The sector commonly uses **Location** as **Network**, and distinguishes in **Point** and **Linear**.

**Point** is used both for so called **Punctual Events**, that are concentrated in a specific location such as accidents, and for **OnPoint Events**, that occur in a predefined Location such as the toll queues. In both cases, the information will be sent about the point of interest or single point of road affected by the event.

**Linear** is used for road events that have non-zero extension.

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## LOCATION SUBTYPES

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As anticipated DATEX II allows the sending of location data through different methodologies. The following ones are currently available:

- **Point By Coordinate:** specify a point by its geographic coordinates.
- **Alert C:** the well-established mode of submission based on the Alert C Location DB used by the RDS-TMC system that is adopted and maintained as the main option in the dealers sector.
- **TPEG Loc:** "On the Fly" localization mode that allows to give a description of the location and specify its position, used in the TPEG system which is widespread on digital channels in the UK, currently it is not frequently used in other contexts.
- **Dinamica Along Linear:** "On the Fly" localization mode that allows to specify the exact position of the point and the geographic reference of the coordinates, identifying a linear axis road on which intermediate points are certified; it specifies with accuracy the point of interest with the distance from the origin or the distance between the intermediate points. The use of this mode is proposed for the future to allow the sending of information even in the absence of a reference DB as in the case of Alert C.

It is also possible to extend localization methods with new ones, in particular published extensions are available that enable the sending of locations coded with Agora C and Open LR, two recent coding methodologies for spatial references, independent from maps provider, that can be interpreted and decoded on the basis of different cartographic reference systems, in particular, both on NavTEQ and TeleAtlas maps.

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## ALERT C

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Preferred and mandatory in exchanges for DATEX1 and TMC compatibility.

Individual attributes are specified in the selection file. The classes management logic with both Linear and Point needs to be clarified and is different than indicated by the DATEX1 use specifics, as it is shared at European and worldwide level that a location with 0 extension is nevertheless considered a Point and it should be managed as such at the level of DB location, by sending only the Primary Location whereas previously it was always handled by sending both the Primary and the Secondary Location.

Some attentions are given for Alert C method encoding:

For On Point events only the point with method 2 is indicated.

For Linear events:



- if the location is known only by the ends and the exact mileage at the beginning and at the end of the event is not known, only the points with Method 2 are indicated.
- if the extension of the events is certified and known with sufficient precision than offsets are indicated with Method 4, possibly the offsets are 0 if they coincide with the axes of the toll flyover.
  - if the event is Punctual than offset will be always indicated with localization Method 4, possibly with offset 0 for events in coincidence with the flyover.

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### DINAMICA ALONG LINEAR

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It's a so-called "on the fly" localization method and therefore it has the advantage of allowing immediately available exchanges even in the absence of a shared database, as is the case of Alert C localization; it allows to send point names and a road path with chosen precision, obviously the accuracy is to the detriment of the number and size of the information exchanged.

It is noted as a very useful option to allow sending information about locations that are unmanaged in the national location Alert C databases.

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### COORDINATES

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It provides the latitude and longitude coordinates and is used only for Point type locations.

## VARIABLE MESSAGE SIGNS

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Sending of VMS data and messages takes place with the VMSTable publication, corresponding to VMS registry, and VMSPublication, for the messages.

There are no special notes to be reported with respect to the use of attributes and classes.

Generally it was avoided the transmitting of information related to the physical characteristics of the panel, that are not essential to the exchange of management information related to messages broadcast.

The model was validated on the basis of the panels and variable signals in use to the sector, it provides for the use of individual messages or messages with alternate text. For pictograms the assignment of a logical symbol with a consolidated semantic statement (Incident , Queue, Snow, etc.) is indicated, which is then implemented by means of a specific image that can be provided but is not essential for the semantic understanding of what the pictogram and the overall message indicates.

For pictograms it is also provided where it is a sign under the Vienna Convention or the documents of Mare Nostrum working group.



## SENSORS AND MEASUREMENT DATA

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This is measurement data of sensors located on the road infrastructure bearing weather conditions or traffic data.

The identified subschema allows the simplification and the use of data commonly used by dealers eliminating certain redundant information.

ISSUE. Some possible optimizations have emerged for those data related to the period and calculation interval, that are required to be expressible at the level of the control unit and not of individual sensor.

EXTENSION: the mode has been identified to indicate some additional data on the individual found vehicle data, that is published and requested with issue.

## TRAVEL TIMES

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They are the measurement data defined in the Measured Data publication but associated to a processing and then referred to a broader range data or to a calculation (e.g. the travel time of a single tracked vehicle between two sampling sections from cameras or Telepass buoys). It refers to the publication of the profile that selects the subset of used data.

