Department for Transport

BRITISH PARKING ASSOCIATION

Traffic Regulation Order Discovery Project

Draft Data Model – User Guidance

1st Edition (July 2019)

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Traffic Regulation Orders – Data Model – User Guidance

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1. Traffic Regulation Order Discovery Project

1.1. Introduction

The British Parking Association, GeoPlace and Ordnance Survey with funding support from the Department for Transport are conducting a discovery into the process by which TROs are made, and how TRO data is stored and used. This is the Traffic Regulation Order Discovery (TRO Discovery) project.

As part of the TRO Discovery project the project partners have developed a draft Data Model for Traffic Regulation Orders. This draft data model is intended to be a free resource for all.

Taking into account the needs arising from the UK Industrial Strategy and recognising the requirements that will emerge from the deployment of Connected and Automated Vehicles (CAVs) this draft data model provides an initial framework for how the data and information relating to TROs can be formed in the future. Availability of such a draft data model, when suitably tested, will support the move towards TROs being easily accessible to the public whether using apps or driving connected vehicles.

This report is presented to the Department for Transport by British Parking Association (BPA).

The content of this data model has been developed by Harrod Booth Consulting Ltd as a sub-contractor to BPA, in conjunction with Ordnance Survey and Buchanan Computing.

The report presents the draft data model.

1.2. About this document

This document outlines the data modelling concepts defined to help support the definition and exchange of information relating traffic regulations, particularly within the scope of Traffic Regulation Orders as specified under UK legislation.

As explained in the introductory sections of this document the data model contained and described here is by its nature developmental and evolutionary, providing data modelling concepts for a domain that has not been heavily modelled previously and it is recognised that the existing informational content of the existing legacy TROs in the UK are diverse, rich, and in some cases some-what incompatible specification of traffic regulations within the facilitating legislative framework. Creating a unique, discrete, singular and complete data model capable of supporting the modelling of all legacy and currently emerging TROs is probably impractical, and certainly beyond the reach of this initial draft data model.

It is expected that this draft data model will create a basis for further development, a basis of future pilot testing, and a focus of discussion and development of supportive guidance material.

The draft data model documentation is informative in nature. The draft data model is not, and could not be, exhaustive.

This document is primarily intended to be read by technologists that are familiar with data modelling concepts, especially use of UML, and its application within some relevant specifications and models, most specifically:

- TN-ITS – which is standardised as CEN/TS17268:2018; and
- The data model from the Alliance for Parking Data Standards (APDS).

As these referenced specifications are in extensive in nature it is not practical to reproduce their full contents; this document includes necessary cross references to ensure the integration of the models are documented.

Throughout this document when reference is made to the TN-ITS specification, specifically this is the version that is specified in CEN/TS17268:2018.

- The draft data model defined in this document is a first output concerning the modelling of TROs and therefore stakeholders are welcomed to review and comment upon its content.

As this specification evolves it is expected that additional context material will be made available to support ease of access to key concepts and principles for non-technical readers.

1.3. TROs in context

Traffic Regulation Orders (TROs) are UK legislative instruments used by highways authorities to implement changes on the road network. They are used for such diverse things as:

- managing the use of the road with measures such as parking restrictions and speed limits,
- allowing temporary closures for street parties and roadworks, and
- experimental changes.

The new **UK Industrial Strategy**[1] has four Grand Challenges focused on global trends which will transform our future. One challenge is for the UK to become a world leader in shaping the Future of Mobility.

One of the **Future of Mobility**[2] Initial Priorities is to provide a **regulatory framework** to ensure we continue to have one of the most open environments in the world for transport innovation.

Data is a key enabler for innovation. Exploring and encouraging the **use of data** to support more effective operation of our transport system is one of our early priorities for the Future of Mobility Grand Challenge.

The **North Highland Report**[3]**,** commissioned by DfT in 2018, explored the transport data held by Local Authorities. Its key findings relating to TROs were that:

- TRO data is difficult and time consuming to access, clean and process,
- TRO data is not in a standardised, machine readable format,
- TROs lack of a centralised point of reference,
- Private sector organisations are being forced to collect TRO data manually, and
- The current process for amending and implementing a TRO to be labour intensive, time consuming, and costly.

The report recommended that the Department for Transport sponsor data projects which encourage and foster better local authority transport services, including streamlining and digitising Traffic Regulation Orders.

As a result, the TRO Discovery project was commissioned to develop amongst other products a draft Data Model for TROs, with the scope given above.

[1] https://www.gov.uk/government/topical-events/the-uks-industrial-strategy
[2] https://www.gov.uk/government/publications/future-of-mobility-urban-strategy
[3] https://www.gov.uk/government/publications/local-transport-data-discovery-findings-and-recommendations

1.4. About the British Parking Association

British Parking Association are the largest, most established and trusted professional association representing parking and traffic management in Europe and the recognised authority within the parking profession.

Our diverse membership community of around 700 organisations includes technology developers & suppliers, equipment manufacturers, learning providers, consultants, structural & refurbishment experts, local authorities and parking on private land operators including retail parks, healthcare facilities, universities, airports and railways stations.

We engender collaboration between stakeholders, members and government to support growth for our communities, improve compliance amongst those managing and using parking facilities, and encourage fairness and consistency to achieve the vision of excellence in parking for all. We are committed to promoting innovation, technology, growth and sustainability, and the very highest of standards with the aim of making parking a recognised profession.

We are a not-for profit organisation and a company limited by guarantee.

1.5. Acknowledgements

This document has been prepared with the kind support of Ordnance Survey and Buchanan Computing. The report has been authored by Harrod Booth Consulting Ltd, under contract to the British Parking Association.

1.6. The TRO Discovery project

This draft data model has been developed within the Department for Transport (DfT) TRO Discovery project, a collaborative initiative with the BPA, GeoPlace and Ordnance Survey. The Discovery Project was designed to collect evidence into the process by which TROs are made, and how TRO data is stored and used to help inform our response to the challenges of the 'digital by default' world of apps, connected and automated vehicles. There are three key strands to the TRO Discovery Project:

- **User research** - this is a wide-ranging exploration of the TRO landscape, intended to establish the current situation, current concerns and future needs. Findings of the user research have informed the contents of this guide.
- **Data modelling** - developing from the user research, leading industry experts have reviewed the types of data structures that will need to be in place to support the digital future.
- **The Guide** - also coming out of the user research, the project team has drawn together best practice from the industry and from the user research to create this Guide.

1.7. Non-proprietary terms

There are numerous companies currently servicing the TRO market and it is anticipated that this will increase as TROs become more important in the future of transportation.

The BPA and the Department for Transport do not endorse any particular companies and non-proprietary terms are used throughout this Guidance.

1.8. Disclaimer

This draft data model is developmental and experimental in nature. It cannot be considered to be complete or error-free. It should not be viewed as stable and may be subject to alteration without notice.

1.9. Licensing

The Department for Transport are sharing this document and the data model it contains to support iteration and development by the Department for Transport.

2. Data Modelling Approach

2.1. Background

Data modelling is by its nature open to interpretation, different approaches and may reflect the personal preferences of those developing it.

The project partners agreed with DfT that the modelling approach would seek to achieve several aims:

- It provides as simple a modelling structure as is possible to model as wide a spectrum of traffic regulation concepts as is practicable
- Based on internationally recognised standards.
- Based on an appropriate and relevant data structure.
- Compatible with other standards where possible.
- As open and accessible as possible.

The management and exchange of traffic regulations, traffic regulations orders (or their international equivalents) is a strengthening need, that will support the digitisation of traffic, vehicle automation and enhanced data-centric transport and mobility services.

Transport and mobility include both the short local and cross-border long-distance journey. There is a need to develop common national and international mechanisms to ensure the efficient and safe movement of vehicles and road users. Commonality is needed to support travel between jurisdictions.

At present, although international conventions support the free movement of road traffic and general conditions for safe common road use, and other road features such as common aspects of road signs, there are no existing common technical standards for how to encode and model road traffic regulations.

This draft data model is perhaps the first recognised effort to support such encoding, expressly for the purpose of exchanging details concerning road traffic regulations, their location and features as well as the traffic impact that they create.

In recognition of this evolving and necessary international harmonisation the project partners in agreement with DfT have sought to create a draft data model built on internationally used modelling conventions and builds upon similar initiatives that are seeking to perform broadly similar functions.

2.2. Choice of the Modelling Framework

The choice of modelling framework is discussed in a separate document (Data Model Workstream – Modelling Framework). This document lays out the criteria that were considered in the choice of the modelling framework, mentioned in the Approach section above.

The recommendation and choice of the modelling framework consisting of INSPIRE and ISO/TC211 standards (Geomatics). It is the most familiar framework to the project team modellers but also the most relevant. In addition, existing products that are readily available to all highways authorities already conform to the standards and specifications defined in this option as well as building strong links to other initiatives such as TN-ITS.

TN-ITS is a European wide initiative to make road network data available in a common way from road authorities. TN-ITS is standardised in a CEN Technical Specification CEN/TS 17268:2018 – "Intelligent transport systems – ITS spatial data – Data exchange on changes in road attributes".

Within the introduction to the European Committee for Standardisation's (CEN's) Technical Specification reference is made to EU Delegated Regulations. The "Commission Delegated Regulation (EU) 2015/962 of 18 December 2014 supplementing Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of EU wide real-time traffic information services" sets out the requirements, for road authorities, road operators and service providers, for the accessibility, exchange, re-use and provision of updates of static road data, road status data and traffic data.

Road authorities and road operators provide the static road data they collect and update in a standardized format, if available, or in any other machine-readable format, on a non-discriminatory basis, and digital map providers collaborate with the data providers to ensure that any inaccuracies related to static road data are signalled without delay to the road authorities The Delegated Regulation provides a list of types of static road data to be addressed. This document takes full account of the part of the Regulation concerning static road data, and supports and facilitates road authorities, road operators and digital map providers to implement and fulfil the requirements of the Regulation with respect to the provision and use of such data.

The document's specification is well aligned with Directive 2007/2/EU establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). Under this directive, public authorities provide road network geospatial data sets in an INSPIRE-compliant way.

The INSPIRE Road Transport Network application schema contains data types to manage a range of "Transport Properties", particularly related to 'moving' orders such as Access Restrictions (by weight, height, length, width; as well as distinguishing between 'legal' and 'physical). All these can also have "valid from" & "valid to" date/times.

Other initiatives such as TN-ITS already embrace the INSPIRE model, specifically the specification developed for Transport Networks. There is also a synergy with other Europe-wide traffic management exchange initiatives, such as the DATEX II standards for traffic management information exchange, particularly in the quest to harmonise common information.

Additionally, OS MasterMap Highways Network, which every Highway Authority in GB has access to, extends the INSPIRE Transport Networks (Road and Water) Technical Specification (version 3.2). OS MasterMap Generic Network model extends the INSPIRE Base Models - Generic Network Model (version 3.0rc3).

Finally, UK Government has already put in place legislation about the use of the INSPIRE specifications and standards by public authorities:

http://www.legislation.gov.uk/uksi/2009/3157/contents/made

There is also a post Brexit version that demonstrates a commitment to this position:

http://www.legislation.gov.uk/uksi/2018/1338/contents/made

INSPIRE & ISO/TC211 provide a basis for a modelling approach which is commonly given as a UML-based (Unified Modelling Language) model drive architecture driven (MDA) modelling framework. This specific approach underpins the TN-ITS model and specification. The modelling preferences are specified within ISO/TC211 standards.

3. Linkage to the user research

The TRO Discovery project has conducted thorough user research activities, reviewing the existing TRO processes, pain points and potential areas for improvement.

User feedback has demonstrated a need for a national data standard, supported by guidance and templates. The lack of common standards is seen by potential users of the data as a single barrier to interoperability.

To this end the development and evolution of common data standards, reinforced by a common data model is seen as a beneficial step forward.

4. TRO Modelling Key Concepts

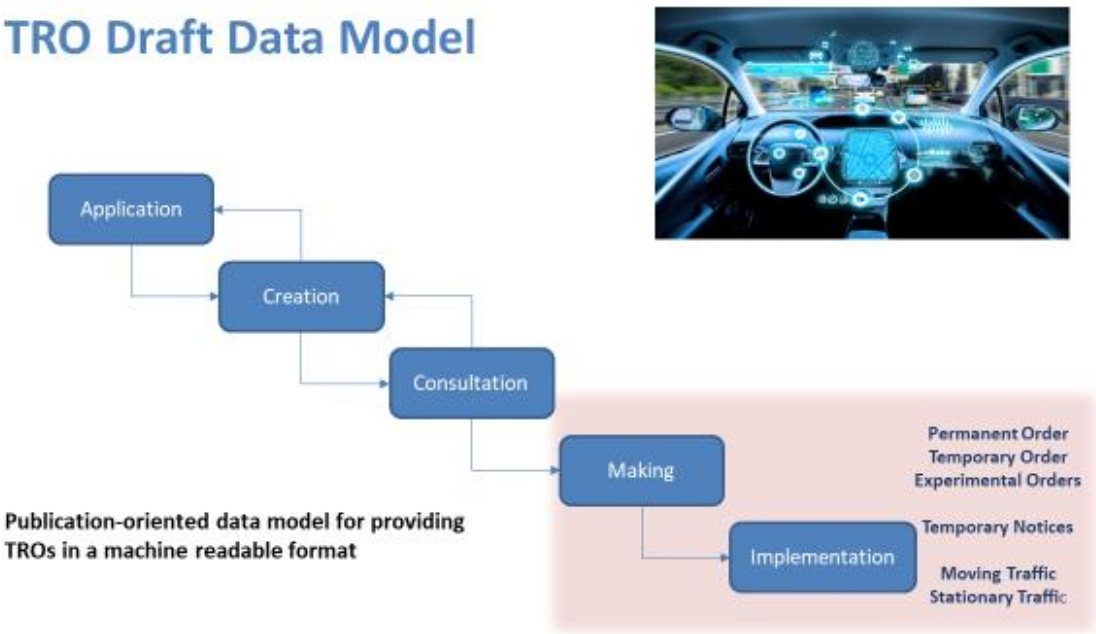
TROs are complex and have been specified by highway authorities over an extended period, with quite some variation of style and approach. Developing a draft version of a first data model is challenging and therefore choices and simplifications are needed. Onward reviews of this model will identify omissions and exceptions, but the approach adopted within the project sought to provide clear first data modelling constructs to cover a range of key concepts.

Clear modelling of key concepts related to TROs:

- The legal Order itself, as made by the traffic authority
- Road network features (instantiated by the Order) that control the movement of traffic, use of the highways, etc, which includes the modelling of the traffic effect of the regulation for that feature
- Basic modelling of road traffic signs
- Basic modelling of road markings

The making and implementing of TROs is a multi-step process. The focus of this initial draft data model characterising relevant data towards the latter end of the TRO process, that is data concerning:

- TROs that have been made, or are just about to be made;
- TRO implementation through road traffic signs and road markings.



The scope of the TRO Discovery draft data model aims to cover different forms of Order (permanent, temporary, experimental and notices) for both moving and stationary traffic.

This document does not replicate the content and specification of the TN-ITS specifications which are detailed in CEN/TS17268:2018. However, the approach adopted reuses the TN-ITS concepts both for the definition and encoding of the data and the exchange mechanisms that are used to exchange the data. Many of the existing concepts from TN-ITS are appropriate for the exchange of road attribute data from data supplier to data consumer. However, the user research elements of the TRO Discovery project require additional data concepts to be exchanged.

To achieve this, this specification extends the existing TN-ITS specification. Such extensions are clearly denoted in this specification.

