

User-friendly Information

Tool on Urban and Regional Access Regulations Schemes

Contract: MOVE/B4/SER/2019-498/SI2.832125

DATEX II Profiles for UVAR data Exchange and Template for SDG

Consortium:



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Administrative section

1 Document bios

Document file name	Work package	Tasks
UVARBox_WP1_Deliverable1.3_2021-09_v0.9.docx	WP1	1.3 & 1.4

2 Version history

Version	Date	Description of changes	Author	Partner
0.9	10-08-2021	Initial draft	WP1	AlbrechtConsult
	15/10/21	Review		Neves
	21/10/21	Review		Sadler
0.10	26/10/21	Updated Draft	WP1	AlbrechtConsult

3 Disclaimer

The views and opinions expressed in this document are the sole responsibility of the author(s) and do not necessarily reflect the views of the European Commission.

General section

4 Executive Summary

This deliverable summarises the work done in the UVAR Box Tasks 1.3 & 1.4. As the time schedule for both tasks has been extended to month 24 (end of the UVAR Box project), this document describes the current state of work of Tasks 1.3 & 1.4 and will further evolve. At the end of the UVAR Box project an updated version of this deliverable will be created summarising the final results.

Task 1.3 developed a DATEX II model for UVAR data exchange based on the data profiles that were developed in Task 1.2. This work was based on input received from the DATEX II PSA, covering a draft CEN standard for traffic regulations, as well as an initial model created for UVARs in the scope of the SOCRATES 2.0 project. The task has amended these models according to the requirements elicited so far in the UVAR Box project. This work led to an update of the UVAR model, plus extensions for the underlying existing DATEX II standards, including the traffic regulations model.

Task 1.4 created a template structure for providing UVAR information, complying with the requirements of the Single Digital Gateway. This template is described as a document structure, which corresponds to the data profile for UVARs developed in Task 1.3. For each structural element, this deliverable describes the content to be contained, including a reference to where the corresponding semantic elements reside in the DATEX II data profile. The template can be used for inputting the data in directly either manually or from certain other formats, thus harmonising the representation of UVAR data on the SDG even if machine processable data is not available. In case DATEX II content exists, the description points out how the template could be filled automatically. This will require additional textual elements in the language of the SDG entry, plus a corresponding DATEX II data dictionary in this language. For some sections additional graphical elements are included, which would need further processing, e.g. where maps are to be displayed, the location references contained in a DATEX II message have to be rendered on a digital map, or vice versa when a digital map is entered into the UVARBox software to be converted into DateX II.

5 Detailed Work

5.1 DATEX II Profiles for UVAR data Exchange

5.1.1 Introduction

This section describes the current state of the work done in Task 1.3, which should define and develop necessary interfaces – including DATEX II profiles – based on the data profiles developed in Task 1.2, allowing the exchange of UVAR data. The specification of the developed DATEX II profiles is done in cooperation with the DATEX II CEF Programme Support Action, including a validation. The following description of the developed DATEX II model for UVAR data exchange refers to the second draft that

has been developed in Task 1.3 and was created based on the feedback that was received on the first draft of the model. At the end of the UVAR Box project, an updated version of this document will be provided, summarising the final DATEX II profile for UVAR data exchange.

The DATEX II model for UVARs is composed of two main parts. The *TrafficRegulation* model (prCEN/TS 16157-11) that is currently under standardisation at CEN and the developed *ControlledZone* model that adds elements that are necessary for the definition of UVARs. The latter has essentially been created based on input of the SOCRATES 2.0 project. Besides that, the model contains two extensions of existing DATEX II content models. Firstly, the *Common* model [2], which is a collection of data concepts that appear in many different DATEX II data publications, including data characteristics for classes of vehicles and a model for time validity. Besides that, the *LocationReferencing* model [1] provides data structures that support a number of methods for providing the location of an object. Both models contain essential concepts that are relevant for the definition of UVAR information. Besides that, existing DATEX II standards can be extended via the DATEX II "LevelBExtension" mechanism, which offers backwards compatibility. Such extensions can be proposed to be taken into account in a future revision of the standard, becoming "approved extensions". The *TrafficRegulation* model already defines some LevelBExtensions for both the *Common* and the *LocationReferencing* model, adding relevant elements for the definition of traffic regulations and having been approved by the DATEX II PSA. During the development of the DATEX II model for UVARs, additional required model elements have been identified and added to the extension packages, which are described in section 5.1.4.

In the following sections, the developed DATEX II model for UVARs is presented, starting with an overview of the basic components of the *TrafficRegulation* model (section 5.1.2) as this is the foundation of the *ControlledZone* model (section 5.1.3). Furthermore, section 5.1.4 describes the relevant elements of the extension to *TrafficRegulation*, *Common* and *LocationReferencing*.

5.1.2 The "TrafficRegulation" model

The *TrafficRegulation* model provides a structure for publishing traffic regulations. The DATEX II model for UVARs uses the *TrafficRegulationOrder* class for the definition of UVARs that are implemented by a traffic regulation order (TRO) (see Figure 1).

A *TrafficRegulationOrder* instance is composed of the following elements:

- An optional *LegalBasis* defined by name, version, and date of the legal document.
- An optional *implementedLocation* and/or *locationByOrder* defining the overall location of the traffic regulations contained in the TRO.
- An optional *implementedValidity* and/or *validityByOrder* defining the overall time validity of the traffic regulations contained in the TRO.
- One or more *TrafficRegulation* instances defining the regulations that are issued via the TRO, which are described in detail in the following.