## FEEDBACK

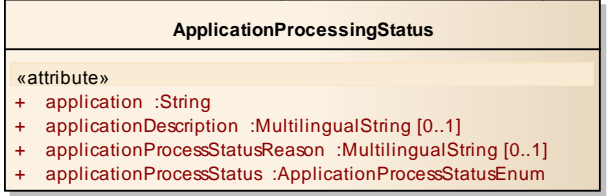
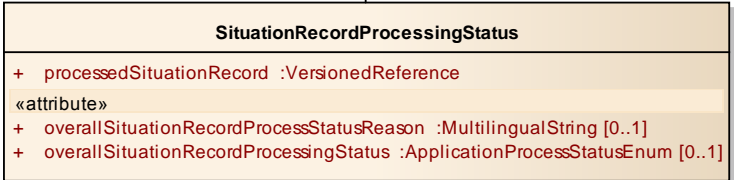
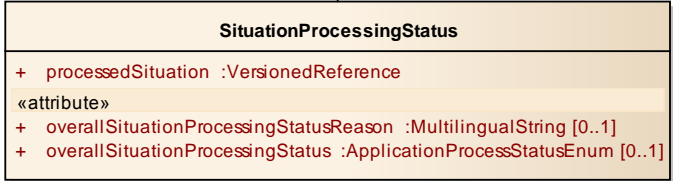
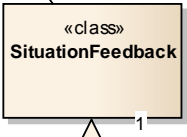
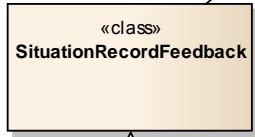
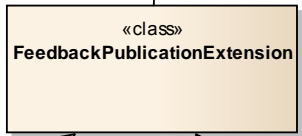
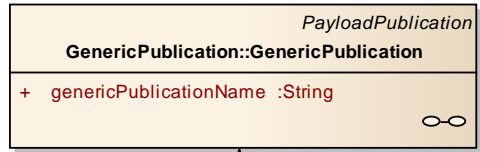
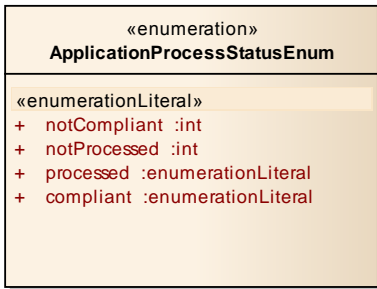
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For the feedback of occurred receipt on Client system and for the notification of the status of event processing, the Client provides an URL that can be accessed for the acquisition of the list of the last correctly received and processed events.

This information will be available through a Feedback publication fully documented at TMP Extension