Key differences between the TN-ITS and TRO Discovery data models are:

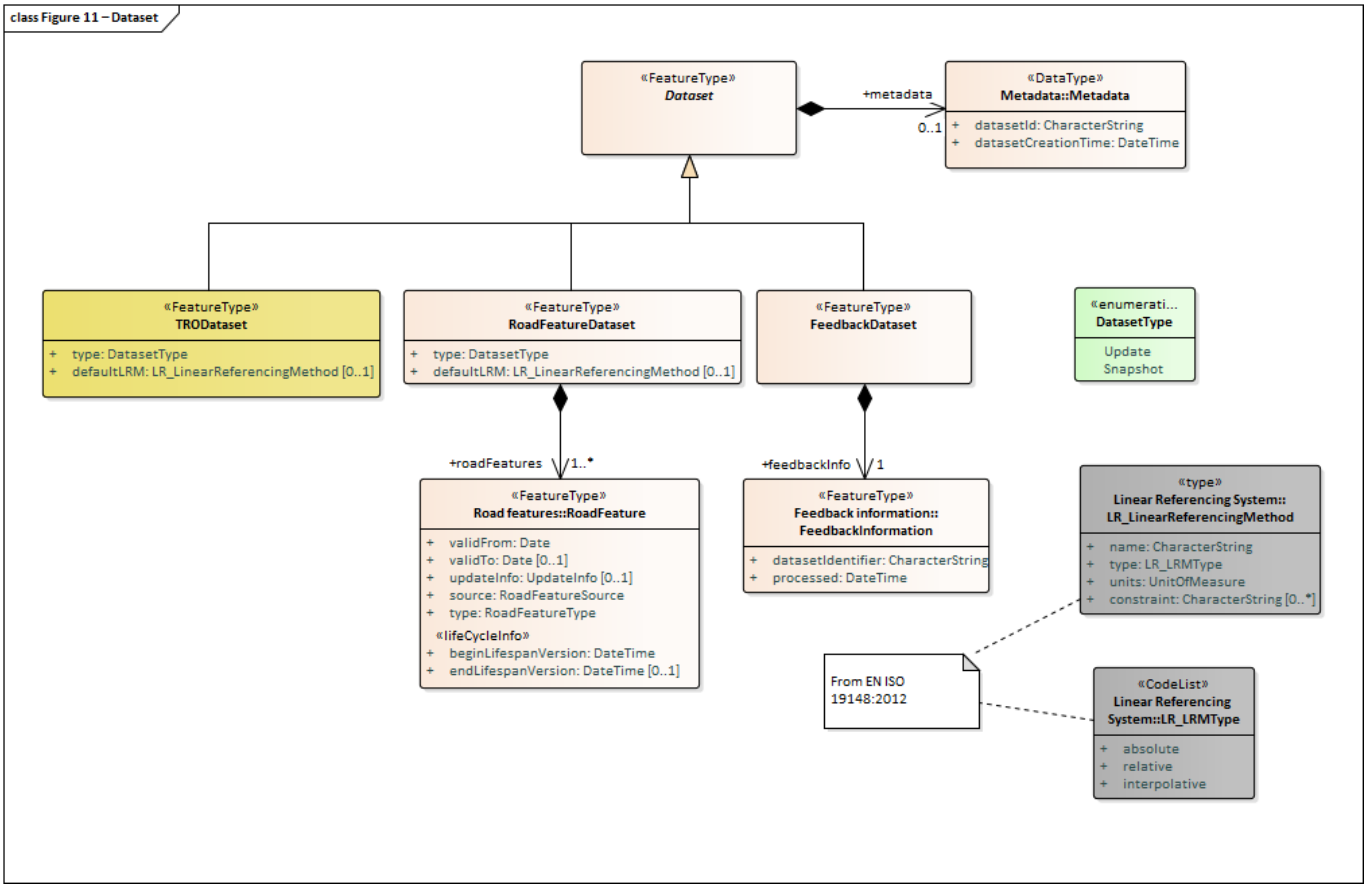
- TN-ITS is centred around the exchange of road attributes, which includes concepts such as speed limits, but also enables the exchange of basic attribution concerning road signs. The TN-ITS modelling of traffic signs is limited to the location of the sign and basic attribution that dictates the specific messaging purpose of the sign.
- The TRO Discovery draft data model explicitly supports the exchange of information concerning road traffic regulations (Traffic Regulation Orders in the UK context) – noting that the content of the legal order may be distinct and different from the road features (lines and signs) that indicate some aspects of its presence. It is common for the set of conditions applying to a TRO to be broader than those illustrated by the visual clues such as signs. Therefore, in preparation for higher levels of vehicle automation it is essential that all of the conditions that apply under a TRO can be encapsulated and exchanged, not just the presence of a specific sign.
- Additionally, the TRO Discovery draft data model enables the exchange of a greater set of attribution concerning road signs including key dimensions and the mounting height. This is expected to support improved sign recognition matching by enhanced vehicle vision detection systems augmented by map data.
- Furthermore, the TRO Discovery draft data model supports the encoding of a simple representation of the road markings, including horizontally mounted road signage.
- The TN-ITS data model assumes all features (extended to include RegulationFeatures in our model) are located against the road network link/node model. For the modelling of traffic regulation orders, a richer ability to define location must be provided and therefore the TRO Discovery draft data model includes the ability to reference geometric point, linear and area locations that are not related to the reference road network reference line.
- When considering the different forms of conditions that may be applied to a road feature (or regulation feature in the case of the TRO Discovery data model) many options exist. For example, TN-ITS supports conditions that relate to the vehicle type, vehicle usage, vehicle dimensions, fuel type, etc. These condition lists were reviewed from the viewpoint of normal practice in the UK by experienced practitioners. This has resulted in a profiling of these condition types and lists that are more suitable for current UK practice – in general, forming much shorter lists than the lists found in TN-ITS.

The TRO Discovery draft data model has been specified as an extension/modification of the TN-ITS model as characterised in CEN/TS17268:2018. Where options exist the preference for extension rather than modification is chosen – to maintain compatibility with the standardised TN-ITS approach.

As the RoadFeatures classes of TN-ITS do not to seem to suit well the definition of Traffic Orders, their sub-elements and features they refer to, a new specialisation of Dataset, TRODataset, has been defined.

4.2. Extending TN-ITS with the TRODataset

Figure 1 – TN-ITS Dataset with TRODataset extension



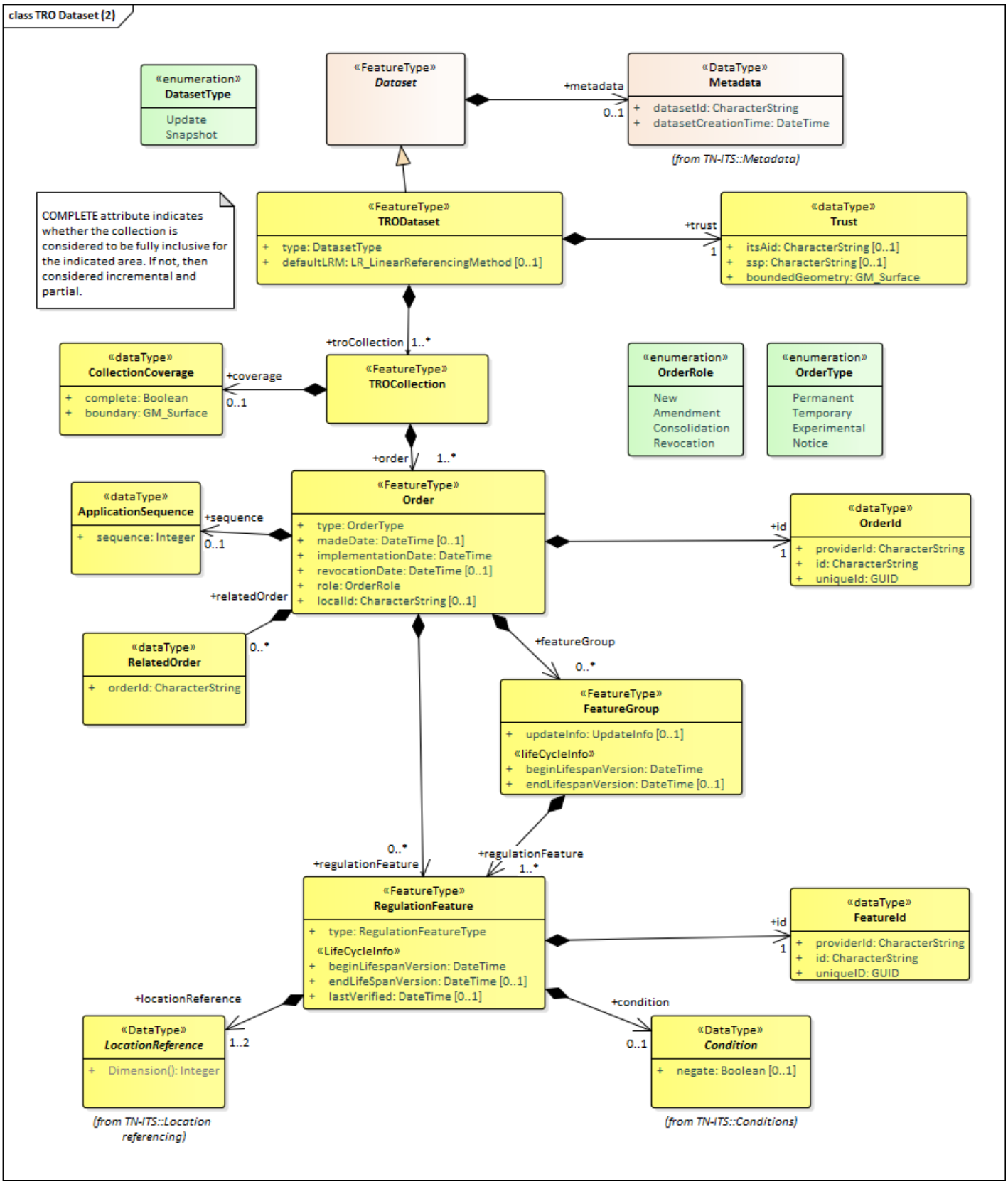
Note: Colour coding is used in this document – yellow shading indicates additions proposed for the TRO Discovery draft data model, baselined against the TN-ITS model.

Figure 1 is an adaptation of Figure 11 found in CEN/TS17268:2019.

The Data Dictionary section later in this document, provides full details of each class.

Within the TRODataset construct, we define a hierarchical structure containing, respectively, TRODataset, TROCollection, Order, FeatureGroup, RegulationFeature.

Figure 2 - TRODataset extension



Order and RegulationFeature have unique identifiers and hold independent lifecycle information.

The TRODataset construct has been defined to enable uses in several modes:

- Specification of a new set of TROs which each identify defined Features.
- Specification of a snapshot, which is a status report of Orders within a defined geography.

The TRODataset contains the following:

- One or several TROCollections, which in turn contain Orders. A TROCollection is attributed to indicate within the geographic scope it covers whether it is considered to be complete or incomplete – and as such representing a subset of Orders that are meaningful to the data supplier.
- The TRO (Order Class) can identify the Order itself as new, an amendment, or a consolidation.
- Individual Orders themselves may support multiple FeatureGroups which in turn identify one or several RegulationFeatures. Alternatively, the Order, as a whole, may identify one or several RegulationFeatures. Each Order class shall have at least one RegulationFeature and/or FeatureGroup. Each FeatureGroup shall have at least one RegulationFeature.
- RegulationFeatures.
  - Each RegulationFeature may have one set of Conditions.
  - When using the following means of specifying a location reference for a RegulationFeature: by reference to a link; by reference to a point on a link; by reference to a linear location defined on a link; by reference to a series of links; by reference to a node and the affected Links – each RegulationFeature shall have one location reference.
  - When using the following means of specifying a location reference for a RegulationFeature: by reference to a geometric linear or area shape, which may be unrelated to the road link – each RegulationFeature shall have two location references.
  - One location reference shall utilise geometric linear or area location to define the "real world" location of a regulation. This is beneficial in defining the location of, for example, specific parking bays or kerbside parking restrictions.
  - The second location reference shall utilise one of the location referencing method that relates the location back to the road network model (namely: by reference to a link; by reference to a point on a link; by reference to a linear location defined on a link; by reference to a series of links; by reference to a node and the affected Links). This enables all regulations to be related to the road network which is expected to ease computational load and support routing and other algorithms.

Where an Order covers both the specification of new features and the revocation of other existing features, it is necessary to separate the original legal Order into several Order objects, each of which achieves a specific purpose of creating new features, revoking existing parts or whole features, or consolidation.

The RelatedOrder class enables linked Orders to be associated.

It should be noted that the TRODataset construct has been developed to support a publication

mechanism to provide changes in status – it has not been developed to support the creation and exchange of a full history of the evolution of Orders and RegulationFeatures.

Note: The RelatedOrder class may be used to provide a reference to an earlier version of an Order, or a previous Order that this current Order replaces. In this version of the specification, no additional attribution is provided to describe the nature of the relationship provided by a RelatedOrder – it is assumed that the data recipient will be able to derive the nature of the relationship from the supplied Orders. This may be changed in later versions of this specification.

The class ApplicationSequence may be applied. If applied, it shall be applied to all Orders within a TROCollection. If applied, it indicates the sequence in which the orders shall be applied, with the first Order being applied given the sequence number 1, the second 2 and so on. The use of the ApplicationSequence concepts enables more general orders to be applied for larger zones and then subsequent, later applied Orders to provide exceptions within the original zone. Example: a residential zone in which streets in general have a speed limit of 30 mph, but one instance of an arterial route passing through the zone has a speed limit of 40 mph. This concept does not exist in TN-ITS.

Note: Use of the ApplicationSequence concept are not intended to replicate precisely the content of legal Orders which are not expected to be created in an additive cumulative manner. Use of the Application sequence concept is provided to support IT and data management application of sequences of Order classes intended to derive and model equivalence of the real-world legal Orders.

The lifecycle attribute "lastVerified" is included. This attribute permits the data supplier to update and indicate when this feature was last validated – although this is not expected to be used much in current practice, it is expected with higher quality requirements that this may be populated more in the future.

If a data supplier is using this data model structure to provide on-street captured content and proposed TROs, a dummy identifier may be developed to support the exchange of this information.

4.3. Specifying Conditions for TROs

Being able to specify conditions that apply to features is a key element of TN-ITS. Such conditions enable feature properties to detail, for example, width restrictions; access restrictions by vehicle type; conditions applied under different weather conditions, etc.

The nature of TN-ITS specified conditions was centred initially on moving traffic features and particularly those that support ADAS (Advanced Driver Assistance Systems applications), most significantly those related to speed warning and alerts.

The TRO Discovery data model has reviewed the conditions specified in TN-ITS, with those that exist in other data sets and products, and with expert views of conditions most commonly found within UK TROs.

The TRO Discovery draft data model is based on the existing TN-ITS data model as specified in CEN/TS 17128:2018.

The TN-ITS model for Conditions are used to specify conditions or constraints that apply to a road feature (or TRO RegulationFeature in our draft data model). These include time period, vehicle type, weather conditions, etc.);

To address complex conditions a ConditionSet can be specified using a sequence of Conditions with logical operators specifying the relationship of the conditions. The example taken from TN-ITS is as follows:

<ConditionSet operator = ”OR”>

<ConditionSet operator = ”AND” >

<TimeCondition…/>

<VehicleCondition…/ >

</ConditionSet>

<ConditionSet operator = ”AND” >

<TimeCondition…/ >

<VehicleCondition…/ >

</ConditionSet>

</ConditionSet>

Or, the same example in an alternate notation:

((TimeCondition and VehicleCondition) or (TimeCondition and VehicleCondition))

A condition stating VehicleType = EmergencyVehicle and negate = true would mean all vehicles except those of type EmergencyVehicle.

An unset negate value means the same as false, i.e. no negation applied.

For the TRO Discovery draft data model, the overall set of types of conditions that can be specified is the same as TN-ITS, but there are modifications in the details of how conditions are specified and values permitted.