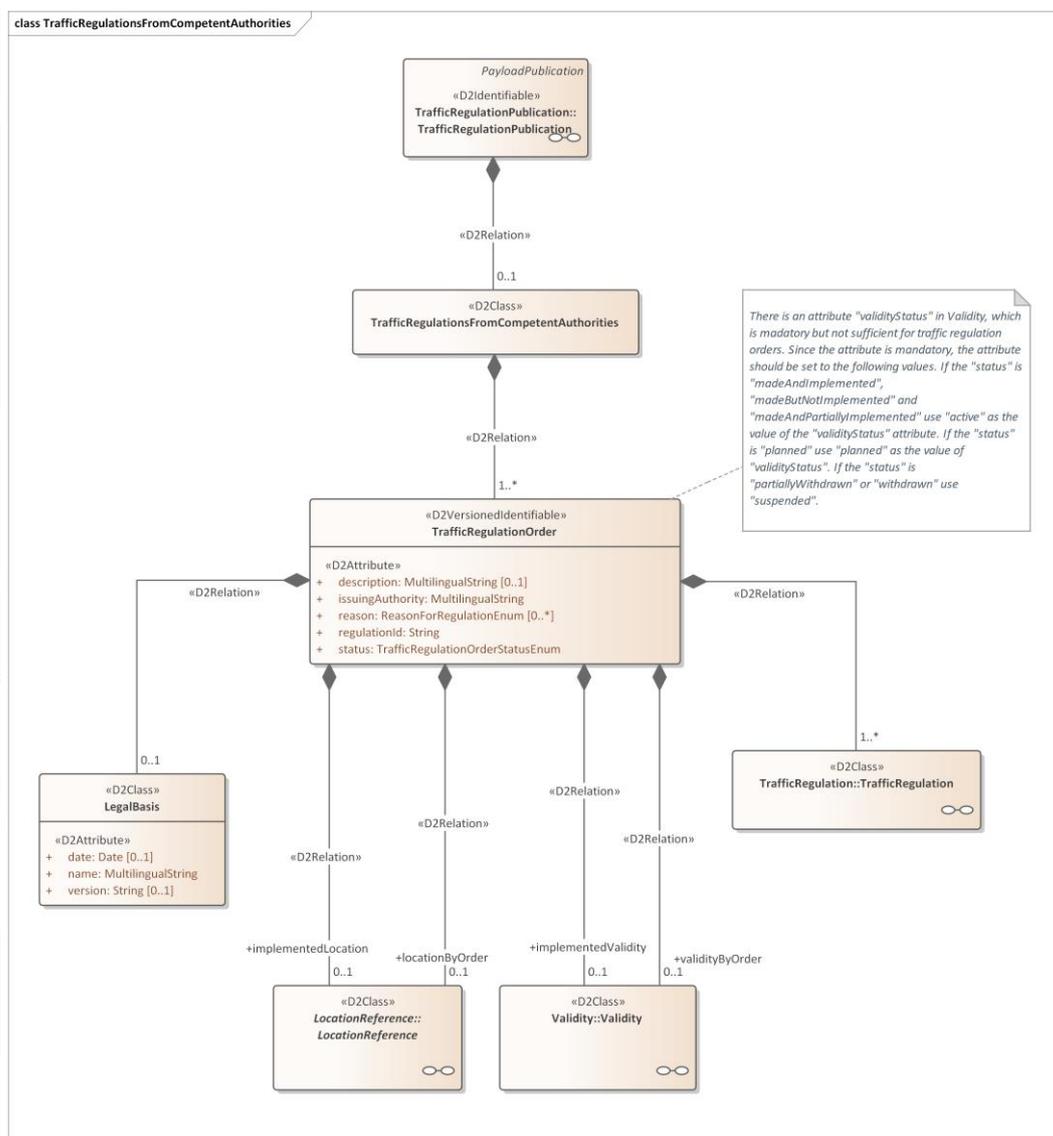


Figure 1 - The "TrafficRegulationOrder" class model

A *TrafficRegulation* (see Figure 3) is composed of one or more *TypeOfRegulation* instances defining a regulation (see Figure 2). For low emission zones, limited traffic zones and pedestrian zones this is mostly the *AccessRestriction* class as it specifies the restriction to enter a specific region, but for restricted parking zones also the *StandingOrParkingRestriction* class is relevant. However, it is not excluded that other types of traffic regulations can be chosen for UVARs – for example in some of the reactive-pollution schemes speed limit reductions are triggered.