<http://www.datex2.eu/content/vms-operational-exchange-and-tmp-management>

class FeedbackPublicationExtension



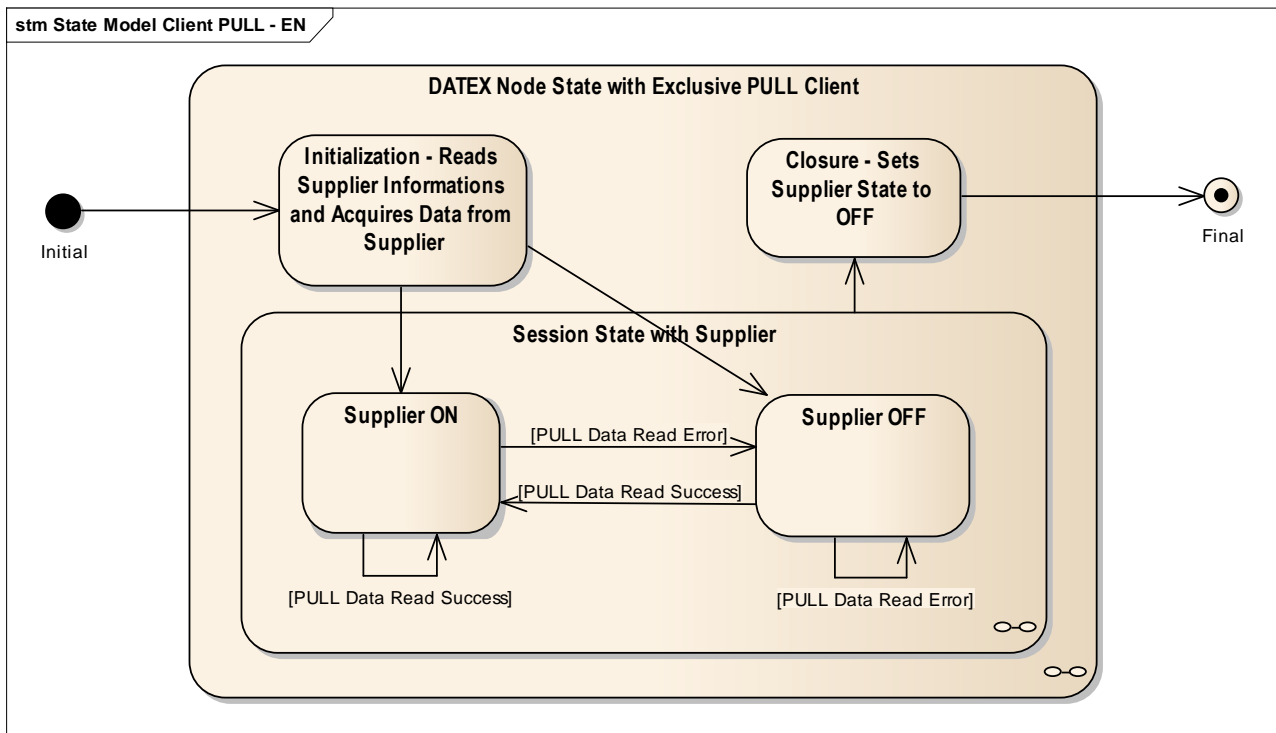


## DATA EXCHANGE

### LOW COST PROFILE

Low Cost Profile involves the interaction between Supplier and Client through the creation of static XML files accessible through a simple http protocol, to which the client accesses with a logic defined by the client itself (periodically or on occurrence of events defined and triggered by the client, e.g. interval cycle timeout).

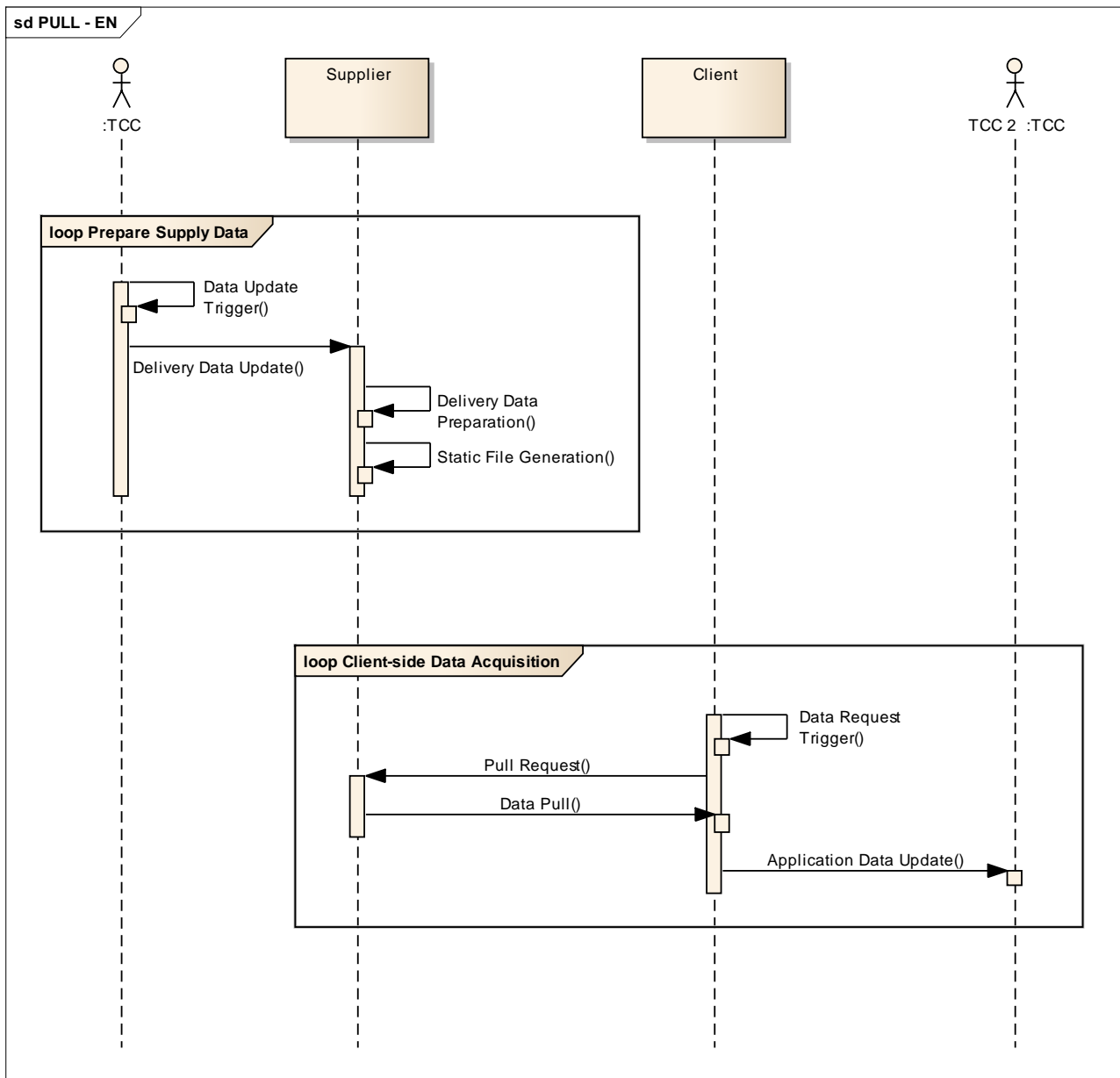
The description of the state of the Client accessing Supplier data using Pull is summarized in the following diagram.



Upon the initialization of the acquisition process, after the referring URLs of the Supplier are acquired, the Client makes a first attempt to receive data from Supplier. Based on the result of this first attempt, the Client-side state of the Supplier can be set to ON or OFF, and this state transition can be potentially updated on every following attempt to acquire data, depending on the logic adopted by the Client.