The types of Condition that may be specified are:

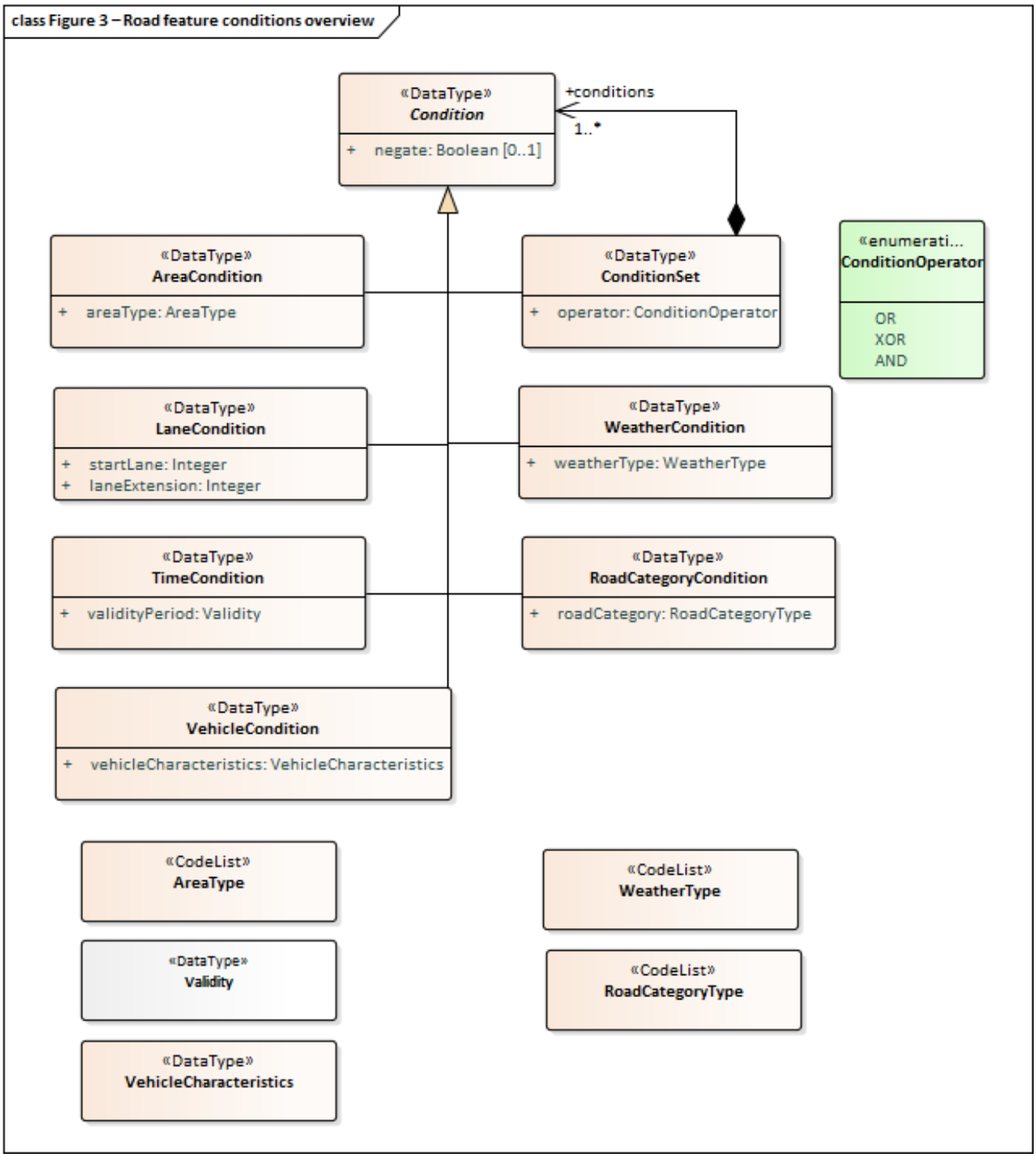
- Area Condition
- Lane Condition
- Time Condition
- Vehicle Condition
- Weather Condition
- Road Category Condition

These are specified as per TN-ITS, except Time Condition and Vehicle Condition.

Where the specification is the same as the TN-ITS specification the content is not repeated here.

Figure 3 below replicates the contents of Figure 3 of CEN/TS17268:2018.

Figure 3 - Road Feature Condition Overview



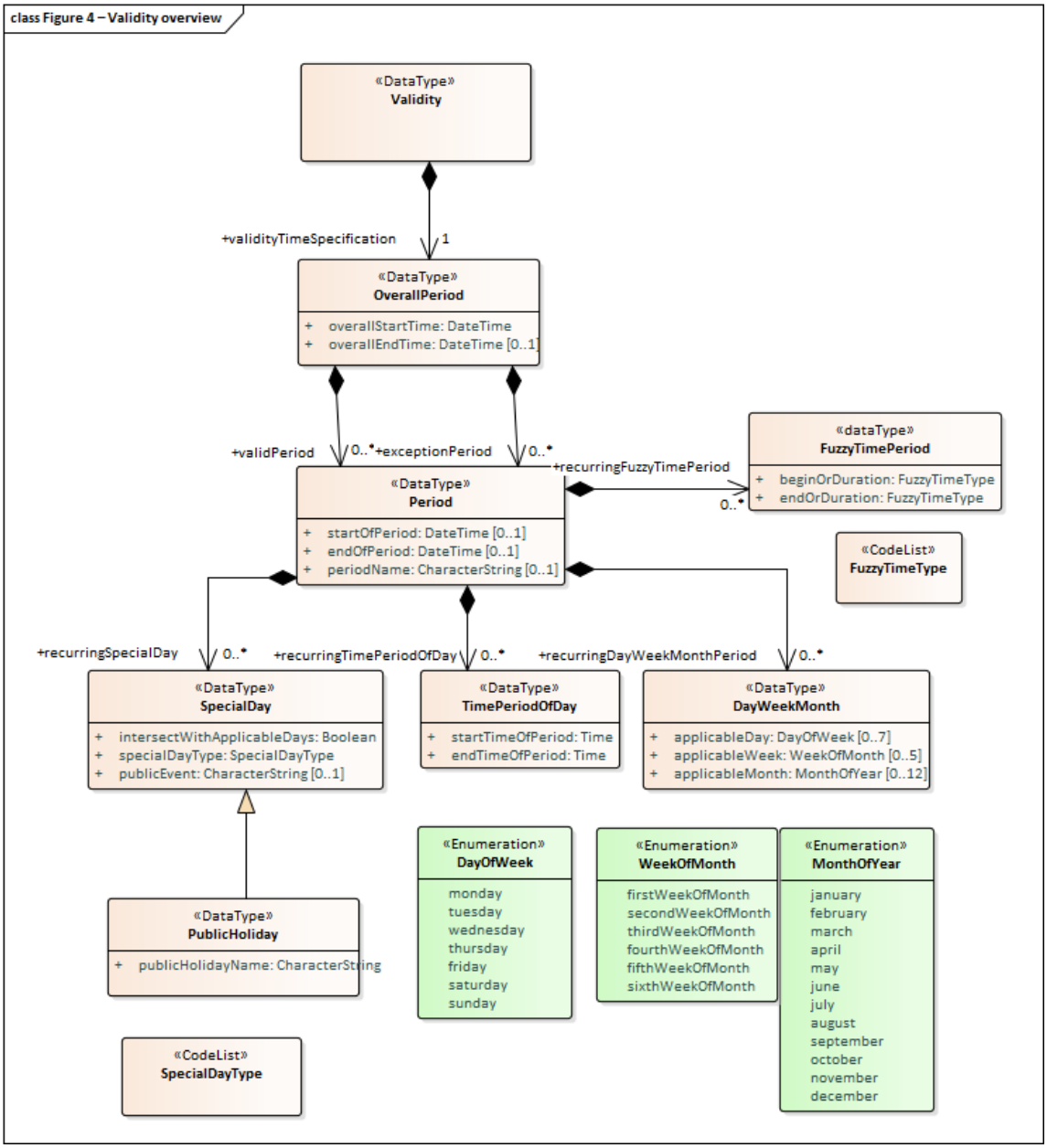
The following section details modifications made to the TN-ITS specification (in CEN/TS17268:2018) to reflect the requirements of the TRO Discovery draft data model.

Note: This model has been tailored to include common concepts that are known to be used on UK highways. Other attribution which appears in the TN-ITS specification which is not known to appear in UK TROs has been suppressed. Such values may be altered with subsequent reviews and testing.

4.4. Specifying Time Conditions

Figure 4, given below, replicates figure 4 in CEN/TS17268:2018.

Figure 4 - Validity overview



The TRO Discovery draft data model has been adapted to reflect common practice found within UK TRO.

For time validity modelling the TN-ITS Validity model is unchanged except for the following modifications.

Modification 1 – The attribute applicableWeek within the DayWeekMonth class shall not be used (i.e. multiplicity = 0). Consequentially the WeekOfMonth Enumerations are not used.

Modification 2 – The use of enumerations within the FuzzyTimeType Class have been restricted from the list found in TN-ITS. Table 26 replicates the content of Table A.14 of CEN/TS17268:2018, which defines the characteristics of the FuzzyTimeType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethrough. A full copy of the Class definition is given in the Data Dictionary section.

A summarised view is as follows:

Values retained from TN-ITS:

- external
- dawn
- dusk
- holiday

Values suppressed from TN-ITS:

- school
- winter
- spring
- summer
- autumn
- high tide
- low tide
- high water
- low water
- wet season
- dry season
- peak hours
- off peak hours
- day
- night

Modification 3 – The use of enumerations within the SpecialDayType Class have been restricted from the list found in TN-ITS. Table 27 replicates the content of Table A.38 of CEN/TS17268:2018, which defines the characteristics of the SpecialDayType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethrough. Additional enumerations are marked in green. A full copy of the Class definition is given in the Data Dictionary section.

A summarised view is as follows:

Values retained from TN-ITS:

- public holiday
- school day
- school holiday
- other

The following values are proposed to be added:

- good friday (the Friday immediately before Easter)
- market day
- match day
- event day

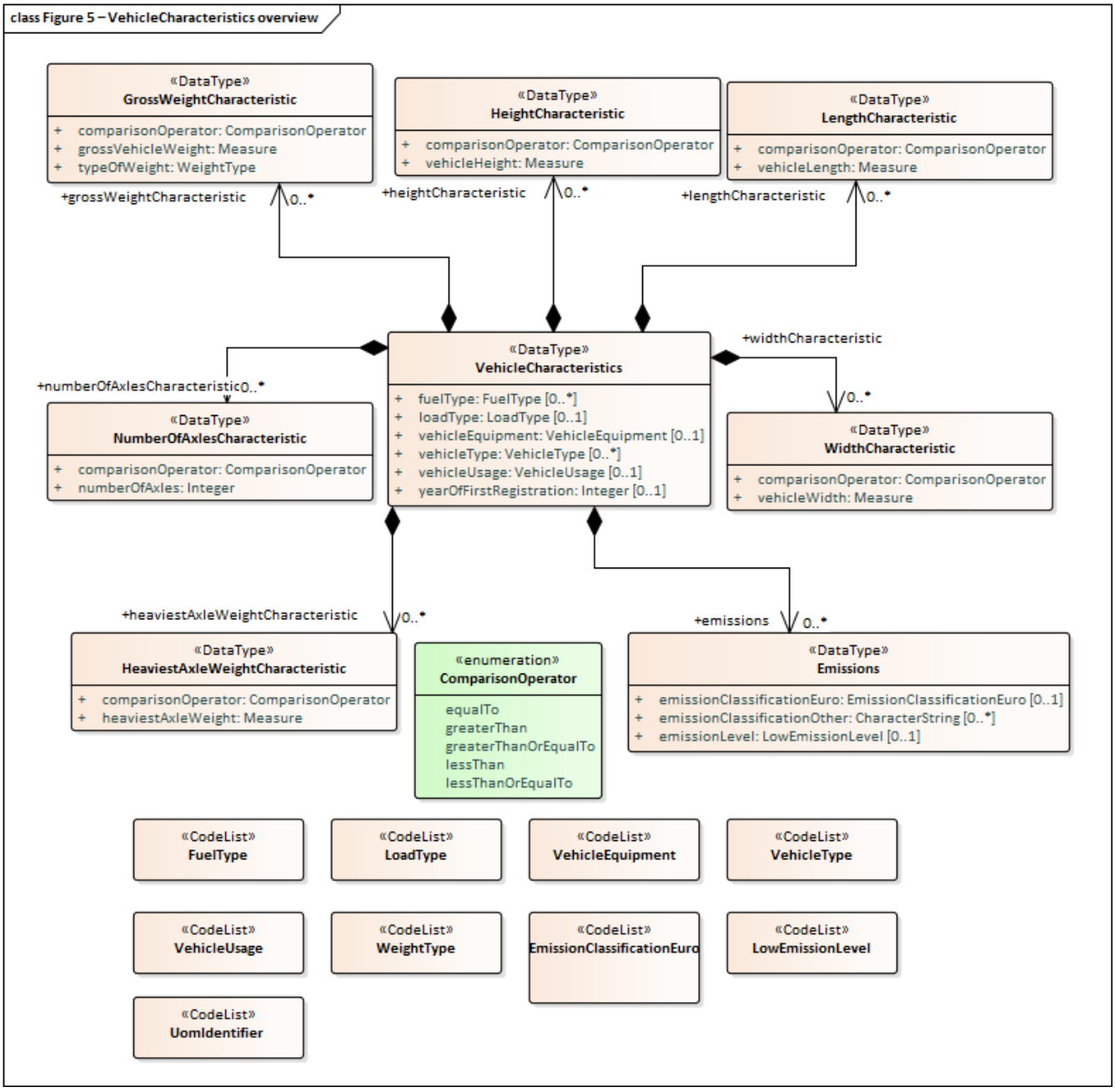
Values suppressed from TN-ITS:

- day before public holiday
- day following public holiday
- long weekend day
- in lieu of public holiday
- public event day

4.5. Specifying Vehicle Conditions

Figure 5, given below, replicates figure 5 in CEN/TS17268:2018.

Figure 5 - VehicleCharacteristics overview



For vehicle condition modelling the TN-ITS VehicleCondition is unchanged except for the following modifications.

Modification 1 – To reflect current UK TRO practice the following attributes within the VehicleCharacteristics Class shall not be used: fuelType, vehicleEquipment, yearOfFirstRegistration.

Modification 2 – To reflect current UK TRO practice the following attributes within the Emissions Class shall not be used: emissionsLevel, emissionClassificationOther.

Modification 3 – The use of enumerations within the LoadType Class have been restricted from the list found in TN-ITS. Table 28 replicates the content of Table A.18 of CEN/TS17268:2018, which defines

the characteristics of the LoadType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethrough. A full copy of the Class definition is given in the Data Dictionary section.

A summarised view is as follows:

Values retained from TN-ITS:

- empty
- explosiveMaterials

Values suppressed from TN-ITS:

- abnormalLoad
- ammunition
- chemicals
- combustibleMaterials
- corrosiveMaterials
- debris
- extraHighLoad
- extraLongLoad
- extraWideLoad
- fuel
- glass
- goods
- hazardousMaterials
- liquid
- livestock
- materials
- materialsDangerousForPeople
- materialsDangerousForTheEnvironment
- materialsDangerousForWater
- oil
- ordinary
- perishableProducts
- petrol
- pharmaceuticalMaterials
- radioactiveMaterials
- refrigeratedGoods
- refuse
- toxicMaterials
- vehicles
- other

The following values are proposed to be added:

- dangerousGoods

Modification 4 – The use of enumerations within the VehicleType Class have been restricted from the list found in TN-ITS. Table 29 replicates the content of Table A.35 of CEN/TS17268:2018, which defines the characteristics of the VehicleType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethrough. A full copy of the Class definition is given in the Data Dictionary section.

A summarised view is as follows:

Values retained from TN-ITS:

- anyVehicle
- articulatedVehicle
- bicycle
- motorcycle
- car
- caravan
- bus
- vehicleWithTrailer
- agriculturalVehicle

The following values are proposed to be added:

- lightRailTram
- mopedSmallMotercycle
- emergencyServicesVehicle
- taxi
- goodsVehicle
- horseDrawnVehicle
- pedestrian
- riddenOrAccompaniedHorses
- trackLayingVehicle
- herdedAnimals

Values suppressed from TN-ITS:

- moped; motorscooter, motorcycleWithSideCar, largeCar, passengerCar, smallCar, carOrLightVehicle, carWithCaravan, carWithTrailer, articulatedBus, fourWheelDrive, highSidedVehicle, heavyGoodsVehicle, heavyGoodsVehicleWithTrailer, heavyDutyTransporter, heavyVehicle, lightCommercialVehicle, largeGoodsVehicle, lightCommercialVehicleWithTrailer, longHeavyLorry, lorry, van, minibus, motorhome, constructionOrMaintenanceVehicle, tanker, twoWheeledVehicle, threeWheeledVehicle, vehicleWithCaravan, vehicleWithCatalyticConverter, vehicleWithoutCatalyticConverter, withEvenNumberedRegistrationPlates, withOddNumberedRegistrationPlates, metro, lightRail, trailer, tram, trolleyBus, articulatedTrolleyBus, unknown, other

Modification 5 – The use of enumerations within the VehicleUsage Class have been restricted from the list found in TN-ITS. Table 30 replicates the content of Table A.36 of CEN/TS17268:2018, which defines the characteristics of the VehicleUsage Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethrough. A full copy of the Class definition is given in the Data Dictionary section.