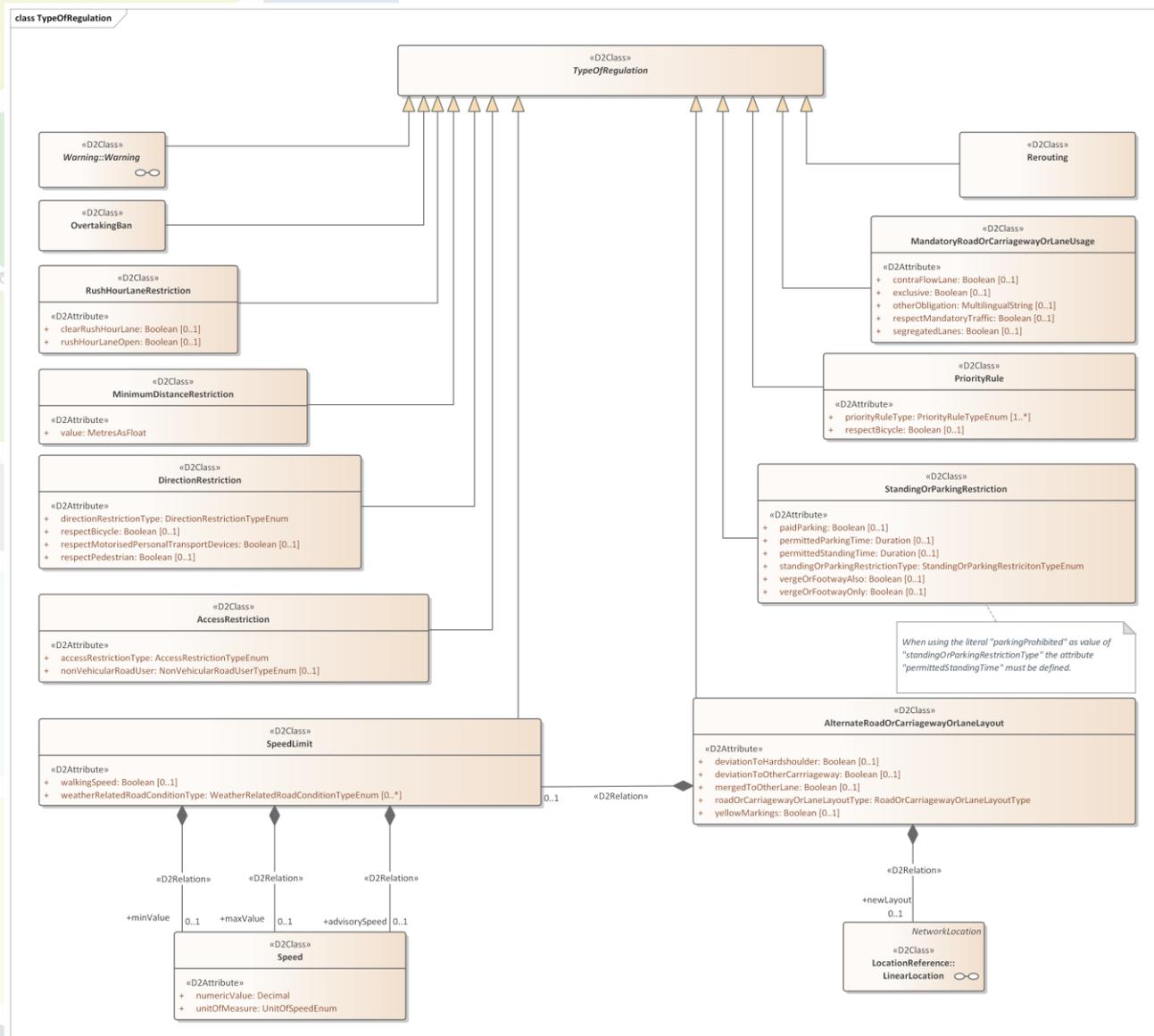


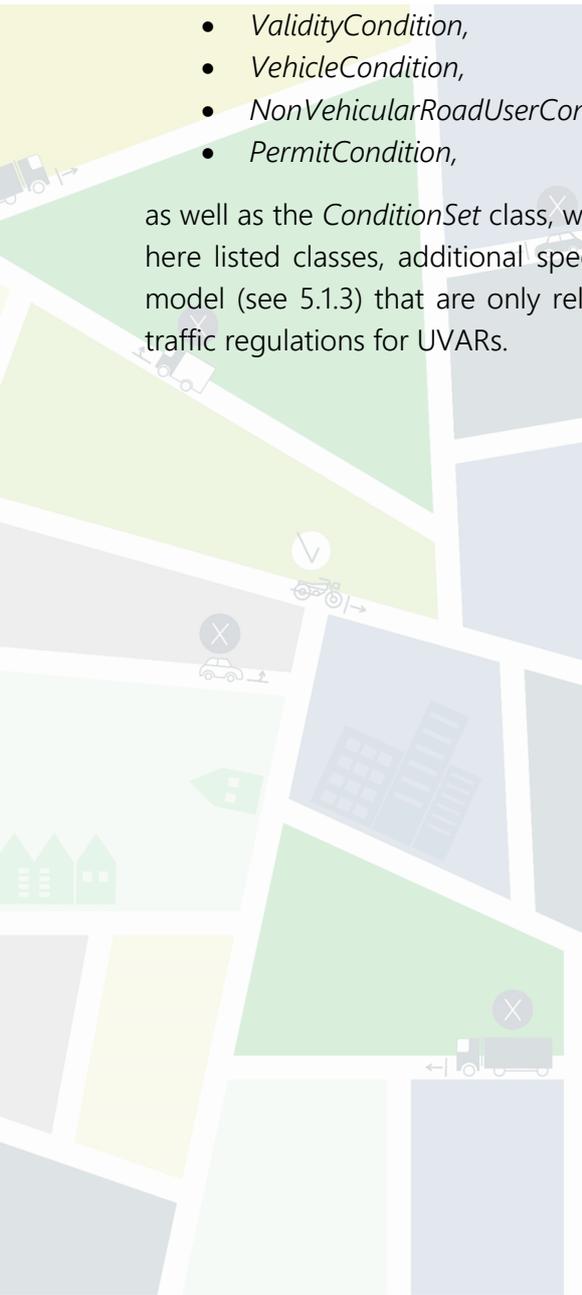
Figure 2 - The "TypeOfRegulation" class model

Furthermore, a corresponding set of conditions under which the traffic regulation applies can be defined with the *Condition* model (see Figure 4). For this, the *Condition* model offers to define an arbitrarily complex set of bitwise operations using the operators *and*, *or*, *xor* and *not*. The abstract *Condition* class can be specialised in one of the following ways:

- *RoadCondition*,
- *OccupantCondition*,
- *DriverCondition*,
- *AccessCondition*,
- *LocationCondition*,

- *ValidityCondition*,
- *VehicleCondition*,
- *NonVehicularRoadUserCondition*,
- *PermitCondition*,

as well as the *ConditionSet* class, which can be used to specify a combination of conditions. Besides the here listed classes, additional specializations of the *Condition* class are added in the *ControlledZone* model (see 5.1.3) that are only relevant for defining conditions for the applicability or exemptions of traffic regulations for UVARs.



class TrafficRegulation

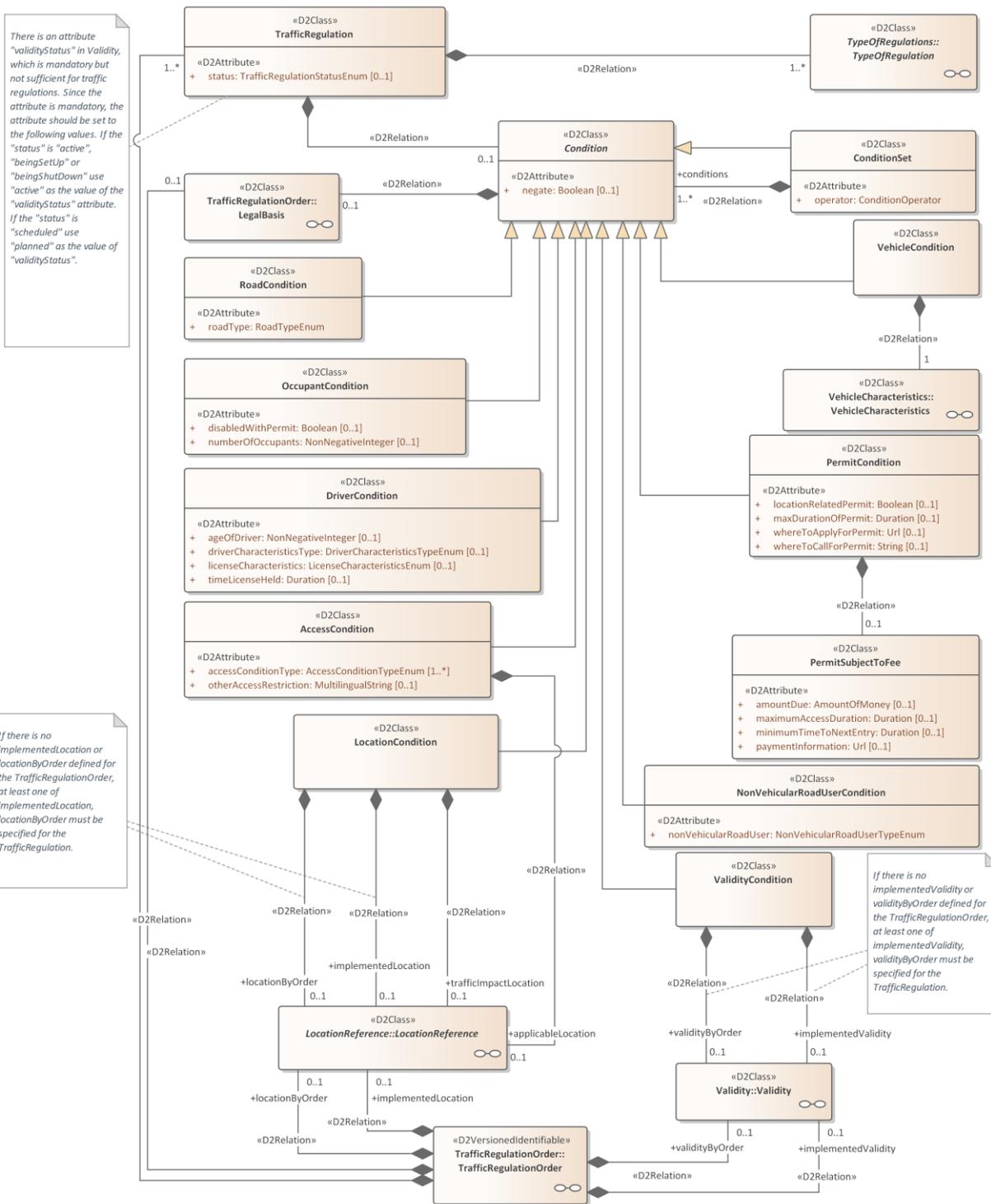


Figure 3 - The "TrafficRegulation" class model

Each *ConditionSet* contains a collection of *Condition* specialisations and an operator, which connects the conditions. A *Condition* can also be negated by setting the *negate* attribute to "true", which means that the condition is exempted. As this *Condition* model is so generic, its use is restricted for the UVAR Box tools by structuring the *ConditionSet* for each traffic regulation as shown in Figure 4. A *TrafficRegulation* has a *TypeOfRegulation*, which for low emission zones, limited traffic zones and pedestrian zones is an *AccessRestriction* with *accessRestrictionType* set to "noEntry" and for restricted parking zones a *StandingOrParkingRestriction*. We cannot totally exclude, that in the future other types of traffic regulations will be used for these UVAR types. Besides a type, a traffic regulation also contains conditions that govern the applicability of the traffic regulation. These conditions are represented by a single *ConditionSet*, which has at most the following four *Condition/ConditionSet* instances that are combined with the "and" operator to give the complete UVAR rules:

1. One of the components defines the time validity of the traffic regulation by either specifying a single *ValidityCondition* or a *ConditionSet* containing multiple *ValidityCondition* instances.
2. The second component defines the location of the traffic regulation by either specifying a single *LocationCondition* or a *ConditionSet* containing multiple *LocationCondition* instances.
3. The third component defines all conditions under which the traffic regulation applies. This can either be a single *Condition*, e.g. a *VehicleCondition* with *vehicleType* set to "anyVehicle" or a *ConditionSet* defining multiple conditions or combinations of conditions.
4. The last component shall include all exemptions of the traffic regulation by defining a *Condition/ConditionSet* with the *negate* attribute set to "true" and the *operator* attribute to "or". This means that if one of the exemptions holds, the overall *ConditionSet* is "false" and therefore the conjunction in the topmost *ConditionSet* becomes "false" as well. Thus, the traffic regulation does not apply. Note that both the *ConditionSet* for applicability conditions and the *ConditionSet* containing all exemptions can in principle contain specific time validity and location specifications as well.

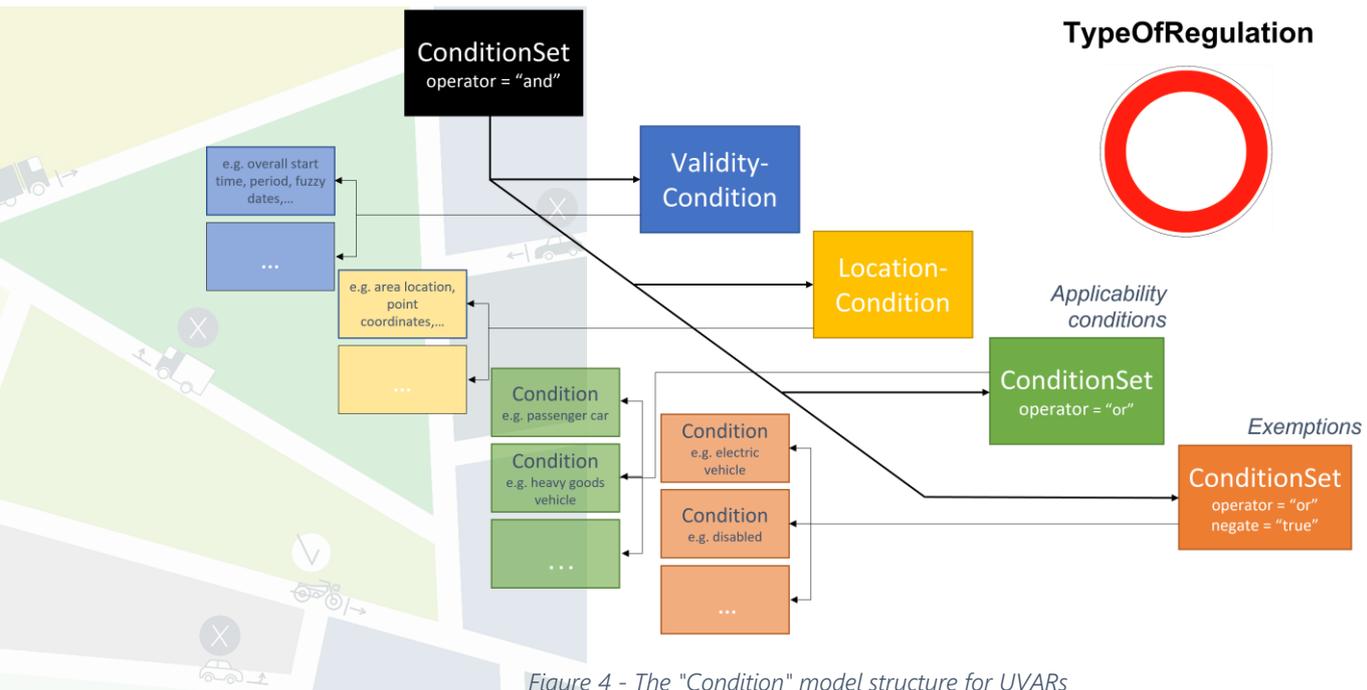


Figure 4 - The "Condition" model structure for UVARs

One important component of the *Condition* model is the *ValidityCondition* class, which links to the *Validity* model from the *Common* model. The *Validity* class has an attribute *validityStatus*, which is usually set to *definedByTimeSpec*, but can also be explicitly set to *active* or *suspend*. In the last two cases, all further information concerning the validity control is ignored.

If the validity turns out to be complex, periods can either be included or excluded. A period is composed of any combination of times, weekdays, weeks of a month or months, e.g.:

- Every Monday 9 am – 5 pm
- Every 3rd and 5th week of a month
- Sat. and Sun. 7 – 8 am and 5 – 6 pm
(note: Sat. and Sun. 7 – 8 am and 5 – 6 pm would have to be modelled in form of two periods)
- Every day except Sundays and bank holidays

In addition, a period can be assigned with its own start and end time validity within which it is active, e.g. every Monday 9 am – 5 pm in the summer holidays, whereof the summer holidays are given by absolute dates (*startOfPeriod*, *endOfPeriod*).

The following chart illustrates the interaction of the *overallPeriod* and any additional specified periods. The green bars describe "valid time periods", shown on the time axis. The vertical lines delimit the different periods (*overallStartTime*, *overallSendTime* or *startOfPeriod*, *endOfPeriod*):

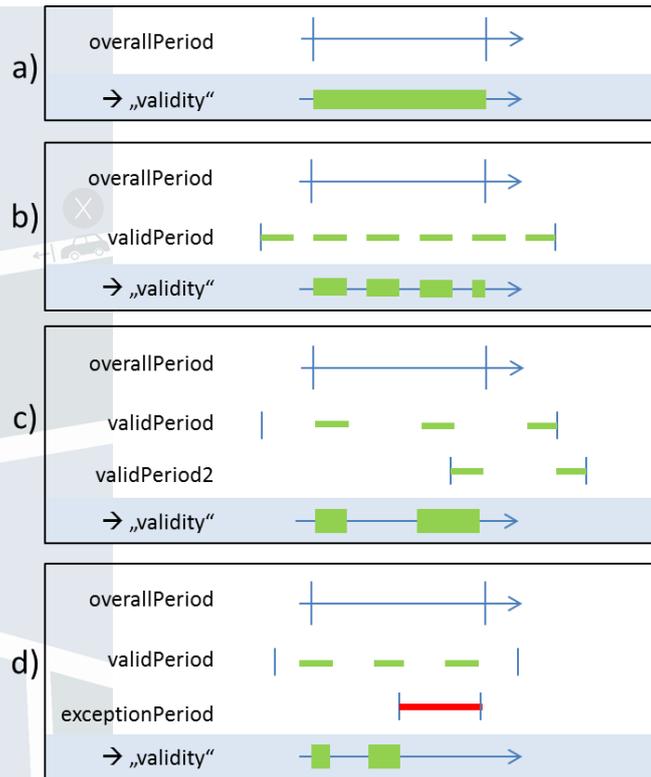


Figure 5 - Validity when using multiple periods

In case a) the actual validity corresponds exactly to the *overallPeriod*. In case b) it corresponds to the proportion of *validPeriod* that lies within the *overallPeriod*. In case c) the set union of the two specified periods is cut with the *overallPeriod*. And in case d) the period specified as *exceptionPeriod* is taken out of validity.