When acquisition process ends it conventionally sets as OFF the state of connection (Client-side monitored) of all Suppliers and stops acquiring data, without necessarily communicate anything to Suppliers.

The following sequence diagram of Pull activities identifies asynchronously the cyclic tasks on both Supplier-side and Client-side (TCC = Traffic Control Center, the application managing traffic in the control center / Radio Room).



In case of Static Pull, to simplify data access rules and required processing the URLs are differentiated by the different contents of the publication / payload, with a reference nomenclature / URL:

- Events
  - Possibly differentiated in
    - Total Events
    - Road Works
    - Not Road Works Events
    - Immediate Dangers (vehicles against traffic and the like)
- VMS
  - Registry
  - Messages



- Sensors
  - Registry
  - Measurements
- Travel Times
  - Registry
  - Measurements
- Feedback

Each URL will have a base suffix of the path and then will contain a string valued as per the following table:

Information	URL completion: filename.xml
Total Events	SituationPublication.xml
Constructions	SituationPublicationRoadworks.xml
Not Construction Events	SituationPublicationNotRoadworks.xml
Hazard Warnings	SituationPublicationImmediateDanger.xml
PMV Registry	VmsTablePublication.xml
PMV State and Messages	VmsPublication.xml
Sensors and Units Registry	MeasurementSitesPublication.xml
Sensors Data and State	MeasuredDataPublication.xml
Travel Times, Road Sections Registry	ElaboratedDataSites.xml
Travel Times, Elaborated Data	ElaboratedData.xml
Feedback	Feedback.xml

## WEB SERVICES

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### PULL WEB SERVICE / DELTA PULL

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A standard Client Pull is expected to send data grouped in the same categories provided by low cost profile, then using reference URLs with similar nomenclatures that will result in different WSDL each, to collect the information of interest (Events, VMS, Road Works, etc.).

In Pull Web Services a service that returns the same content but in fact implemented via WebServices is called in place of the static file provided in the PULL static http / Low Cost Profile,.

To improve the transmission efficiency it is assumed that it will implemented for the subdomains of interest some services called "DeltaPull" that allow to send to the Client only the updated data based on a timestamp / id of the last data received from the Client. This is not DATEX II standard but more efficient.

Details for the sending of the timestamp / id by the Client



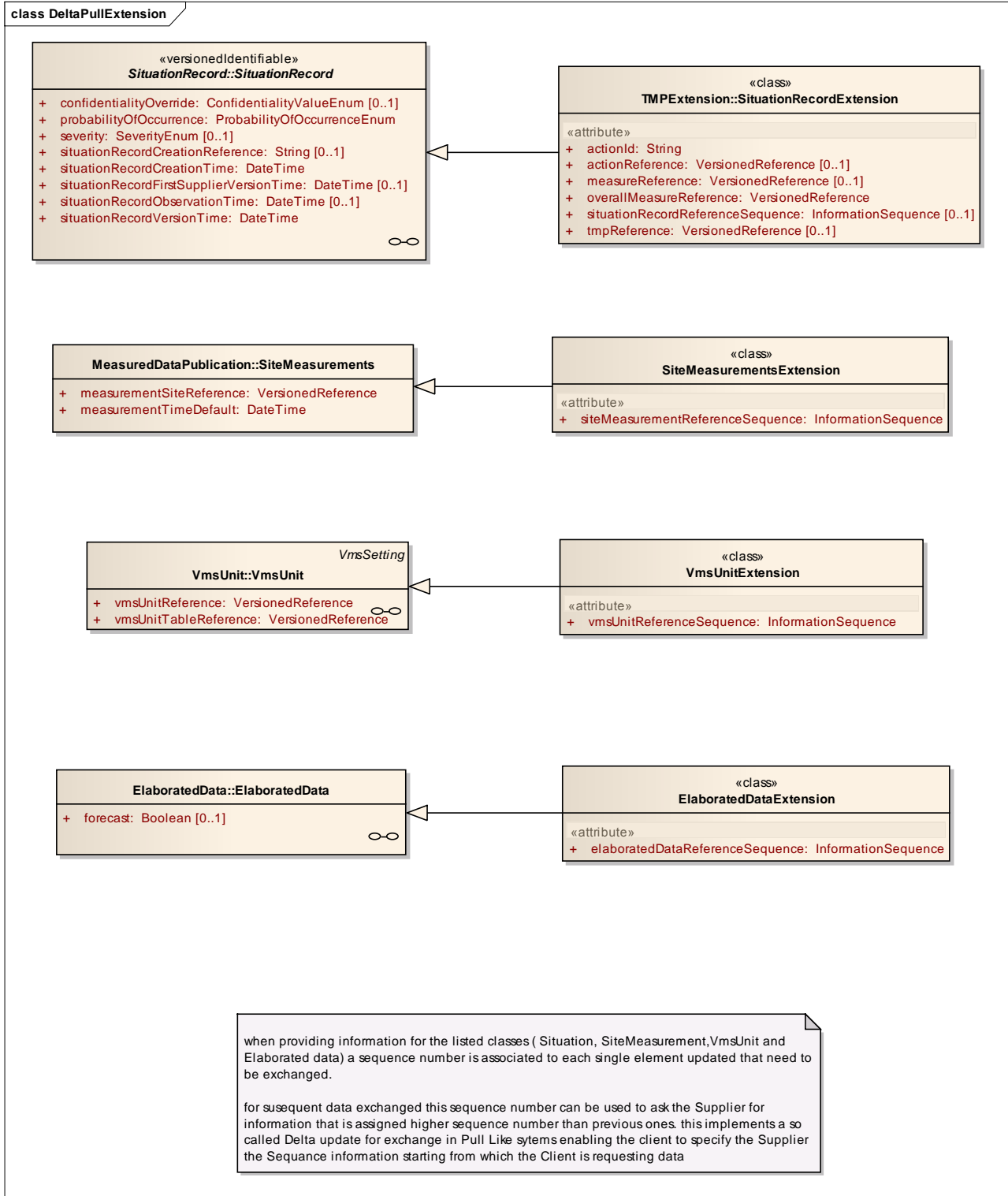
- Information supplier system associates with the basic information to be transmitted (situation record, vms message, sensor measurement) a progressive insertion number into the system (long integer).
- The Client receives the snapshot publication with Pull or DeltaPull and extracts the maximum received progressive. In order to accomplish this the progressive is a number so that the implementation of the function that determines the maximum progressive is only identifiable regardless of the Client.
- At the next DeltaPull request the Client provides as parameter the data of the last and maximum received progressive so that the Supplier provides only information associated with following progressives.
- A prerequisite is to create an extension that allows to store the timestamp associated with the elements that are decided to be sent with DeltaPull mode (situation record, vms message, measured data).