A summarised view is as follows:

Values retained from TN-ITS:

- Military

The following values are proposed to be added:

- access
- accessToOffStreetPremises
- authorisedVehicles
- guidedBuses
- loadingAndUnloading
- localBuses
- paymentOrRestrictedParking
- pedestrians
- privateHireVehicle
- locallyRegisteredPrivateHire Vehicle
- settingDown
- settingDownByTaxi
- settingDownDisabledPerson
- noStopping
- noLoading
- noWaiting
- Parking
- highwayAuthorityPurpose
- statutoryUndertakerPurpose
- busOperationPurpose
- electricVehicleCharging

Values suppressed from TN-ITS:

- agricultural
- carsharing
- cityLogistics
- commercial
- emergencyServices
- nonCommercial
- Patrol
- recoveryServices
- roadMaintenanceOrConstruction
- roadOperator
- Taxi

4.6. Condition Modelling for Payment and Permits

The TN-ITS Condition model omits any ability to model conditions that relate to either payment or different forms of permit.

Modelling work undertaken by the Alliance for Parking Data Standards provides modelling structures that support many features relating to aspects of parking and facility usage. The APDS modelling specifications are suitable for both off-street and on-street parking, and as such provide modelling structures that cover many aspects of relating to payment and the use of permits.

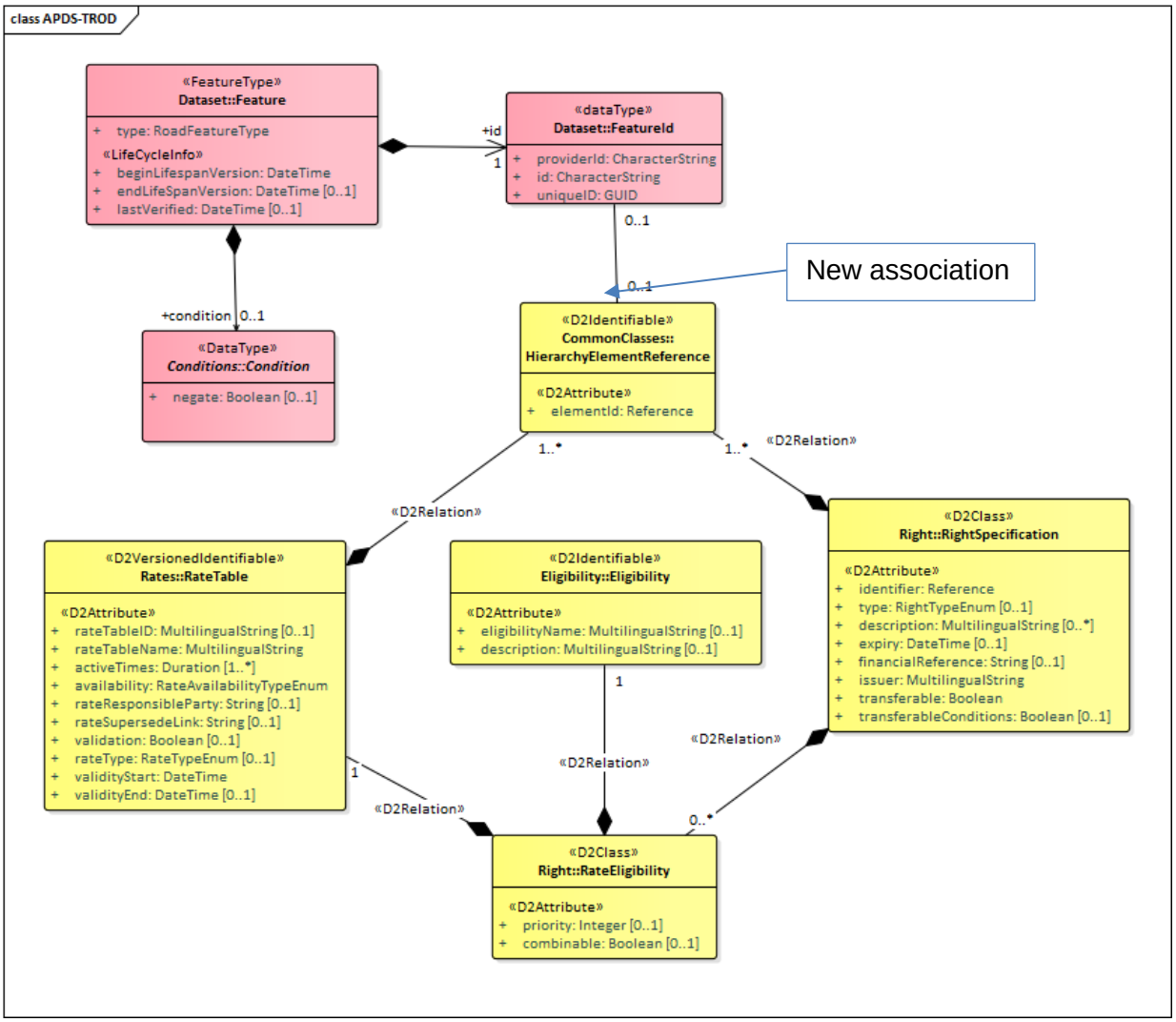
A future development may see integration of common aspects of the APDS model and the TRO-D model, but this will require collaboration between several different communities of interest.

A first option is to provide a means to relate objects in both the APDS model and the TRO-D model.

The obvious link between the APDS model and the TRO-D data model is to support a cross reference between any element of the APDS Place hierarchy and a TRO Feature. APDS already has a concept of a HierarchyElementReference that supports referencing to any specific part of a Place hierarchy.

Bringing together elements from APDS and TRO-D, using the Feature – Place reference link, it is possible to define eligibility criteria related to (Parking) rights, and associated rates. The figure below integrates elements of APDS and TRO-D.

Figure 6 – Linking the APDS data model and the TRO Discovery data model



Commentary:

- The TRO-D Conditions and APDS Eligibility both enable setting of condition criteria. There is some similarity here, but also some differences. TRO-D are more road-centric whereas APDS Eligibility are more user-centred. Both are presented in the figures below.
- The combined use of the two models, with practical worked examples, is likely to suggest that there should be a rationalisation of concepts. Although not ideal, this is somewhat natural given the stepwise evolution of the APDS release 1, APDS release 2 and TRO-D models.
- Given that APDS Release 2 is notionally finalised and ready for public review and time is pressing for the TRO-D release for review, it is not suggested to make larger scale changes at this time.

4.7. Link to a Trust Model

On the assumption that the TRODataset is a bundle of data that is delivered homogeneously, it also has an association to the trust model. The elements of the trust model that are characterised in this data model are:

- The Provider Service Identifier (PSID), as defined in IEEE1609.2 WAVE, which is the ITS-AID (the ITS Application Identifier) which indicates the unique identifier of the service provided
- The Service Specific Permission (SSP) (from IEEE1609.2 WAVE) which identifying specific sender permissions within that PSID's application area. The syntax and semantics of the SSP are specific to each PSID value. The SSP can be used to indicate, for example, the service group (e.g. I am an authority that can public traffic regulations/restrictions), [4]and
- The Generation Location, as defined in IEEE1609.2 WAVE, which enables encoding of the boundary of the supplier geography. Encoding is specified in IEEE1602.2 WAVE, using a PolygonalRegion which is a sequence of 3 or more TwoDLocation each of which contains a latitude and longitude (WGS84).

These tie into the C-ITS security concepts – use of certificates and ISO 21177/21185 concepts. The specific encoding of the Trust class elements requires further investigation.

Note: For future consideration: In principle certificates and trust could also be applied at the feature level, given that Features have a potentially independent lifecycle.

The precise characteristics and attribution to support an authentication and trust model enabling confidence in traffic regulation exchange will require further consideration – and is presented here is a first potential option.

[4] As an example of SSP use, SSPs have been defined by the European Telecommunications Standards Institute (ETSI) for use by senders of the Cooperative Awareness Message (CAM) (ETSI EN 302 637-2 [B5]) and Decentralized Environmental Notification Message (DENM) (ETSI EN 302 637-3 [B6]). For CAM, the message contains several possible extension fields; the SSP defines which extension fields a sender can include, as well as optional fields within those extension fields.

5. Modelling lines and signs

In addition to supporting a mechanism to model data related to the traffic regulations themselves, there is an expectation that data concerning road traffic signs and road markings (lines, icons and text) will be required to provide key visible contextual references to support drivers and automated services interpreting road traffic regulations.

Although ultimately, there are advocates for the view that future automated data-centric capabilities will remove the need for road signs and marking – this is certainly not a near-term possibility.

Therefore, the TRO Discovery draft data model specifies basic mechanisms to convey information concerning signs and road markings, and these may be linked to TRO Features.

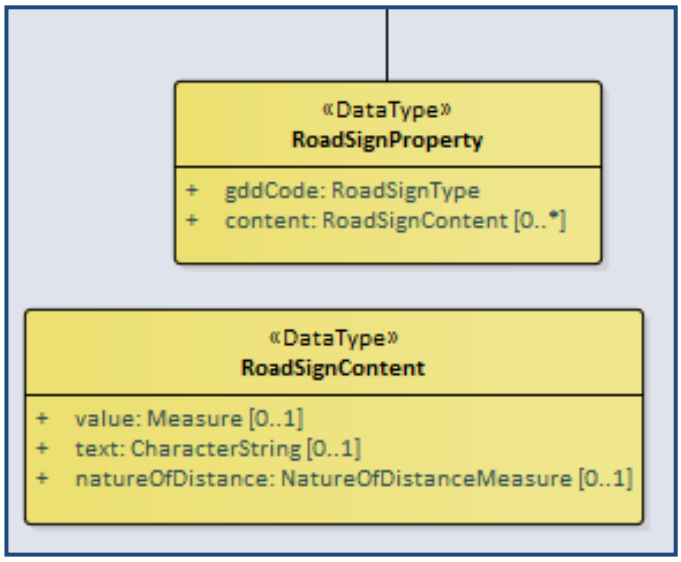
TN-ITS does provide a mechanism for passing limited information concerning road signs, but this has been extended by the TRO draft data model.

The TN-ITS modelling of road signs is limited. Figure 7 shows the current TN-ITS model for road signs, which supports the specification of one code identifying the nature/purpose of the sign (gddCode) and zero to many sets of RoadSignContent. The gddCode references codes specified in the ISO standard ISO 14823 (ISO, 2017) which provides a structured catalogue of categories of fixed plate road sign icons and semantic meanings.

The RoadSignContent enables basic attribution to be specified and conveyed. This includes a value (example: 200 metres); a natureOfDistance attributes which provides the option to state the quoted value is applicable for that distance (e.g. for the next 200 metres) or applicable at that distance (e.g. low bridge in 200 metres).

For the user needs associated with the TRO Discovery draft data model, it is acknowledged that ISO 14823 may not cover all necessary road signs and therefore a mechanism has been introduced to create an alternate record for a road sign and make reference to a local reference catalogue (in the case of the UK, the TSRGD). Additionally some basic attribution concerning the physical size dimensions of the sign, its mounting height and direction it is intended to be read from are also supported – as these attributes are considered to be supportive for digital databases that support road sign recognition systems within vehicles.

Figure 7 – RoadSignProperty model in TN-ITS



The TRO Discovery draft data model for road signs is seen in Figure 8.

Additionally, the TRO Discovery draft data model introduces a basic mechanism to exchange simple information on the physical characteristics of road markings, including lines, icons and text. Guidance from UK TRO practitioners has suggested that it is currently non-trivial to provide a simple mechanism to classify the semantic purpose of a road marking and therefore this is currently omitted. This is an area for further work in the future.

The RoadMarking and RoadSign property classes have an attribute to enable linkage to specific TRO Features.

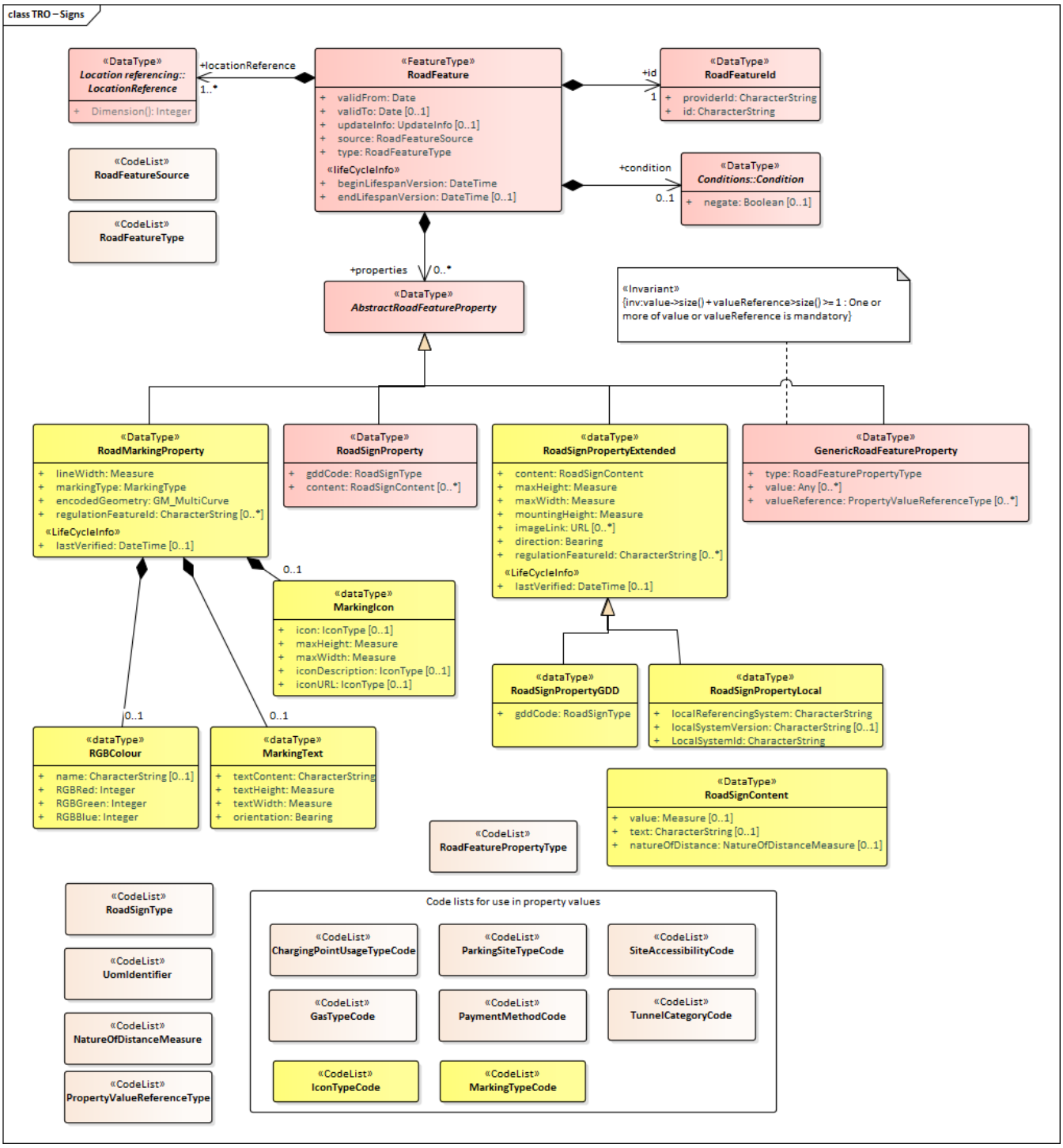
Road markings are characterised as lines, icons or text.

They also contain an optional last verified attribute, to support data quality validation.