Particularly in the case of triggered low emission zones, the UVAR can be triggered by monitored or predicted high pollution levels. This can be incorporated by setting the *validityStatus* attribute to either *"suspend"* (in case the pollution level is below threshold and the scheme is inactive) or *"active"* (in case the pollution level exceeds the threshold and the scheme is active). Note that *ControlledZone* model described in the next section does have a dedicated mechanism to describe triggers.

5.1.3 The "ControlledZone" model

The *ControlledZone* model has two different entry points. On the one hand, a *ControlledZoneTable* containing one or more *ControlledZone* instances can be published using the *ControlledZoneTablePublication* class (see Figure 6). On the other hand, activation statuses of controlled zones can be published in a *CzDynamicActivationPublication* by referencing controlled zones that have already been published in a *ControlledZoneTablePublication*. The class *CzActivation* is used to describe whether the activation is due to a predefined condition (class *PredefinedConditionActivation*) or whether the activation is defined ad-hoc (class *NonPredefinedConditionActivation*). It is also possible to activate individual traffic regulation orders inside one *ControlledZone* (class *CzRestrictionActivation*).

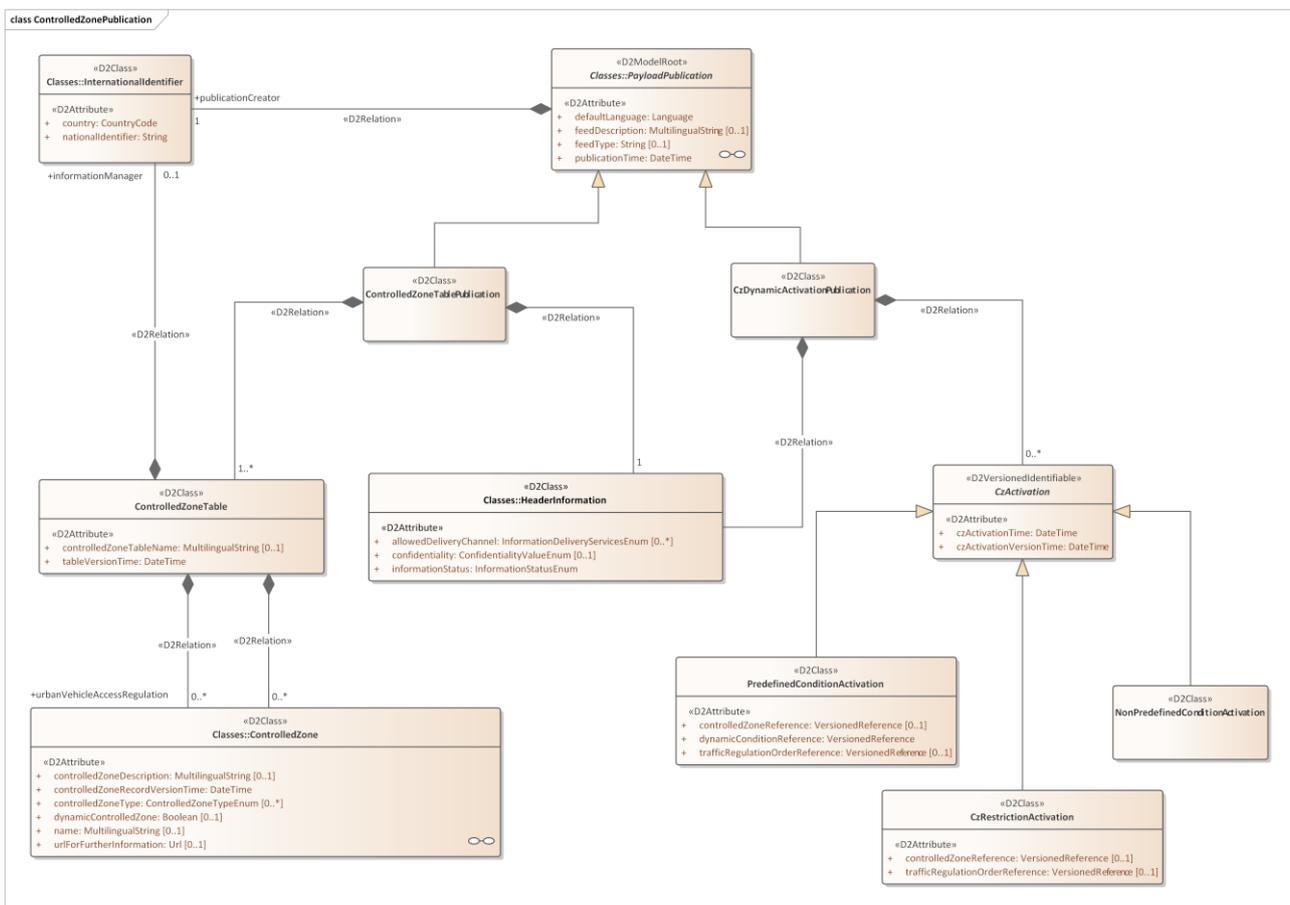


Figure 6 - The "ControlledZonePublication" class model

A *ControlledZone* may be implemented in two different ways.

Firstly, the *ControlledZone* may be implemented by a *TrafficRegulationOrder*, connecting the *ControlledZone* model to the *TrafficRegulation* model (see Figure 7). A detailed description of the *TrafficRegulationOrder* class can be found in section 5.1.2. Besides the traffic regulation order, a *ControlledZone* may also contain general information describing the controlled zone as well as alternative mobility options and tariff information. The TRO contains one or more traffic regulations defined by the *TrafficRegulation* class.

As an alternative – if the UVAR is not implemented by a TRO – the traffic regulations of a *ControlledZone* can also be defined as *ControlledZoneRegulation* instances. The *ControlledZoneRegulation* class is a specialisation of the *TrafficRegulation* class from the *TrafficRegulation* model and therefore inherits all model elements from its super class (see Figure 3). Besides these, it is also composed of the following additional elements:

- *Penalty*: A penalty for violating the traffic regulation defined by an amount and a description.
- *AdministrativeAccessConstraints*: Constraints put on vehicles and/or users that do have access (e.g., whether the regulations apply to foreign vehicles)

- *CzRegulationOperationalCharacteristics*: Operational characteristics of the controlled zone regulations.