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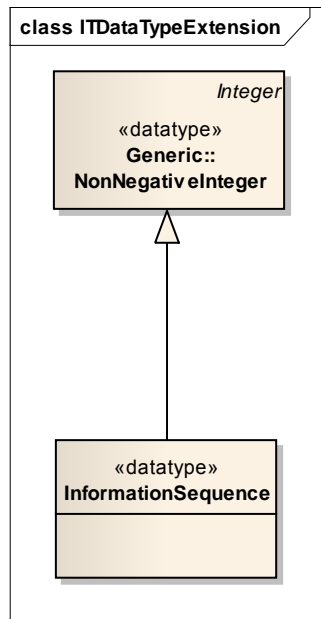
### SYSTEM ENTRY PROGRESSIVE EXTENSION

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The following model extension allows to transfer an entry progressive along with SituationRecord information:



In which:




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## DELTA PULL DETAIL

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The current standard WSDL Datex II Pull provides that the system exports the following method as a Datex II service:

```

<message name="inputMessage"/>
<!-- This version of the DATEX II Pull service doesn't use any input message but
its declaration is here mandatory for a few Web Service frameworks-->
<message name="exchangeMessage">
  <part name="body" element="d2ns:d2LogicalModel"/>
</message>
<portType name="clientPullInterface">
  <operation name="getDatex2Data">
    <input message="tns:inputMessage"/>
  <!-- This version of the DATEX II Pull service doesn't use any input message but
its declaration is here mandatory for a few Web Service frameworks-->
    <output message="tns:exchangeMessage"/>
  </operation>
</portType>
  
```

In the case of DeltaPull, the proposal is to export a Datex II Pull service extended in the following way:

```

<message name="inputMessage"/>
<!-- This version of the DATEX II Pull service doesn't use any input message but
its declaration is here mandatory for a few Web Service frameworks-->

<message name="inputMessageDelta"/>
  <part name="sequenceNumber" element="xsd:long"/>
<message name="exchangeMessage">
  <part name="body" element="d2ns:d2LogicalModel"/>
</message>
<portType name="clientPullInterface">
  <operation name="getDatex2Data">
    <input message="tns:inputMessage"/>
    <output message="tns:exchangeMessage"/>
  </operation>
  <operation name="getDeltaDatex2Data">
  
```



```
<input message="tns:inputMessageDelta"/>
<output message="tns:exchangeMessage"/>
</operation>
</portType>
```

Cioè lo stesso servizio Pull esporta il metodo classico getDatex2Data per la comunicazione standard e in più il metodo getDeltaDatex2Data che ha come parametro il sequence number di partenza da cui si vogliono i dati

That is the same Pull service exports the classical getDatex2Data method for standard communication and in addition the getDeltaDatex2Data method that takes as parameter the starting sequence number for required data.

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## PUSH WEB SERVICE

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Push web services are DATEX II standard services providing the Supplier to send data through the activation of a Push webservice call implemented on the Client side. The timing of the call depends on the logic defined and implemented exclusively on the client side.

They are distinguished:

Push On Occurrence: Puch call activation at the time of the occurrence of a given application condition.