It should be noted that the use of RoadSignProperty and RoadMarkingProperty within the context of the use of the TRO Discovery model are expected to be optional. This is ultimately a DfT policy decision.

As the TRO Discovery draft data model is built as an extension to the TN-ITS model and the characteristic of the modelling of road signs is different to that in TN-ITS an additional specialisation of the AbstractRoadFeatureProperty Class, namely RoadSignPropertyExtended, has been introduced.

Figure 8 - Recording lines and signs

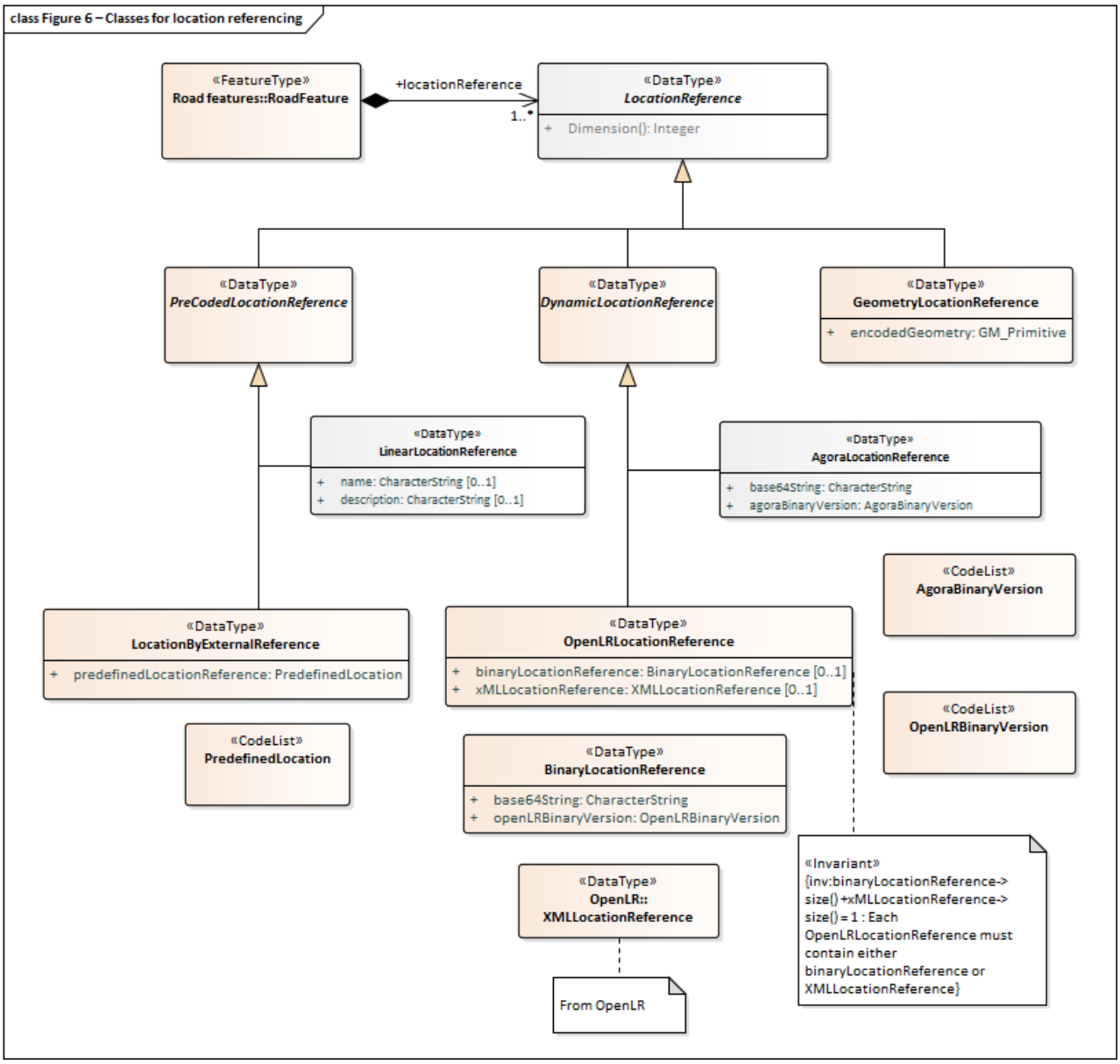


Note: For future consideration: The extended attribution for road signs and the attribution for road markings are initial modelling thoughts and should be verified with entities that are collecting or using road sign and marking data, such as the SENSORIS initiative.

GDD (ISO 14823) forms a good common basis for sharing classification information concerning fixed road signs. There is no common reference list for road marking icons or different line/marking types. There would be benefit in developing both.

6. Location Referencing

Figure 9 – Classes for Location Referencing (Figure 6 of CEN/TS17268)



TN-ITS concepts are oriented around defining locations by means of linear locations or point locations that relate to some underlying linear network (link/node model). TN-ITS supports some well-known location referencing methods such as use of OpenLR, and AGORA C. These are illustrated in Figure 9 and Figure 10. These mechanisms are specified in CEN/TS17268:2018.

The scope of the modelling of concepts in the TRO Discovery draft data model is wider that those supported by TN-ITS. In addition to the TN-ITS location references:

- a point location (on a link);
- a linear location (on a link)
- an entire link

The TRO Discovery draft data model also supports modelling of a location reference to:

- a node
- an area

This approach would also enable zonal traffic conditions to be applied (i.e. all roads within a defined polygonal zone sharing a common speed limit).

Figure 10 – Linear Location Referencing

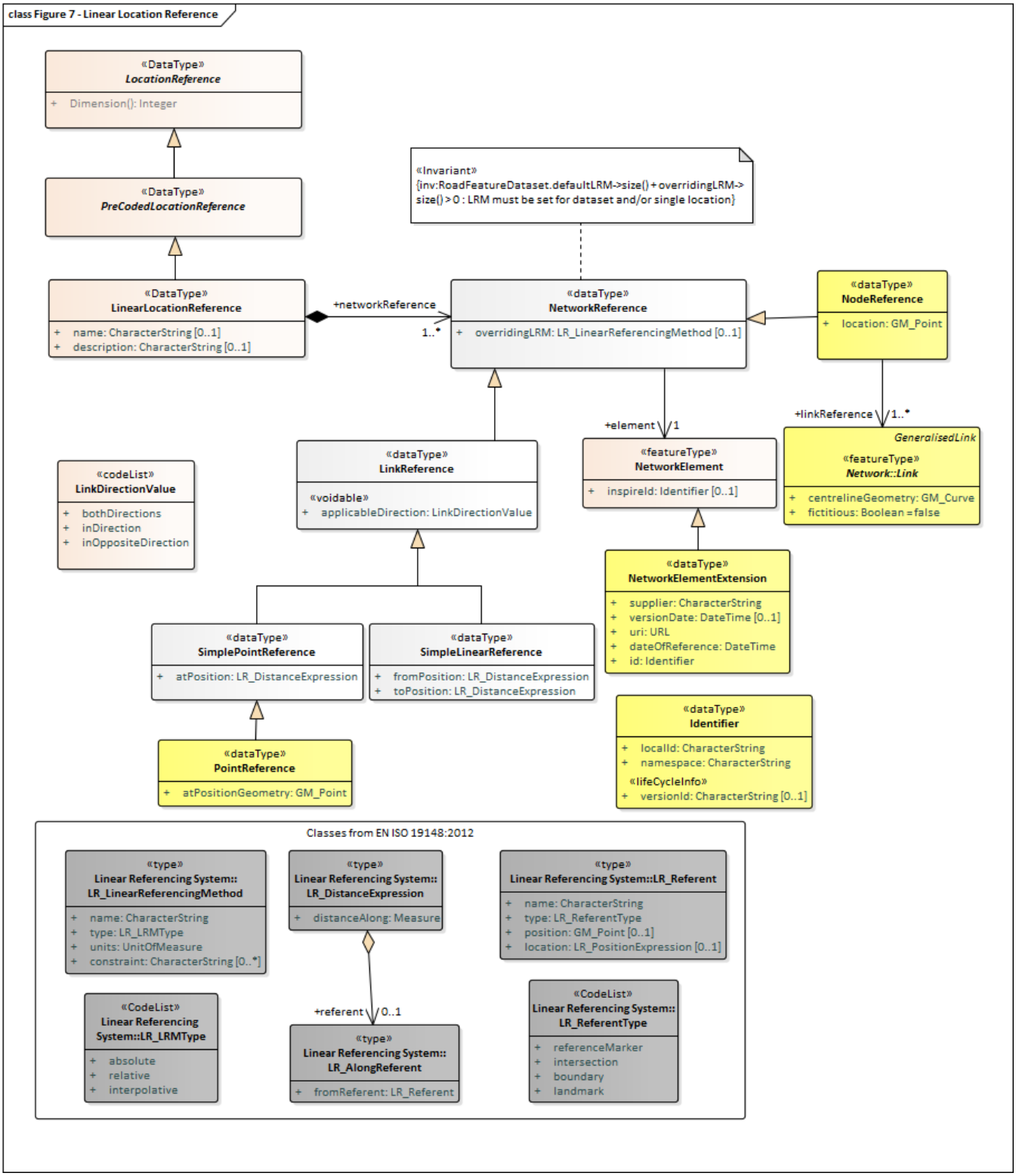


Figure 11 extends the TN-ITS model using standardised modelling concepts that are sourced from INSPIRE (See deliverable D2.10.1) and DATEX II modelling (EN16157-2:2018) to support the modelling of areas.

Figure 11 – Area Location Referencing

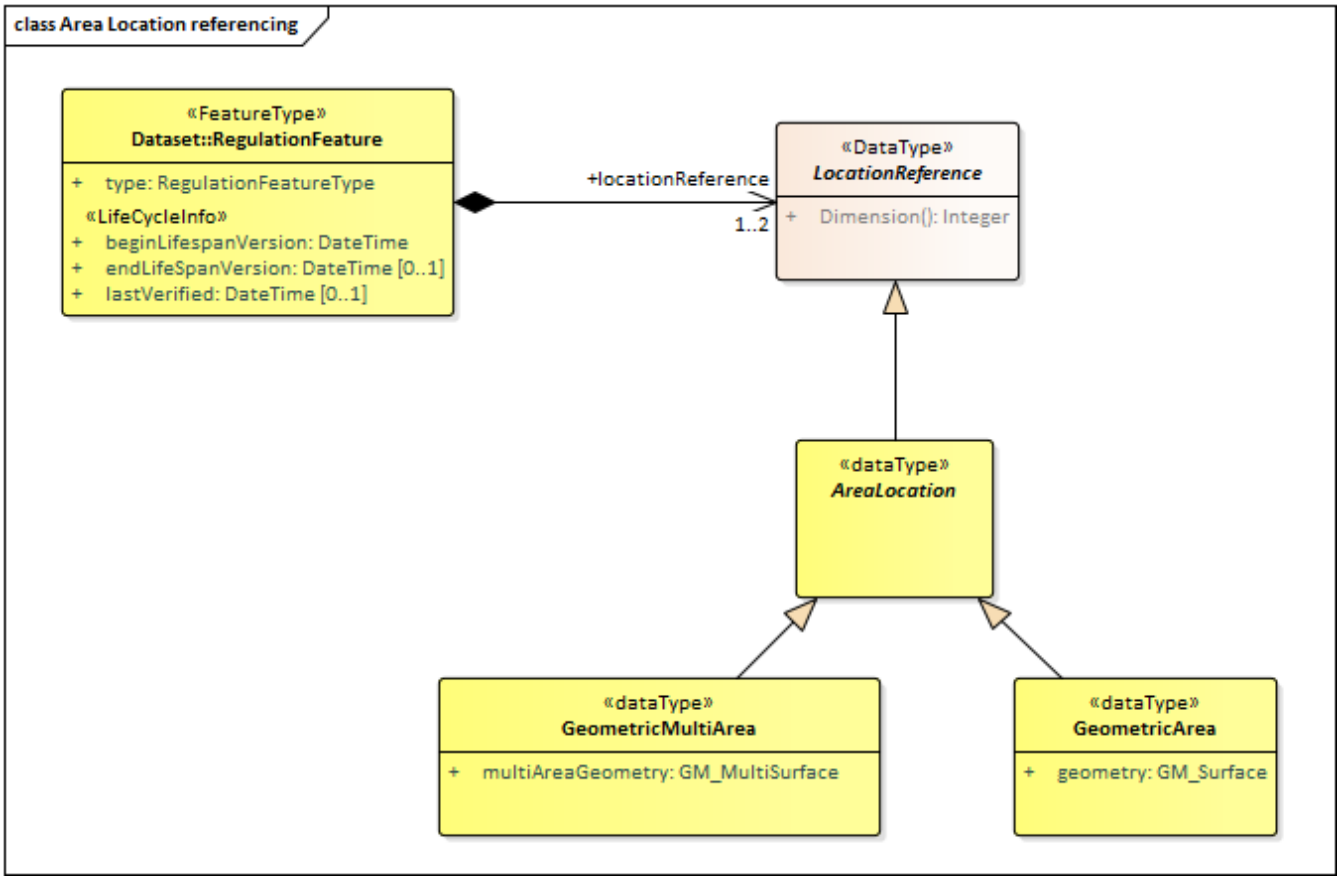
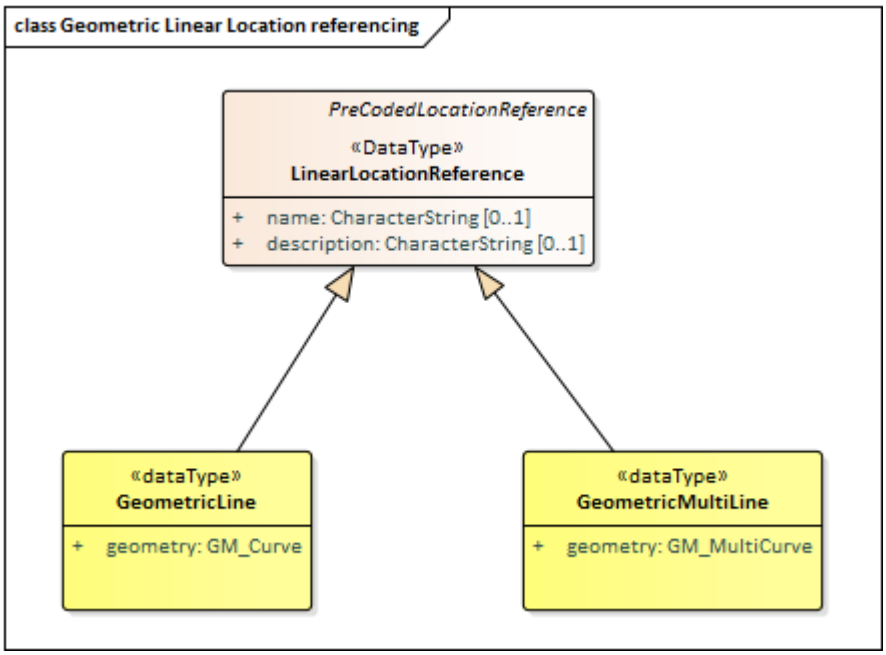


Figure 12 extends the TN-ITS model enabling linear locations to be defined separate to the road link reference line. This construct may be beneficial in defining the geometry of traffic regulatory that, for example, follow the kerb line of the road.

Figure 12 – Geometric Linear Location Referencing



TN-ITS supports linear location referencing borrowing concepts from INSPIRE and ISO 19148. The default expected by TN-ITS is specific reference to an INSPIRE referenced network through the NetworkElement class. To support use in the UK it is appropriate to provide a means to provide linkage

to another form of defined network resource. This can be done via the NetworkElementExtension specialisation, which provides attribution to identify the supplier of the network resource, a version date (if applicable), a URL locator to access the network resource, the specific date of the network resource reference (for continuously maintained resources). An identifier (id) identifies the specific link.

Additionally, to support understanding the impact of a TRO, when located at a node, the NodeReference feature references all of the Links that are impacted by the TRO (those that start or end at the Node) through a linkReference. This does not necessarily mean that all Links connected to the Node will be referenced, for instance in the case of grade separation a subset of the connecting Links will be referenced.