Besides the *Condition* classes that are defined in the *TrafficRegulation* model, further conditions are required for UVARS. Thus, the *ControlledZone* model adds the following classes to the *Condition* model:

- *RetrofittingCondition*: information on retrofitting details
- *NonCodableCondition*: specification of conditions that are not covered by the condition model by giving a description of the condition and a type, which corresponds to the existing condition classes (e.g., *VehicleCondition*)
- *RegistrationCondition*: information on registration before entering the zone
- *StrickerCondition*: requirements on stickers
- *TariffCondition*: an indicator whether a tariff is paid
- *PeriodCondition*: conditions for time periods
- *ConditionsDueToExternalRegulation*: conditions that are defined in an external regulation and referenced in the traffic regulation order

This way, using either the *ControlledZoneRegulation* alone, or a combination of the *TrafficRegulation* and *ControlledZone* models, all the features of the UVAR can be represented.

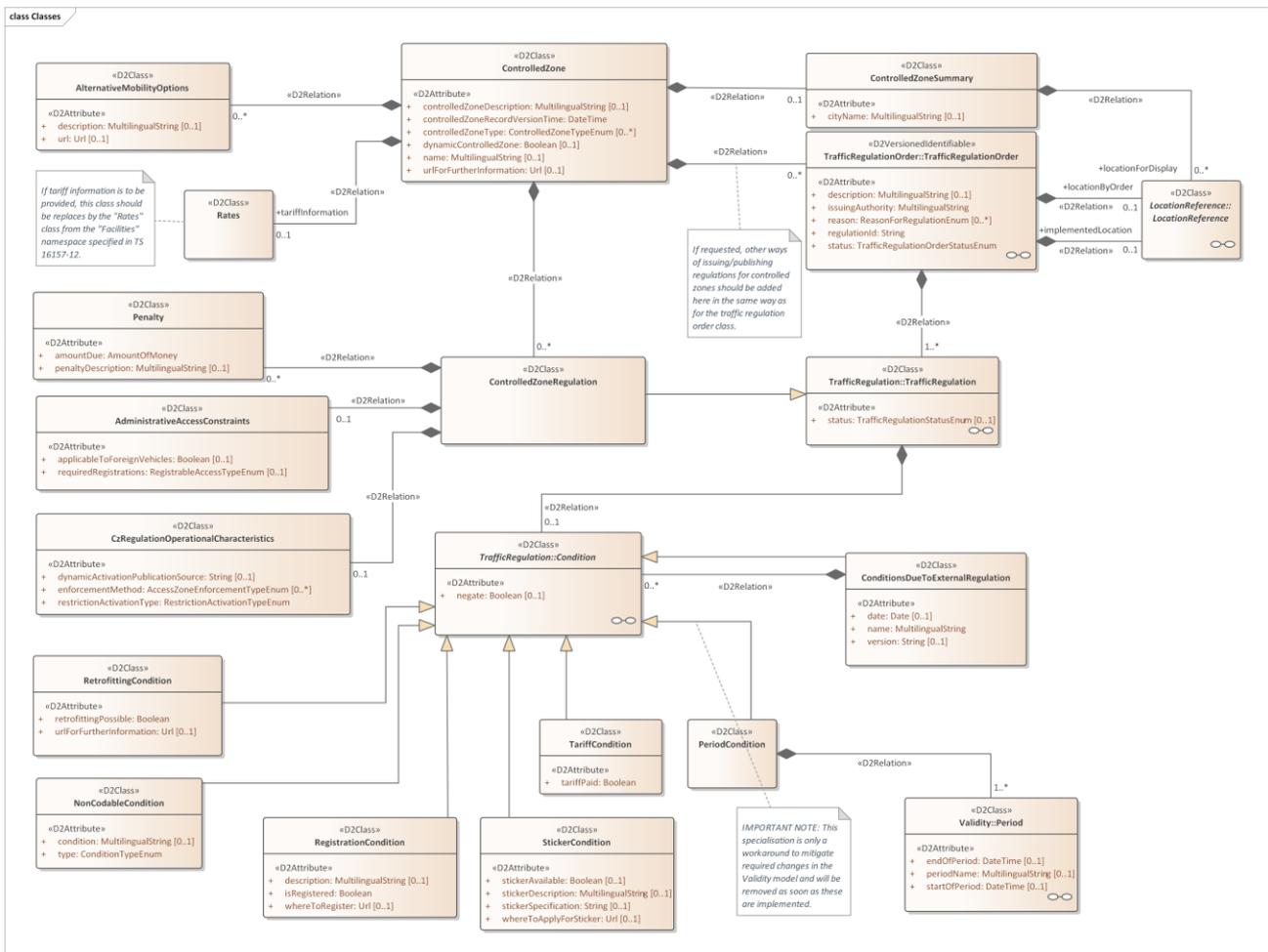


Figure 7 - The "ControlledZone" class model

5.1.4 The "Extension" model

In the *Extension* model, extensions for existing DATEX II models are defined. For *Common* [2] and *LocationReferencing* [1] there have already been extensions defined in the *TrafficRegulation* model. The UVAR model developed required the definition of further extensions to the *Common* model. Besides that, there are also additional model elements required in the *TrafficRegulation* model for the definition of UVAR information. In the following sections, only the extended model elements relevant for UVARs are described, not the pre-existing elements. The following table gives an overview of the extension sequence. The description in this document covers the rightmost column.

Phase (time)	DATEX II PSA ('18)	DATEX II PSA ext. ('21)	Uvar Box ('21/'22)
Location Referencing	CEN/EN 16157-2:2019	Extension 1	
Common	CEN/EN 16157-7:2018	Extension 1	Extension 2
Traffic Regulation		prCEN/TS 16157-11	Extension 1
Controlled Zone			Uvar Box

5.1.4.1 CommonExtended

For the *Common* model, extensions of the *VehicleCharacteristics* class (see Figure 8) are defined. Most of the extended model elements that are shown in Figure 8 are extensions that are already defined for the *TrafficRegulation* model, but there are also some extensions needed on top of these for the *Uvar* model. The *Emission* class has new attributes describing further emission types and a new *OwnerCharacteristics* class has been added.