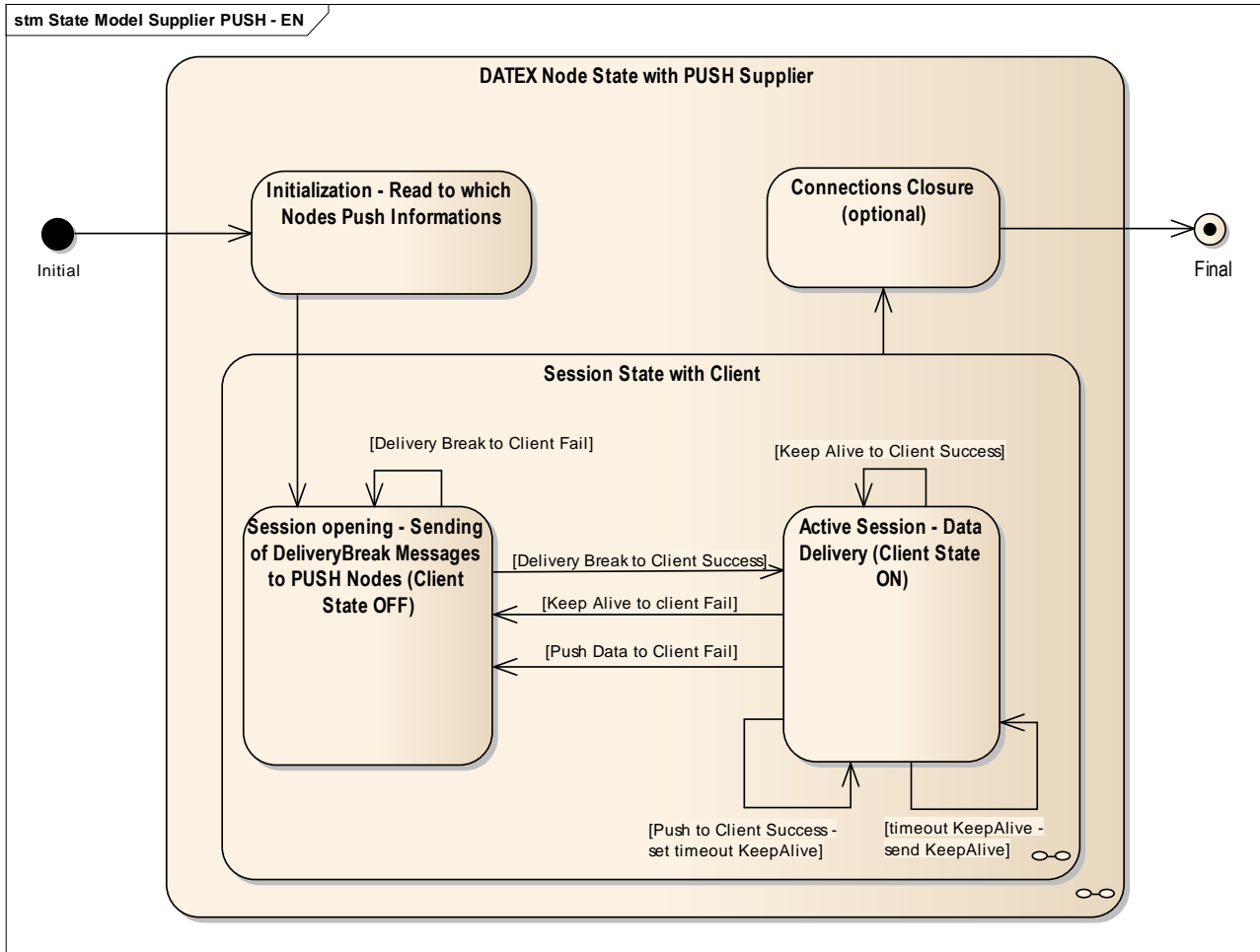
Periodic Push: Push call activation on the basis of an predetermined cyclic period.

Normally the Periodic Push is used in situations of periodic data availability, for example, to collect periodic measurements from road sensors, or when it is necessary to ensure immediate availability of updates.

The Push On Occurrence is normally used in the context of situations that occur randomly and ensures the maximum timeliness in providing the data to the client.

In order to get consistent behavior for Push, "handshaking" phases must be provided in which alignment with Provider data is performed when the system starts or when the connection is restored after network connection losses or maintenance activities. In such cases, the Client is expected to perform a Pull call in order to synchronize the database and retrieve the contents not transmitted during offline period.

The communication with the use of Push methodology between Client and Supplier occurs according to the paradigm illustrated in the following diagrams.



The figure shows the state machine for a DATEX node communicating in Push mode to a given Supplier.

After reading which nodes to connect to, the Supplier must provide a first state of "Session Opening" which allows the system to verify that the Client is operating.

It identifies the need for the Supplier to send in Push mode a DATEX II message called "Delivery Break" that does not contain content payload and notifies to the Client that the Supplier itself is available.