7. Modelling traffic impact

The impact on traffic of the TRO has not been expressly modelled, but through a combination of Conditions (see previous sections) and LocationReferencing a consumer of the data can interpret how traffic is impacted by a TRO. LocationReference communicated the relevant location of the TRO and can be modelled in several ways:

- by reference to a link (with applicable direction) – by use of LinkReference (see Figure 10)
- by reference to a point on a link (with applicable direction) – by use of SimplePointReference or PointReference (see Figure 10)
- by reference to a linear location defined on a link (with applicable direction) – by use of SimpleLinearReference (see Figure 10)
- by reference to a series of links (with applicable direction)
- by reference to a node and the affected Links – by use of NodeReference (see Figure 10)
- by reference to a geometric linear shape, which may be unrelated to the road link reference line – see Figure 12
- by reference to a geometric area shape, which may be unrelated to the road link reference line – see Figure 11.

8. Data Dictionary

This section provides details of all classes, where these classes are extensions to the TN-ITS model or include modifications from the TN-ITS standard (CEN/TS17268:2018). For details of all other classes refer to CEN/TS17268:2018.

8.1. TRODataset

Table 1 defines the characteristics of the TRODataset Class.

Table 1 – TRODataset Class

Class<<FeatureType>>: RoadFeatureDataset		
	Definition:	A dataset containing traffic regulation information and related feature(s) with optional update information.
	Subtype of:	Dataset
	Stereotypes:	FeatureType
Attribute: type		
	Definition:	Specifies the type of dataset
	Value type:	DatasetType
	Multiplicity:	1
	Stereotypes:	
Attribute: defaultLRM		
	Definition:	Specifies the type of dataset
	Value type:	LR_LinearReferencingMethod
	Multiplicity:	0..1
	Stereotypes:	
Association role: troCollection		
	Definition:	The set of traffic regulation orders contained in this dataset
	Value type:	TROCollection
	Multiplicity:	1..* [1]
	Stereotypes:	
Association role: trust		
	Definition:	Reference to the Trust class which provides metadata to support trust model operations.
	Value type:	Trust
	Multiplicity:	1
	Stereotypes:	
Constraint: IncrementalUpdatesDataset Natural language: All road features in a dataset of type Update must contain update information OCL: type = Update implies roadFeatures->forall(s | s.updateInfo->size() = 1)		

Constraint: SnapshotDataset Natural language: All road features in a dataset of type Snapshot must NOT contain update information OCL: type = Snapshot implies roadFeatures->forall(s | s.updateInfo->size() = 0)
NOTE One case where the dataset may be empty is when the dataset is a response to a request for updates when nothing actually did occur.

Table 2 defines the characteristics of the TROCollection Class.

Table 2 – TROCollection Class

Class<<FeatureType>>: TROCollection		
	Definition:	A group of Traffic Regulation Orders.
	Subtype of:	-
	Stereotypes:	FeatureType
Attribute: complete		
	Definition:	Indicates whether the TROCollection is considered to provide a full representation of TROs within the geographic boundary defined for the TROCollection.
	Value type:	Boolean
	Multiplicity:	1
	Stereotypes:	
Association role: order		
	Definition:	Traffic Regulation Order contained within the TROCollection.
	Value type:	Order
	Multiplicity:	1..*
	Stereotypes:	
Association role: coverage		
	Definition:	Geographic area of coverage of Traffic Regulation Order(s) contained within the TROCollection.
	Value type:	CollectionCoverage
	Multiplicity:	0..1
	Stereotypes:	

Table 3 defines the characteristics of the CollectionCoverage Class.

Table 3 – CollectionCoverage Class

Class<<FeatureType>>: CollectionCoverage		
	Definition:	Supports indication of whether the associated TROCollection is considered to provide full content of Traffic Regulation Orders for a specified geographic area.
	Subtype of:	-
	Stereotypes:	DataType
Attribute: complete		
	Definition:	Indicates whether the TROCollection is considered to provide a full representation of TROs within the geographic boundary defined for the TROCollection.
	Value type:	Boolean
	Multiplicity:	1
	Stereotypes:	
Attribute: boundary		
	Definition:	The specified surface representing the area of the extent of the TROCollection.
	Value type:	GM_Surface
	Multiplicity:	1
	Stereotypes:	

Table 4 defines the characteristics of the Order Class.

Table 4 – Order Class

Class<<FeatureType>>: Order		
	Definition:	A Traffic Regulation Order which is a logical collection of road traffic related features with a timescale of applicability, created and authorised by a competent authority.
	Subtype of:	-
	Stereotypes:	FeatureType
Attribute: type		
	Definition:	The type of the order defined
	Value type:	OrderType
	Multiplicity:	1
	Stereotypes:	
Attribute: madeDate		
	Definition:	The date at which this Order is legally sealed (signed) by the competent authority.
	Value type:	DateTime [SOURCE: ISO 19103]
	Multiplicity	0..1
	Stereotypes:	
Attribute: implementationDate		
	Definition:	The date and time at which the contents of this Order are implemented – that is road markings and road signs are placed and visible, and theoretically traffic regulations can be enforced.
	Value type:	DateTime
	Multiplicity	1
	Stereotypes:	
Attribute: revocationDate		
	Definition:	The date and time at which the contents of this Order cease to be implemented (e.g. are revoked for permanent orders, or the planned end date for a temporary order) – that is road markings and road signs are removed.
	Value type:	DateTime
	Multiplicity	0..1
	Stereotypes:	
Attribute: role		
	Definition:	A characterisation identifying role of this specific Order object. Note: Where an Order covers the specification of new features and the revocation of other existing features it is necessary to separate the original legal Order into several Order objects, each of which achieves a specific purpose of creating new features, revoking existing parts or whole features, or consolidation.
	Value type:	OrderRole
	Multiplicity	1
	Stereotypes:	
Attribute: localId		
	Definition:	Identifier for the Order specified by the competent authority
	Value type:	CharacterString
	Multiplicity:	0..1

	Stereotypes:	
Association role: sequence		
	Definition:	If applied it shall be applied to all Orders within a TROCollection. If applied, it indicates the sequence in which the orders shall be applied, with the first Order being applied given the sequence number 1, the second 2 and so on.
	Value type:	ApplicationSequence
	Multiplicity	0..1
	Stereotypes:	
Association role: relatedOrder		
	Definition:	Enables linked Orders to be related to one another. Note: This does not detail the nature of that relationship
	Value type:	RelatedOrder
	Multiplicity	0..*
	Stereotypes:	
Association role: id		
	Definition:	The identity for the order. Permanent identifier for the order in the database of the data provider.
	Value type:	OrderId
	Multiplicity:	1
	Stereotypes:	
Association role: featureGroup		
	Definition:	Identifies a grouped set of features related to an order.
	Value type:	FeatureGroup
	Multiplicity:	0..*
	Stereotypes:	
Association role: regulationFeature		
	Definition:	Identifies a features or features related to an order.
	Value type:	RegulationFeature
	Multiplicity	1..*
	Stereotypes:	
Constraint: MandatoryFeature Natural language: An order shall contain at least one FeatureGroup and/or Feature OCL: inv:Order.FeatureGroup->size() + Order.Feature->size() > 0		

Table 5 defines the characteristics of the ApplicationSequence Class.

Table 5 – ApplicationSequence Class

Class<<DataType>>: ApplicationSequence		
	Definition:	Indicates within a TRO collection the sequence in which Orders shall be applied.
	Subtype of:	-
	Stereotypes:	DataType
Attribute: sequence		
	Definition:	An integer ranking, starting from 1 and increasing that indicates the sequence in which the orders shall be applied, with the first Order being applied given the sequence number 1, the second 2 and so on.
	Value type:	Integer
	Multiplicity:	1
	Stereotypes:	

Table 6 defines the characteristics of the RelatedOrder Class.

Table 6 – RelatedOrder Class

Class<<DataType>>: RelatedOrder		
	Definition:	Enables linked Orders to be related to one another. Note: This does not detail the nature of that relationship
	Subtype of:	-
	Stereotypes:	DataType
Attribute: orderId		
	Definition:	The unique identifier for a related Order.
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	

Table 7 defines the characteristics of the OrderId Class.

Table 7 – OrderId Class

Class<<DataType>>: OrderId		
	Definition:	The identity for the order. Permanent identifier for the order in the database of the data provider.
	Subtype of:	-
	Stereotypes:	DataType
Attribute: providerId		
	Definition:	An identifier for the data provider. Note: this is proposed to be (ISO 2-alpha country code [ISO3166] + nationally agreed competent authority code. Example: in the UK this is proposed to be the DfT SWA authority codes.
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: id		
	Definition:	An externally specified identifier specified by the data provider for the specific order. Note: does not necessarily need to be unique
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: uniqieId		
	Definition:	A unique identifier specified by the data provider for the specific order.
	Value type:	GUID
	Multiplicity:	1
	Stereotypes:	

Table 8 defines the characteristics of the FeatureGroup Class.

Table 8 – FeatureGroup Class

Class<<FeatureType>>: FeatureGroup		
	Definition:	A grouped set of related features, with the group sharing common lifecycle information
	Subtype of:	-
	Stereotypes:	FeatureType
Attribute: updateInfo		
	Definition:	The type of update
	Value type:	UpdateInfo
	Multiplicity:	0..1
	Stereotypes:	
Attribute: beginLifespanVersion		
	Definition:	Date and time at which this version of the feature group object was inserted or changed in the spatial data set
	Value type:	DateTime
	Multiplicity	1
	Stereotypes:	lifeCycleInfo
Attribute: endLifespanVersion		
	Definition:	Date and time at which this version of the feature group object was superseded or retired in the spatial data set
	Value type:	DateTime
	Multiplicity	0..1
	Stereotypes:	lifeCycleInfo
Association role: regulationFeature		
	Definition:	Identifies RegulationFeatures contained within the Feature Group.
	Value type:	RegulationFeature
	Multiplicity:	1..*
	Stereotypes:	

Table 9 defines the characteristics of the FeatureGroupId Class.

Table 9 – FeatureGroupId Class

Class<<DataType>>: FeatureGroupId		
	Definition:	The identity for the feature group. Permanent identifier for the feature group in the database of the data provider.
	Subtype of:	-
	Stereotypes:	DataType
Attribute: providerId		
	Definition:	An identifier for the data provider. Note: this is proposed to be (ISO 2-alpha country code [ISO3166] + nationally agreed competent authority code. Example: in the UK this is proposed to be the DfT SWA authority codes.
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: id		
	Definition:	An externally specified identifier specified by the data provider for the specific feature group. Note: does not necessarily need to be unique
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: uniqieId		
	Definition:	A unique identifier specified by the data provider for the specific feature group.
	Value type:	GUID
	Multiplicity:	1
	Stereotypes:	

Table 10 defines the characteristics of the RegulationFeature Class.

Table 10 – RegulationFeature Class

Class<<FeatureType>>: RegulationFeature		
	Definition:	A specific traffic regulation feature with homogeneous traffic regulation conditions, with common lifecycle information
	Subtype of:	-
	Stereotypes:	FeatureType
Attribute: type		
	Definition:	The type of traffic regulation feature
	Value type:	RegulationFeatureType
	Multiplicity:	1
	Stereotypes:	
Attribute: beginLifespanVersion		
	Definition:	Date and time at which this version of the feature object was inserted or changed in the spatial data set
	Value type:	DateTime
	Multiplicity	1
	Stereotypes:	lifeCycleInfo
Attribute: endLifespanVersion		
	Definition:	Date and time at which this version of the feature object was superseded or retired in the spatial data set
	Value type:	DateTime
	Multiplicity	0..1
	Stereotypes:	lifeCycleInfo
Attribute: lastVerified		
	Definition:	Date and time at which this version of the feature object was last validated by the data supplier
	Value type:	DateTime
	Multiplicity	0..1
	Stereotypes:	lifeCycleInfo
Association role: id		
	Definition:	The identity for the regulation feature. Permanent identifier for the feature in the database of the data provider.
	Value type:	FeatureId
	Multiplicity:	1
	Stereotypes:	
Association role: condition		
	Definition:	Defines conditions that apply to establish the criteria for the traffic regulation.
	Value type:	Condition
	Multiplicity:	0..1
	Stereotypes:	
Association role: locationReference		
	Definition:	Indicates by reference the location of the feature
	Value type:	LocationReference
	Multiplicity:	1
	Stereotypes:	

Table 11 defines the characteristics of the FeatureId Class.

Table 11 – FeatureId Class

Class<<DataType>>: FeatureId		
	Definition:	The identity for the regulation feature. Permanent identifier for the (traffic regulation) feature in the database of the data provider.
	Subtype of:	-
	Stereotypes:	DataType
Attribute: providerId		
	Definition:	An identifier for the data provider. Note: this is proposed to be (ISO 2-alpha country code [ISO3166] + nationally agreed competent authority code. Example: in the UK this is proposed to be the DfT SWA authority codes.
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: id		
	Definition:	An externally specified identifier specified by the data provider for the specific feature. Note: does not necessarily need to be unique
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: uniqieId		
	Definition:	A unique identifier specified by the data provider for the specific feature.
	Value type:	GUID
	Multiplicity:	1
	Stereotypes:	

Table 12 defines the characteristics of the Condition Class, which is taken from CEN/TS 17268:2018.

Table 12 – Condition Class

Class<<DataType>>: Condition		
	Definition:	Abstract class that specifies a condition for the validity of a certain road feature such as time, weather conditions, vehicle type, vehicle propulsion fuel, vehicle occupancy, vehicle usage, restrictions of the vehicle driver's licence permissions, vehicle dimensions or weight characteristics.
	Subtype of:	-
	Stereotypes:	DataType
Attribute: negate		
	Definition:	If set to true means that the entire condition shall be negated. [2]
	Value type:	Boolean
	Multiplicity:	0..1 [3]
	Stereotypes:	

Note 1 The data structure allows for conditions such as:

```
<ConditionSet operator="OR">
<ConditionSet operator="AND">
<TimeCondition…/>
<VehicleCondition…/>
</ConditionSet>
<ConditionSet operator="AND">
<TimeCondition…/>
<VehicleCondition…/>
</ConditionSet>
</ConditionSet>
```

Or, the same example in an alternate notation:
((TimeCondition and VehicleCondition) or (TimeCondition and VehicleCondition))

Note 2 A condition stating VehicleType=EmergencyVehicle and negate = true would mean all vehicles except those of type EmergencyVehicle.

Note 3 Unset value means the same as false, i.e. no negation applied.

Note: In the TRO Discovery a convention is applied, which is that any condition that is stated is done so in a positive sense. The conditions with the negate attribute set to TRUE are used to state exceptions to the general condition.

Table 13 defines the characteristics of the LocationReference Class, which is taken from CEN/TS 17268:2018.

Table 13 – LocationReference Class

Class <<FeatureType>>:: LocationReference		
	Definition:	Abstract class that specifies any type of location reference for TN-ITS
	Subtype of:	
	Stereotypes:	FeatureType
Operation: Dimension		
	Definition:	Returns the dimension for the location reference: 0 : Point 1 : Linear 2 : Area

Class <<FeatureType>>:: LocationReference		
	Return type:	Integer
	Stereotypes:	
Note The operation is currently only intended to be used to be able to specify the required location reference dimension for the various road feature types in the application schema.		

Table 14 defines the characteristics of the DatasetType Class, which is taken from CEN/TS 17268:2018.

Table 14 – DatasetType Class

Class <<Enumeration>>: DatasetType		
	Definition:	Specifies the different possible types of datasets for road features
	Stereotypes:	Enumeration
Code	Value	Definition
1	update	A dataset consisting of only incremental updates for road features
2	snapshot	A snapshot dataset contains information (current status) of all road features in an area, or of all occurrences of one or more specified types of road features.

Table 15 defines the characteristics of the OrderRole Class.

Table 15 – OrderRole Class

Class <<Enumeration>>: OrderRole		
	Definition:	Specifies the different possible types of roles for the order object
	Stereotypes:	Enumeration
Code	Value	Definition
1	New	Traffic Regulation Order fragment providing details on new traffic regulations.
2	Amendment	Traffic Regulation Order fragment used to amendment the content of a previously made Order
3	Consolidation	Traffic Regulation Order fragment used to bring together previously stated separate Orders
4	Revocation	Traffic Regulation Order fragment relating to the removal/revocation of a previously made Order.