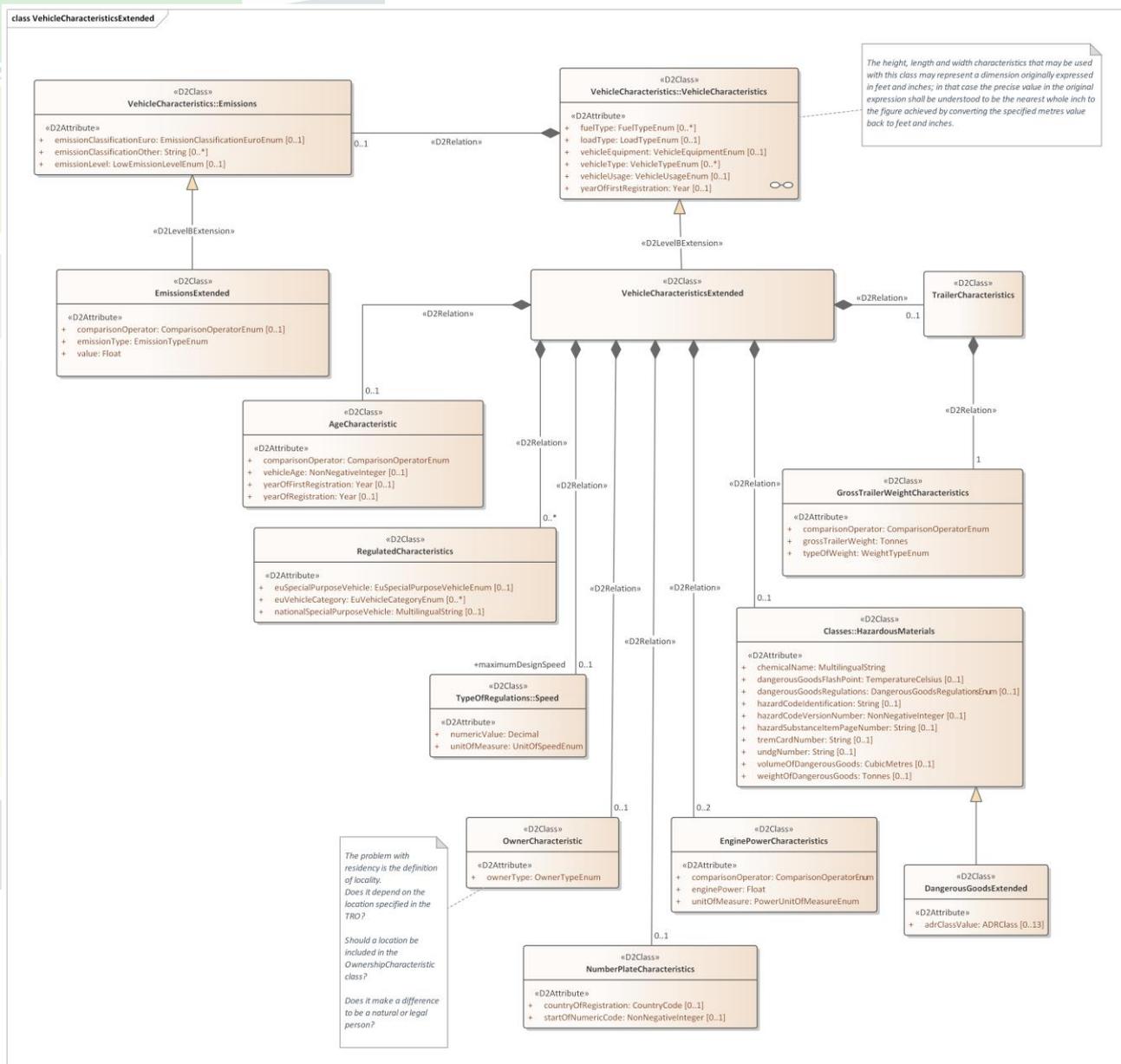


Figure 8 - The "VehicleCharacteristicsExtended" class model

Besides the extension classes that are shown in Figure 8, several enumerations from the *Common* model are also extended (see Figure 9). Especially the *VehicleTypeEnum*, the *EmissionClassificationEuroEnum*

and the *EuVehicleCategoryEnum* have been extended to include further possible values. Besides that, a new enumeration for the specification of emission types was added.

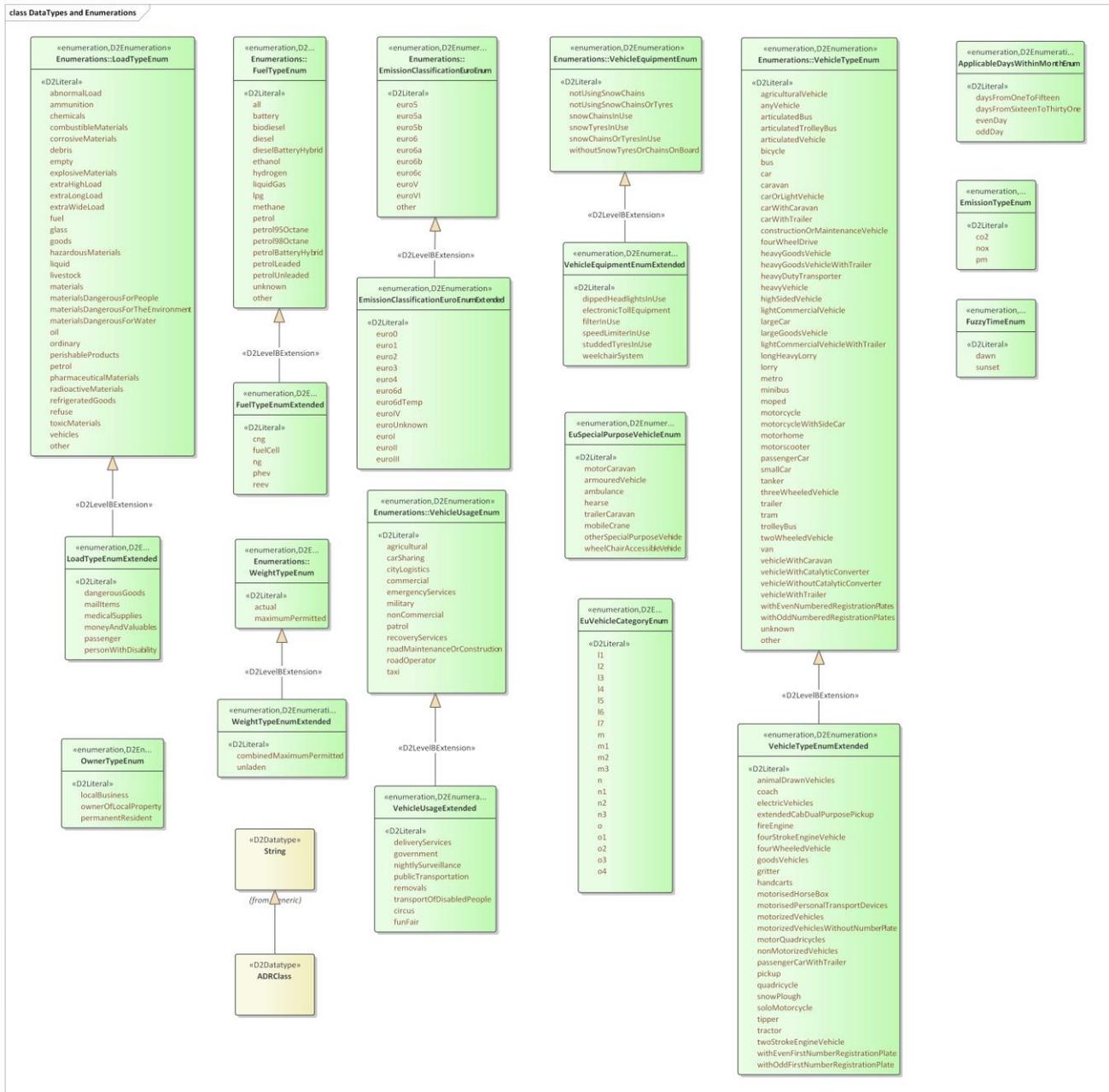


Figure 9 - Extended model elements from the "Common" model

5.1.4.2 TrafficRegulationExtended

Extensions are also defined for the *TrafficRegulation* model (see Figure 10), including additional attributes for permits, characteristics of occupants, road signs and additional enumeration literals for types of driver characteristics and access conditions. In addition to the model elements shown in Figure 10, other extensions needed are beyond LevelB. The DATEX II LevelB

extension mechanism does not allow extending abstract classes, such extensions are LevelC. In order to distinguish these two interoperability levels, the LevelC extensions are not placed in the *Extension* package.