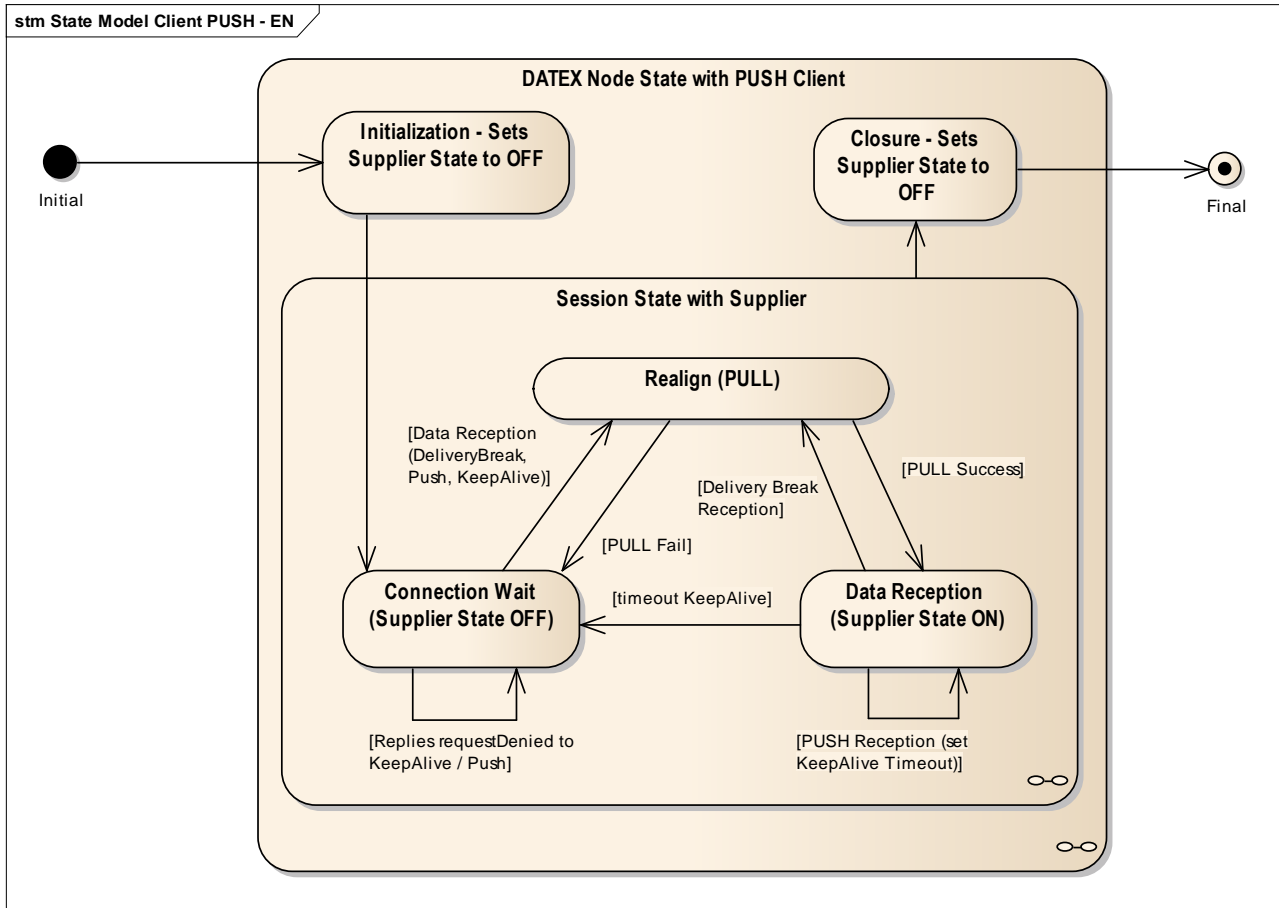
Upon successfully sending the "Delivery Break" message the Supplier considers that the Session is Active for that Client and begins sending continuously in Push mode both the data, when new content is available, and the "Keep Alive" messages, to control the state of the channel in case there is no need to update content.

In case of communication errors that may occur in the Push or KeepAlive notifications, due to connection losses or Client-side closures of the service, the Supplier indicates that the session with the Client is OFF and get back in the "Session Opening" state, trying again to connect to the service through the Delivery Break messages.

In case of service termination it is optional to set the Client state to OFF. Obviously, ceasing Push and KeepAlive notifications in the fixed timeout, the Client will consider the Supplier as not available.