Table 16 defines the characteristics of the OrderType Class.

Table 16 – OrderType Class

Class <<Enumeration>>: OrderType		
	Definition:	Specifies the different possible types for the order object
	Stereotypes:	Enumeration
Code	Value	Definition
1	Permanent	A permanent legal instrument by which traffic authorities implement most traffic management controls on their roads
2	Temporary	A time-limited legal instrument by which traffic authorities implement most traffic management controls on their roads

Class <<Enumeration>>: OrderType		
3	Experimental	A time-limited legal instrument, which is intended to test and validate a proposed permanent legal instrument by which traffic authorities implement most traffic management controls on their roads
4	Notice	*Definition to be added*

Table 17 defines the characteristics of the RegulationFeatureType Class. This is derived from Table A.28 of CEN//TS17268:2018, but is being applied to type regulationfeatures rather than roadfeatures. Markup is shown reflecting the modifications made from Table A.28.

Table 17 – RegulationFeatureClass

Class <<CodeList>>: RegulationFeatureType		
	Definition:	Specifies the available list of enumerations for the various types of regulations features
	Stereotypes:	CodeList
Code	Value	Definition
~~1~~	~~pedestrianCrossing~~	~~A specified part of a road where pedestrians have right of way to cross~~
2	restrictionForVehicles	Restriction for vehicles regarding weight, height or length
3	speedLimit	Location of a speed restricted zone which defines a speed limit characteristic (e.g. maximum, compulsory minimum, advisory [maximum]) providing context for vehicles travelling on a particular stretch of road
~~4~~	~~startOfSpeedLimit~~	~~Location of the start of a speed restricted zone which defines a speed limit characteristic (e.g. maximum, compulsory minimum, advisory [maximum]) providing context for vehicles travelling on a particular stretch of road~~
~~5~~	~~endOfSpeedLimit~~	~~Location of the end of a speed restricted zone which defines a speed limit characteristic (e.g. maximum, compulsory minimum, advisory [maximum]) providing context for vehicles travelling on a particular stretch of road~~
~~6~~	~~prohibitionOfOvertaking~~	~~Indicating a zone where overtaking of other vehicles is prohibited.~~ [1]
~~7~~	~~startOfProhibitionOfOvertaking~~	~~Indicating the start of a zone which is subject to a prohibition of overtaking.~~
~~8~~	~~useOfAudibleWarningDevicesProhibited~~	~~Indicating a zone which is subject to a prohibition on the use of audible warning devices.~~ [2]
~~9~~	~~startOfUseOfAudibleWarningDevicesProhibited~~	~~The start of a zone which is subject to a prohibition on the use of audible warning devices.~~
~~10~~	~~endOfProhibitionOrRestriction~~	~~A zone which is the end of prohibition or restriction.~~ [3]
11	prohibitedTurn	Indicating a prohibited turning motion and a junction of roads. [4]
~~12~~	~~passingWithoutStoppingProhibited~~	~~Indicating a zone which is subject to a prohibition of continuing without coming to a stop.~~ [5]
~~13~~	~~motorway~~	~~Indicating the presence of a motorway.~~ [6]
~~14~~	~~startOfMotorway~~	~~indicating the start of a motorway.~~
~~15~~	~~endOfMotorway~~	~~indicating the end of a motorway~~
16	noEntry	indicating no entry to a section of road. [7]

Class <<CodeList>>: RegulationFeatureType		
17	closedToAllVehiclesInBothDirections	indicating a section of road is closed to all vehicles in both directions of travel.
18	directionToBeFollowed	indicating a mandatory route or turn to be followed.
~~19~~	~~snowChainsCompulsory~~	~~indicating a zone where the use of snow chains or equivalent winter equipment is mandatory.~~
20	compulsoryDirectionForVehicleCarryingDangerousGoods	indicating a mandatory route or turn to be followed for vehicles carrying Dangerous Goods. [8]
~~21~~	~~roadForMotorVehicles~~	~~indicating a zone which is a road intended for use by motor vehicles.~~
~~22~~	~~startOfRoadForMotorVehicles~~	~~indicating the start of a zone which is a road intended for use by motor vehicles~~
~~23~~	~~endOfRoadForMotorVehicles~~	~~indicating the end of a zone which is a road intended for use by motor vehicles~~
~~24~~	~~builtUpArea~~	~~indicating a zone which is of an urban developed nature.~~ [9, 10]
~~25~~	~~startOfBuiltUpArea~~	~~indicating the start of a zone which is of an urban developed nature.~~
~~26~~	~~endOfBuiltUpArea~~	~~indicating the end of a zone which is of an urban developed nature.~~
~~27~~	~~residentialArea~~	~~indicating a zone which is of a residential housing nature.~~ [11]
~~28~~	~~startOfResidentialArea~~	~~indicating the start of a zone which is of a residential housing nature~~
~~29~~	~~endOfResidentialArea~~	~~indicating the end of a zone which is of a residential housing nature.~~
~~30~~	~~roadSign~~	~~indicating the presence of a road sign~~
31	tollStation	Toll or road usage fee collection point known as toll booths, toll houses, plazas, stations or gates
32	tollRoad	Public or private roadway for which a road-usage fee or toll is assessed for passage. There are various fee charging concepts and toll collection methods available
33	parkingSite	named according to DATEX II Package ParkingSite
~~34~~	~~chargingPoint~~	~~Electric vehicle charging point, also called EV charging station (element in an infrastructure that supplies electric energy for the recharging of electric vehicles).~~
~~35~~	~~refillPointGas~~	~~Refill point for gas is an element in an infrastructure that supplies different kind of gas fuels for recharging for natural gas vehicles~~
~~36~~	~~publicTransportStop~~	~~Public transport stop~~
~~37~~	~~transferNodeStopPoint~~	~~Stop point at a transfer node, e.g. Airport, Railway station, where people or goods may change mode of transport [SOURCE: ISO 19147]~~
~~38~~	~~trafficSignal~~	~~indicating the presence of a traffic signal, for road user control.~~
39	stationaryVehicleRestriction	Indicating the presence of some form of traffic restriction for stationary vehicles, which may include parking, waiting, loading, setdown/pickup.

Note: there is also a need to extend the RoadFeatureType codelist to include the value stationaryVehicleRestriction.

8.2. Trust Model

Table 18 defines the characteristics of the Trust Class.

Table 18 – Trust Class

Class<<DataType>>: Trust		
	Definition:	Class holding metadata that supports trust model operations
	Subtype of:	-
	Stereotypes:	DataType
Attribute: itsAID		
	Definition:	*See IEEE1609.2*
	Value type:	*See IEEE1609.2*
	Multiplicity:	0..1
	Stereotypes:	
Attribute: ssp		
	Definition:	*See IEEE1609.2*
	Value type:	*See IEEE1609.2*
	Multiplicity:	0..1
	Stereotypes:	
Attribute: boundedGeometry		
	Definition:	*See IEEE1609.2*
	Value type:	*See IEEE1609.2*
	Multiplicity:	1
	Stereotypes:	

8.3. Lines and Signs

Table 19 defines the characteristics of the RoadSignPropertyExtended Class.

Table 19 – RoadSignPropertyExtended Class

Class<<DataType>>: RoadSignPropertyExtended		
	Definition:	A representation of a road feature property value in the case of the road feature being a road sign with extended properties
	Subtype of:	AbstractRoadFeatureProperty
	Stereotypes:	DataType
Attribute: content		
	Definition:	Defines quantifiable content of the traffic sign
	Value type:	RoadSignContent
	Multiplicity:	0..*
	Stereotypes:	
Attribute: maxHeight		
	Definition:	Defines measure of the maximum vertical dimension of the traffic sign
	Value type:	Measure
	Multiplicity:	0..1
	Stereotypes:	
Attribute: maxWidth		
	Definition:	Defines measure of the maximum horizontal display dimension of the traffic sign
	Value type:	Measure
	Multiplicity:	0..1
	Stereotypes:	
Attribute: mountingHeight		
	Definition:	Defines measure of the distance from notional ground level to the lowest part of the display face of the traffic sign
	Value type:	Measure
	Multiplicity:	0..1
	Stereotypes:	
Attribute: image		
	Definition:	Defines a Universal Resource Locator to an image of the traffic sign
	Value type:	URL
	Multiplicity:	0..*
	Stereotypes:	
Attribute: bearing		
	Definition:	Defines the direction from which the traffic sign is intended to be read – i.e. the bearing direction of a perpendicular of the sign face, oriented towards the sign face
	Value type:	Bearing
	Multiplicity:	0..1
	Stereotypes:	
Attribute: regulationFeatureID		
	Definition:	An externally specified identifier specified by the data provider for the specific feature.

Class<<DataType>>: RoadSignPropertyExtended		
	Value type:	CharacterString
	Multiplicity:	0..1
	Stereotypes:	
Attribute: lastVerified		
	Definition:	Date and time at which this version of the feature object was last validated by the data supplier
	Value type:	DateTime
	Multiplicity	0..1
	Stereotypes:	lifeCycleInfo

Table 20 defines the characteristics of the RoadSignPropertyGDD Class.

Table 20 – RoadSignPropertyGDD Class

Class<<DataType>>: RoadSignPropertyGDD		
	Definition:	A representation of a road feature property value in the case of the road feature being a road sign, represented as a GDD code
	Subtype of:	RoadSignPropertyExtended
	Stereotypes:	DataType
Attribute: gddCode		
	Definition:	The type of the road sign by reference to an item in the RoadSignType external code list
	Value type:	RoadSignType
	Multiplicity:	1
	Stereotypes:	

Table 21 defines the characteristics of the RoadSignPropertyLocal Class.

Table 21 – RoadSignPropertyLocal Class

Class<<DataType>>: RoadSignPropertyLocal		
	Definition:	A representation of a road feature property value in the case of the road feature being a road sign, represented within a local sign reference catalogue
	Subtype of:	RoadSignPropertyExtended
	Stereotypes:	DataType
Attribute: localReferencingSystem		
	Definition:	Reference to a locally defined road traffic sign catalogue
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: localSystemVersion		
	Definition:	Version number or reference for the locally defined road sign catalogue
	Value type:	CharacterString
	Multiplicity:	0..1
	Stereotypes:	
Attribute: localSystemId		
	Definition:	Specific reference to the road sign within the locally defined road traffic sign catalogue
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	

Table 22 defines the characteristics of the RoadMarkingProperty Class.

Table 22 – RoadMarkingProperty Class

Class<<DataType>>: RoadMarkingProperty		
	Definition:	A representation of a road feature property value in the case of the road feature being a horizontal road marking
	Subtype of:	AbstractRoadFeatureProperty
	Stereotypes:	DataType
Attribute: encodedGeometry		
	Definition:	Defines the geometry of the road marking
	Value type:	GM_MultiCurve
	Multiplicity:	1
	Stereotypes:	
Attribute: regulationFeatureID		
	Definition:	An externally specified identifier specified by the data provider for the specific feature.
	Value type:	CharacterString
	Multiplicity:	0..1
	Stereotypes:	
Attribute: lastVerified		
	Definition:	Date and time at which this version of the feature object was last validated by the data supplier
	Value type:	DateTime
	Multiplicity	0..1
	Stereotypes:	lifeCycleInfo
Association: rgbColour		
	Definition:	An RGB colour described by values for red, green and blue (0..255) as well as an optional name.
	Value type:	RGBColour
	Multiplicity	0..1
	Stereotypes:	

Table 23 defines the characteristics of the MarkingIcon Class.

Table 23 – MarkingIcon Class

Class<<DataType>>: MarkingIcon		
	Definition:	A representation of a road feature property value in the case of the road feature being a horizontal road marking, which contains a pictogram or icon
	Subtype of:	RoadMarkingProperty
	Stereotypes:	DataType
Attribute: icon		
	Definition:	The type of the icon.
	Value type:	IconType
	Multiplicity	1
	Stereotypes:	
Attribute: maxHeight		
	Definition:	The maximum longitudinal dimension of a road marking icon, e.g. the measurement in the axis of travel of the road
	Value type:	Measure
	Multiplicity	0..1
	Stereotypes:	
Attribute: maxWidth		
	Definition:	The maximum lateral dimension of a road marking icon, e.g. the measurement perpendicular to the axis of travel of the road
	Value type:	Measure
	Multiplicity	0..1
	Stereotypes:	
Attribute: orientation		
	Definition:	Defines the direction from which the road marking icon is intended to be read – i.e. oriented towards icon
	Value type:	Bearing
	Multiplicity	0..1
	Stereotypes:	
Attribute: iconDescription		
	Definition:	A free text description describing the nature and purpose of the icon.
	Value type:	CharacterString
	Multiplicity	0..1
	Stereotypes:	
Attribute: iconURL		
	Definition:	A URL to enable linking to a stored image of the icon
	Value type:	URL
	Multiplicity	0..1
	Stereotypes:	

Table 24 defines the characteristics of the MarkingText Class.

Table 24 – MarkingText Class

Class<<DataType>>: MarkingText		
	Definition:	A representation of a road feature property value in the case of the road feature being a horizontal road marking, which is text
	Subtype of:	RoadMarkingProperty
	Stereotypes:	DataType
Attribute: textContent		
	Definition:	A free text characterstring containing the given road text marking.
	Value type:	CharacterString
	Multiplicity	1
	Stereotypes:	
Attribute: maxHeight		
	Definition:	The maximum longitudinal dimension of a road marking text, e.g. the measurement in the axis of travel of the road
	Value type:	Measure
	Multiplicity	0..1
	Stereotypes:	
Attribute: maxWidth		
	Definition:	The maximum lateral dimension of a road marking text, e.g. the measurement perpendicular to the axis of travel of the road
	Value type:	Measure
	Multiplicity	0..1
	Stereotypes:	
Attribute: orientation		
	Definition:	Defines the direction from which the road marking text is intended to be read – i.e. oriented towards text
	Value type:	Bearing
	Multiplicity	0..1
	Stereotypes:	

Table 25 defines the characteristics of the MarkingLine Class.

Table 25 – MarkingLine Class

Class<<DataType>>: MarkingLine		
	Definition:	A representation of a road feature property value in the case of the road feature being a horizontal road marking, which is lining
	Subtype of:	RoadMarkingProperty
	Stereotypes:	DataType
Attribute: lineWidth		
	Definition:	The mean width of the road marking line.
	Value type:	Measure
	Multiplicity	0..1
	Stereotypes:	
Attribute: markingType		
	Definition:	The physical characteristic type of the road marking line.
	Value type:	MarkingType
	Multiplicity	1
	Stereotypes:	

8.4. Time Conditions

Table 26 replicates the content of Table A.14 of CEN/TS17268:2018, which defines the characteristics of the FuzzyTimeType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethough.

Table 26 - FuzzyTimeType Class

Class <<CodeList>>: FuzzyTimeType		
	Definition:	Specifies the available list of enumerations for the fuzzy time concepts, which provided the definition of start, end or duration time concepts that support the expression of a non-precise or variable qualified concept, resulting in a non-precise, potentially circumstantial defined time period. [1]
	Stereotypes:	CodeList
Code	Value	Definition
1	external	Starting period controlled by external device
2	dawn	Starts at dawn
3	dusk	Starts at dusk
~~4~~	~~school~~	~~Starts at any school period (date and hour)~~
5	holiday	Starts at any holiday
~~6~~	~~winter~~	~~Beginning of winter~~
~~7~~	~~spring~~	~~Beginning of spring~~
~~8~~	~~summer~~	~~Beginning of summer~~
~~9~~	~~autumn~~	~~Beginning of autumn~~
~~10~~	~~highTide~~	~~Beginning of high tide~~
~~11~~	~~lowTide~~	~~Beginning of low tide~~
~~12~~	~~highWater~~	~~Beginning of high water~~
~~13~~	~~lowWater~~	~~Beginning of low water~~
~~14~~	~~wetSeason~~	~~Beginning of wet season~~
~~15~~	~~drySeason~~	~~Beginning of dry season~~
~~16~~	~~peakHours~~	~~Start of peak hours, peak hours include rush hour and activity/ scheduled event based times. These would vary by location and by season~~
~~17~~	~~offPeakHours~~	~~start of off-peak hours~~
~~18~~	~~day~~	~~Start of day~~
~~19~~	~~night~~	~~Start of night~~
NOTE Example roads closed at the start of winter in mountainous areas, which is based on actual experienced weather conditions and therefore is not pre-defined.		

Table 27 replicates the content of Table A.38 of CEN/TS17268:2018, which defines the characteristics of the SpecialDayType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethough. Additional enumerations are marked in green.

Table 27 - SpecialDayType Class

Class <<CodeList>>: SpecialDayType		
	Definition:	Specifies the available list of enumerations for the special days
	Stereotypes:	CodeList
Code	Value	Definition
~~1~~	~~dayBeforePublicHoliday~~	~~The day before a declared Public Holiday~~
2	publicHoliday	The day of a declared Public Holiday, which may be national, or regional.
~~3~~	~~dayFollowingPublicHoliday~~	~~The day following a declared Public Holiday~~
~~4~~	~~longWeekendDay~~	~~Third day of a three-day weekend~~
~~5~~	~~inLieuOfPublicHoliday~~	~~Extra holiday in compensation on a day following a holiday that falls in a weekend~~
6	schoolDay	In the locale a day when schools are open and operating
7	schoolHolidays	In the locale a day when schools are not open and operating
~~8~~	~~publicEventDay~~	~~The day of a declared Public Event, which may be national, or regional.~~ [1]
9	Other	Other than as defined in this enumeration.
10	Easter	Easter Sunday, which is the Sunday following the paschal full moon date. The paschal full moon date is the ecclesiastical full moon date following 20 March.
11	Market Day	Day on which a market occurs in the locality, as specified by the local authority
12	Match Day	Day on which a major sporting fixture occurs in the locality, as specified by the local authority and/or the sports venue organiser
13	Event Day	Day on which an event occurs in the locality, which may change traffic conditions, as specified by the local authority and/or the event organiser
NOTE For example, the day of a Royal Wedding, or the Notting Hill Carnival.		

8.5. Vehicle Conditions

Table 28 replicates the content of Table A.18 of CEN/TS17268:2018, which defines the characteristics of the LoadType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethough.

Table 28 - LoadType Class

Class <<CodeList>>: LoadType		
	Definition:	Specifies the available list of enumerations for types of vehicle loads.
	Stereotypes:	CodeList
Code	Value	Definition
~~1~~	~~abnormalLoad~~	~~A load that exceeds normal vehicle dimensions in terms of height, length, width, gross vehicle weight or axle weight or any combination of these. Generally termed an "abnormal load".~~
~~2~~	~~ammunition~~	~~Ammunition.~~
~~3~~	~~chemicals~~	~~Chemicals of unspecified type.~~
~~4~~	~~combustibleMaterials~~	~~Combustible materials of unspecified type.~~
~~5~~	~~corrosiveMaterials~~	~~Corrosive materials of unspecified type.~~
~~6~~	~~debris~~	~~Debris of unspecified type.~~
7	empty	No load
8	explosiveMaterials	Explosive materials of unspecified type.
~~9~~	~~extraHighLoad~~	~~A load of exceptional height.~~
~~10~~	~~extraLongLoad~~	~~A load of exceptional length.~~
~~11~~	~~extraWideLoad~~	~~A load of exceptional width.~~
~~12~~	~~fuel~~	~~Fuel of unspecified type.~~
~~13~~	~~glass~~	~~Glass.~~
~~14~~	~~goods~~	~~Any goods of a commercial nature.~~
~~15~~	~~hazardousMaterials~~	~~Materials classed as being of a hazardous nature.~~
~~16~~	~~liquid~~	~~Liquid of an unspecified nature.~~
~~17~~	~~livestock~~	~~Livestock.~~
~~18~~	~~materials~~	~~General materials of unspecified type.~~
~~19~~	~~materialsDangerousForPeople~~	~~Materials classed as being of a danger to people or animals.~~
~~20~~	~~materialsDangerousForTheEnvironment~~	~~Materials classed as being potentially dangerous to the environment.~~
~~21~~	~~materialsDangerousForWater~~	~~Materials classed as being dangerous when exposed to water (e.g. materials which may react exothermically with water).~~
~~22~~	~~oil~~	~~Oil.~~
~~23~~	~~ordinary~~	~~Materials that present limited environmental or health risk. Non-combustible, non-toxic, non-corrosive.~~
~~24~~	~~perishableProducts~~	~~Products or produce that will significantly degrade in quality or freshness over a short period of time.~~
~~25~~	~~petrol~~	~~Petrol or petroleum.~~
~~26~~	~~pharmaceuticalMaterials~~	~~Pharmaceutical materials.~~
~~27~~	~~radioactiveMaterials~~	~~Materials that emit significant quantities of electromagnetic radiation that may present a risk to people, animals or the environment~~

Class <<CodeList>>: LoadType		
~~28~~	~~refrigeratedGoods~~	~~Refrigerated goods.~~
~~29~~	~~refuse~~	~~Refuse.~~
~~30~~	~~toxicMaterials~~	~~Materials of a toxic nature which may damage the environment or endanger public health.~~
~~31~~	~~vehicles~~	~~Vehicles of any type which are being transported.~~
~~32~~	~~other~~	~~Other than as defined in this enumeration.~~
33	dangerousGoods	Materials classed as being of a danger

Table 29 replicates the content of Table A.35 of CEN/TS17268:2018, which defines the characteristics of the VehicleType Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethough.

Table 29 - VehicleType Class

Class <<CodeList>>: VehicleType		
	Definition:	Specifies the available list of enumerations for types of vehicle.
	Stereotypes:	CodeList
Code	Value	Definition
1	anyVehicle	Vehicle of any type.
2	articulatedVehicle	Transport vehicle with articulation between component carriage parts of the vehicle
3	bicycle	Pedal-driven two-wheeled vehicle
~~4~~	~~moped~~	~~Moped (a two-wheeled motor vehicle characterized by a small engine typically less than 50cc and by normally having pedals).~~
5	motorcycle	Two-wheeled motor vehicle without pedal propulsion
~~6~~	~~motorscooter~~	~~Motorscooter (a two-wheeled motor vehicle characterized by a step-through frame and small diameter wheels).~~
~~7~~	~~motorcycleWithSideCar~~	~~Three-wheeled vehicle comprising a motorcycle with an attached side car.~~
8	Car	Small, often privately owned, typically four-wheeled vehicle for transport of persons and limited goods.
~~9~~	~~largeCar~~	~~See car, typically greater than 4.5 metres in length~~
~~10~~	~~passengerCar~~	~~See car~~
~~11~~	~~smallCar~~	~~See car, typically greater than 3.75 metres in length~~
12	caravan	Non-motorised trailer for towing, intended for human occupancy
~~13~~	~~carOrLightVehicle~~	~~Car or light vehicle.~~
~~14~~	~~carWithCaravan~~	~~Car towing a caravan.~~
~~15~~	~~carWithTrailer~~	~~Car towing a trailer~~
16	bus	Vehicle for mass road transport
~~17~~	~~articulatedBus~~	~~Articulated vehicle for public transport.~~
~~18~~	~~fourWheelDrive~~	~~Four-wheeled drive vehicle.~~
~~19~~	~~highSidedVehicle~~	~~High sided vehicle.~~
~~20~~	~~heavyGoodsVehicle~~	~~Large road vehicle, typically over 3.5 tonnes gross weight, primarily intended for the transport of goods~~
~~21~~	~~heavyGoodsVehicleWithTrailer~~	~~Large road vehicle, typically over 3.5 tonnes gross weight, primarily intended for the transport of goods with attached towed trailer~~
~~22~~	~~heavyDutyTransporter~~	~~Large road vehicle, primarily intended for the transport of other vehicles~~
~~23~~	~~heavyVehicle~~	~~See Heavy Goods Vehicle~~
~~24~~	~~lightCommercialVehicle~~	~~Road vehicle, typically under 3.5 tonnes gross weight, primarily intended for the transport of goods~~
~~25~~	~~largeGoodsVehicle~~	~~See Heavy Goods Vehicle~~
~~26~~	~~lightCommercialVehicleWithTrailer~~	~~Road vehicle, typically under 3.5 tonnes gross weight, primarily intended for the transport of goods, with attached towed trailer~~
~~27~~	~~longHeavyLorry~~	~~See Heavy Goods Vehicle~~

Class <<CodeList>>: VehicleType		
~~28~~	~~lorry~~	~~Lorry of any type.~~
~~29~~	~~van~~	~~See light commercial vehicle~~
~~30~~	~~minibus~~	~~Road vehicle, typically under 3.5 tonnes gross weight, primarily intended for the transport of people~~
~~31~~	~~motorhome~~	~~Motorised vehicle, intended for human occupancy~~
32	agriculturalVehicle	Vehicle normally used for agricultural purposes, e.g. tractor, combined harvester etc.
~~33~~	~~constructionOrMaintenanceVehicle~~	~~Vehicle normally used for construction or maintenance purposes, e.g. digger, excavator, bulldozer, lorry mounted crane etc.~~
~~34~~	~~tanker~~	~~Vehicle with large tank for carrying bulk liquids.~~
~~35~~	~~twoWheeledVehicle~~	~~Two-wheeled vehicle of unspecified type.~~
~~36~~	~~threeWheeledVehicle~~	~~Three-wheeled vehicle of unspecified type.~~
~~37~~	~~vehicleWithCaravan~~	~~Vehicle (of unspecified type) towing a caravan.~~
~~38~~	~~vehicleWithCatalyticConverter~~	~~Vehicle with catalytic converter.~~
~~39~~	~~vehicleWithoutCatalyticConverter~~	~~Vehicle without catalytic converter.~~
40	vehicleWithTrailer	Vehicle (of unspecified type) towing a trailer.
~~41~~	~~withEvenNumberedRegistrationPlates~~	~~Vehicle with even numbered registration plate.~~
~~42~~	~~withOddNumberedRegistrationPlates~~	~~Vehicle with odd numbered registration plate.~~
~~43~~	~~metro~~	~~Train-like transport vehicle limited to a rail network within a limited area; at surface, below surface or above surface~~
~~44~~	~~lightRail~~	~~Train-like transport vehicle limited to a rail network within a limited area; does not include heavy rail lines~~
~~45~~	~~trailer~~	~~Non-motorised vehicle, intended to be towed~~
~~46~~	~~tram~~	~~Train-like mass transport vehicle, running on rails, typically partially or wholly on the road network~~
~~47~~	~~trolleyBus~~	~~Bus-like mass transport vehicle hocked up to an electrical network for power supply~~
~~48~~	~~articulatedTrolleyBus~~	~~Bus-like mass transport vehicle hocked up to an electrical network for power supply, with articulation between component carriage parts of the vehicle~~
~~49~~	~~unknown~~	~~Unknown vehicle type~~
~~50~~	~~other~~	~~Other than as defined in this enumeration.~~
51	lightRailTram	Train-like transport vehicle limited to a rail network within a limited area; does not include heavy rail lines Note: see entries 44 and 46
52	mopedSmallMotorcycle	Moped (a two wheeled motor vehicle characterized by a small engine typically less than 50cc or having pedals). Note: see entries 4.
53	vehicleWithTrailer	towing a trailer Note: see entries
54	emergencyServicesVehicle	
55	taxi	A vehicle that is licenced for the purpose of taxi operations and bearing physical indicators
56	goodsVehicle	

Class <<CodeList>>: VehicleType		
57	horseDrawnVehicle	
58	pedestrian	
59	riddenOrAccompanied Horses	
60	trackLayingVehicle	
61	herdedAminals	

Table 30 replicates the content of Table A.36 of CEN/TS17268:2018, which defines the characteristics of the VehicleUsage Class. The enumeration values not used in the TRO Discovery draft data model have been marked with strikethough.

Table 30 - VehicleUsage Class

Class <<CodeList>>: VehicleUsage		
	Definition:	Specifies the available list of enumerations for types of usage of vehicles.
	Stereotypes:	CodeList
Code	Value	Definition
~~1~~	~~agricultural~~	~~Vehicle used for agricultural purposes.~~
~~2~~	~~Carsharing~~	~~Vehicles operated by a car-sharing company.~~
~~3~~	~~cityLogistics~~	~~Vehicles that are used to deliver goods in a city area.~~
~~4~~	~~commercial~~	~~Vehicle which is limited to non-private usage or public transport usage.~~
~~5~~	~~emergencyServices~~	~~Vehicle used by the emergency services.~~
6	Military	Vehicle used by the military.
~~7~~	~~nonCommercial~~	~~Vehicle used for non-commercial or private purposes.~~
~~8~~	~~Patrol~~	~~Vehicle used as part of a patrol service, e.g. road operator or automobile association patrol vehicle.~~
~~9~~	~~recoveryServices~~	~~Vehicle used to provide a recovery service.~~
~~10~~	~~roadMaintenanceOrConstruction~~	~~Vehicle used for road maintenance or construction work purposes.~~
~~11~~	~~roadOperator~~	~~Vehicle used by the road operator.~~
~~12~~	~~Taxi~~	~~Vehicle used to provide an authorised taxi service.~~
13	access	
14	accessToOffStreetPremises	
15	authorisedVehicles	
16	guidedBuses	
17	loadingAndUnloading	
18	localBuses	
19	paymentOrRestrictedParking	
20	Pedestrians	
21	electricVehicleCharging	
22	privateHireVehicle	
23	locallyRegsiteredPrivateHireVehicle	
24	settingDown	
25	settingDownByTaxi	
26	settingDownDisabled	

Class <<CodeList>>: VehicleUsage		
	Person	
27	noStopping	
28	noLoading	
29	NoWaiting	
30	Parking	
31	highwayAuthorityPurpose	
32	statutoryUndertakerPurpose	
33	busOperationPurpose	

8.6. Location Referencing

Table 31 defines the characteristics of the NodeReference Class.

Table 31 - NodeReference Class

Class<<DataType>>: NodeReference		
	Definition:	A location reference to a node (point of intersection or terminus) of a road network.
	Subtype of:	NetworkReference
	Stereotypes:	DataType
Attribute: location		
	Definition:	Geometric point location of the node
	Value type:	GM_Point
	Multiplicity:	1
	Stereotypes:	
Association role: linkReference		
	Definition:	Association of links relevant at the node
	Value type:	Link
	Multiplicity:	1..* [1]
	Stereotypes:	

The Link Class is specified in INSPIRE Generic Network Model (D2.10.1).

Table 32 defines the characteristics of the NetworkElementExtension Class.

Table 32 – NetworkElementExtension Class

Class<<FeatureType>>: NetworkElementExtension		
	Definition:	Network element defined in a local network dataset
	Subtype of:	NetworkElement
	Stereotypes:	FeatureType
Attribute: supplier		
	Definition:	Identifier for the supplier of the network dataset
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: versionDate		
	Definition:	The dated release of the network dataset used
	Value type:	DateTime
	Multiplicity:	0..1
	Stereotypes:	
Attribute: url		
	Definition:	The universal resource location for access to the network dataset
	Value type:	URL
	Multiplicity:	1
	Stereotypes:	
Attribute: dateOfReference		
	Definition:	The date time that the network element reference is made.
	Value type:	DateTime
	Multiplicity:	1
	Stereotypes:	
Attribute: id		
	Definition:	The reference to the network element within the network dataset
	Value type:	Identifier
	Multiplicity:	1
	Stereotypes:	

Table 33 defines the characteristics of the Identifier Class.

Table 33 – Identifier Class

Class<<DataType>>: Identifier		
	Definition:	Class identifying a network element within a network dataset
	Subtype of:	
	Stereotypes:	DataType
Attribute: localId		
	Definition:	The identifier for the network element as specified by the network dataset provider
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: namespace		
	Definition:	The namespace for the network dataset
	Value type:	CharacterString
	Multiplicity:	1
	Stereotypes:	
Attribute: versionId		
	Definition:	The version for the network dataset
	Value type:	CharacterString
	Multiplicity:	0..1
	Stereotypes:	Lifecycleinfo
Attribute: dateOfReference		
	Definition:	The date time that the network element reference is made.
	Value type:	DateTime
	Multiplicity:	1
	Stereotypes:	
Attribute: id		
	Definition:	The reference to the network element within the network dataset
	Value type:	Identifier
	Multiplicity:	1
	Stereotypes:	

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