The Client-side state machine is as follows:



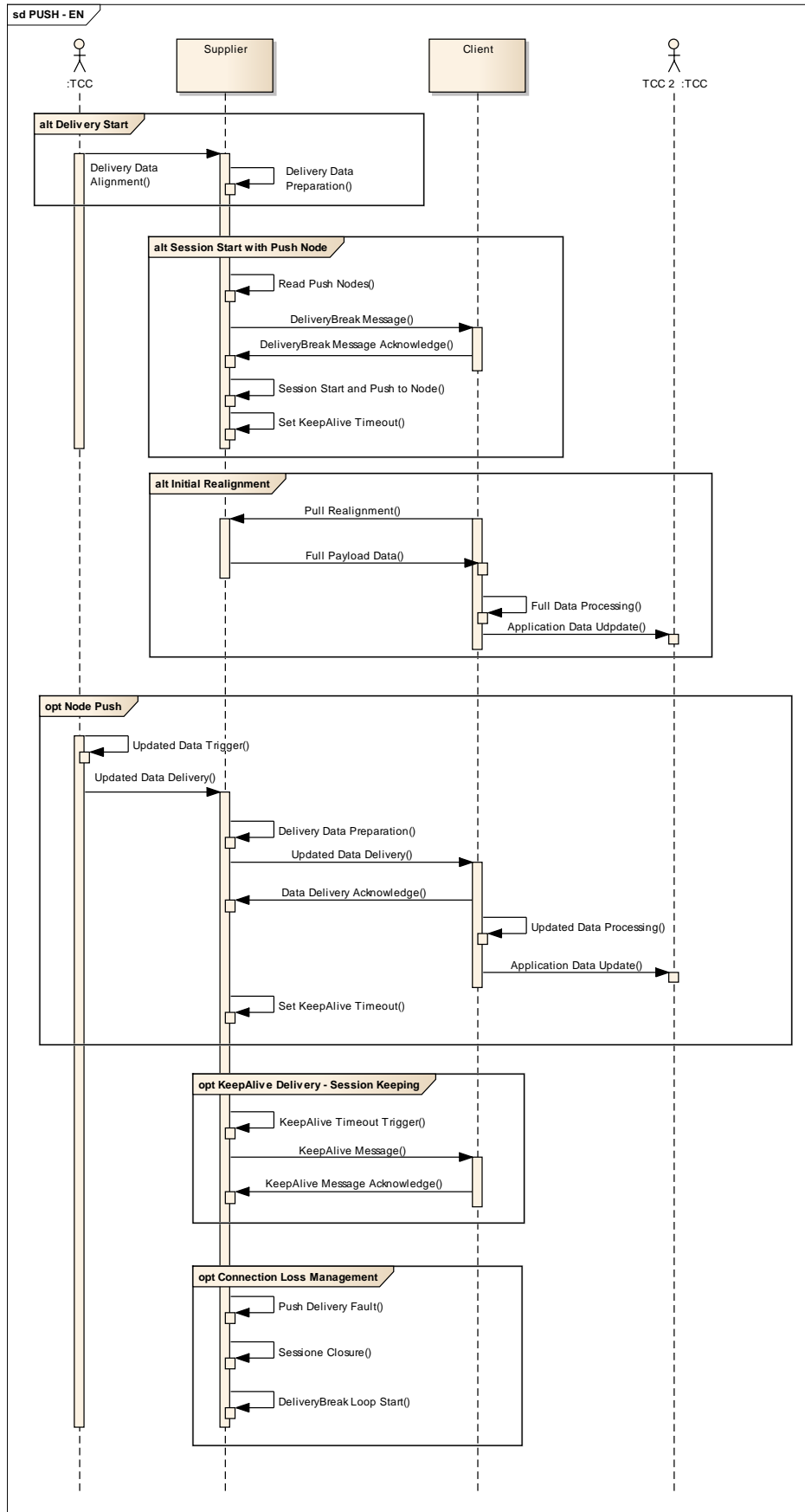


After an initialization phase, the Client enters in a connection-wait state, in which it waits a notification message from the Supplier (normally the DeliveryBreak message).

After receiving this notification message the Client should perform a realignment of the data from the Supplier, so it makes a Pull call to restore all the current content and subsequently arises again in a state of normal reception waiting subsequent notifications, Push or KeepAlive in case of lack of data availability.

In the absence of communication (failure to receive Push content or KeepAlive) the Client will set the Supplier in a disconnection state, waiting for new messages that will lead to a new realignment.

The Sequence Diagrams that show the various steps and state updates of the system are shown in the following figure.



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## IMPLEMENTATION NOTES

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1. Supplier system sends data in Push mode to the Client invoking the Push function implemented by the Client-side webservice.
2. For the monitoring of the communication channel the Supplier uses a dedicated “Keep Alive” message that is implemented as a DATEX II message containing only the Exchange class with the ‘keepAlive’ attribute set to ‘true’:
  - in case the connection is already established the Client replies with a positive response message (property of the acknowledged response);
  - in case the Client still has not connected for the first time, or after a disconnection, it responds with a negative message (requestDenied).
3. For a matter of implementation economy, service names may be grouped into the same categories of content provided by low cost profile, then using reference URLs with similar nomenclatures that will result in different WSDL each, to collect the information of interest (Events, VMS, work , etc.).



## D2 REQUESTS FOR CLARIFICATION OR ISSUES

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In the analysis of the Situation Publication some not understandable points or contradictory points emerged, that are reported to the DATEX Easyway group through the list of issues available on [www.datex2.eu](http://www.datex2.eu) (Referred in this document with ISSUE label).