Hence, extensions of the abstract *Condition* class from the *TrafficRegulation* model are placed in the *ControlledZone* package. A note is placed in the corresponding extension package indicating which classes from the *ControlledZone* package are proposed as extensions of the *TrafficRegulation* model.

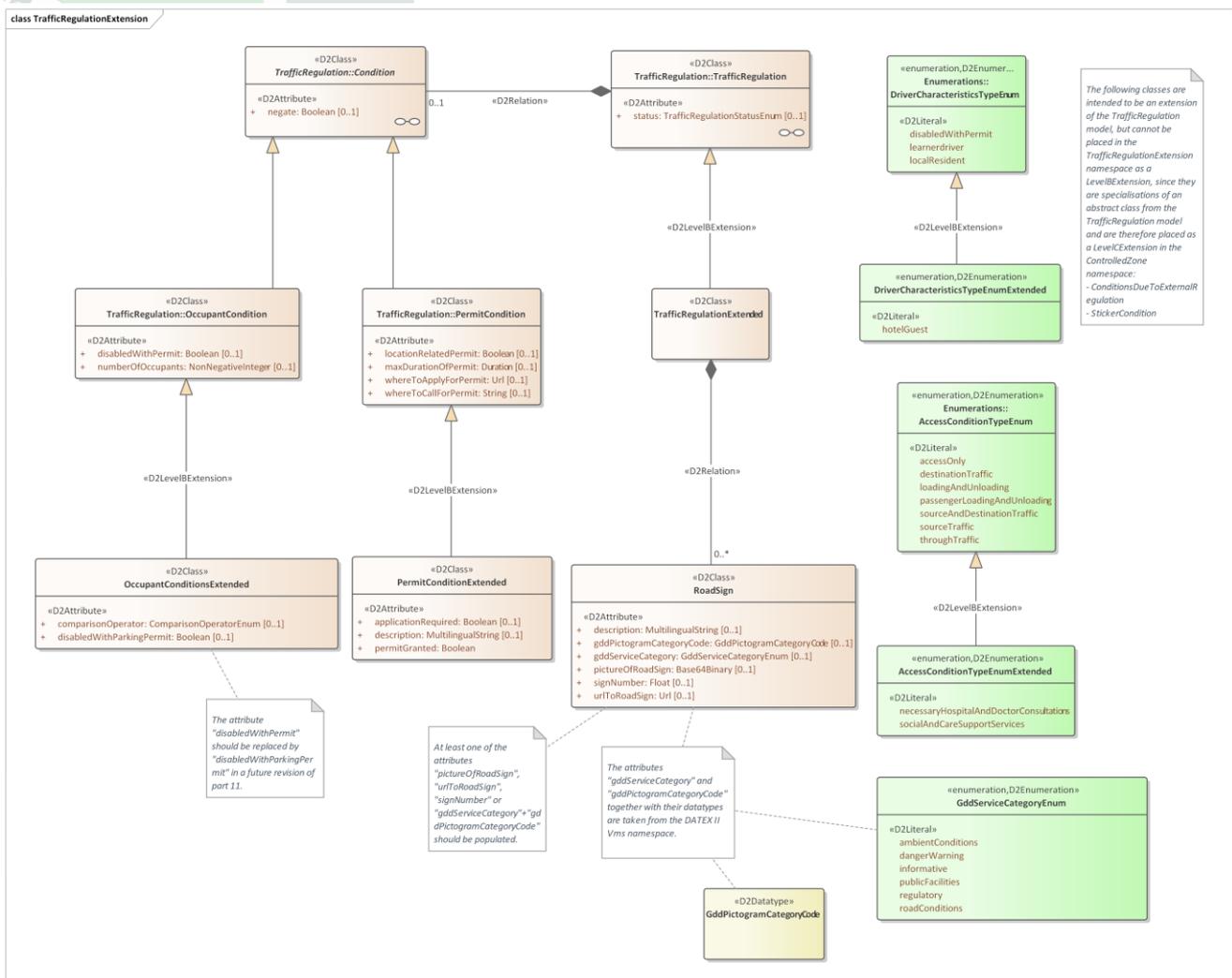


Figure 10 - Extended model elements from the "TrafficRegulation" model

5.2 Template for the SDG

5.2.1 Introduction

This section describes the results of Task 1.4, which defined a template (MS Word file structure), which is coherent with the defined UVAR data structures in the developed DATEX II profiles, to provide UVAR information complying with the Single Digital Gateway (SDG) Regulation.

The template should be used to hold information about UVARs in a structured way, to make UVAR information available on the SDG. It should be possible to fill the template in two different ways.

On the one hand, it will be possible to fill the template automatically by using DATEX II instances of UVARs, using the UVAR Box tools. On the other hand, it will be possible to fill the template manually using the tool that is to be developed in work package 2 of the UVAR Box project, using for example drop-down boxes to aid harmonisation of phrasing.

Similar to Task 1.3, the results presented in the following section describe a draft that will be further improved until the end of the project, as the time schedule of Task 1.4 was extended until month 24. Hence, an updated version of this document will be created at the end of the UVAR Box project, capturing the final results.

5.2.2 Template structure

The following document structure represents the structure of an SDG entry for a UVAR. For each section it is described which information should be contained and where this information can be found in the DATEX II model for UVARs.

Colour code explanation:

Bold: Section names that should be displayed in the SDG entry

Standard: Metatext describing the information that should be contained in the corresponding section

Blue: Metatext describing where the elements come from in the DATEX II model

Urban vehicle access regulation: <put UVAR name here>

General Information

This section contains general information on the UVAR:

1. including the city/town name and the country
2. a description of the UVAR
3. a broad classification of the type(s) of UVAR
4. the traffic sign(s) that are placed at the entry points of the UVAR; where there are several signs with a potential description in case where the different signs are used

5. As an overview the UVAR is highlighted in a map of the city/town, ideally with zooming and panning features, if possible. This is only a location for guiding the reader to where the UVARs are within the city. The actual UVAR location itself is described in a separate section below. This is especially relevant when there are multiple traffic regulations contained in the UVAR – potentially with different locations – so that a single representative location can be used.

The corresponding information comes from the attributes *controlledZoneDescription* (2.) and *controlledZoneType* (3.) from the *ControlledZone* class, the attribute *cityName* (1.) and *locationForDisplay* (5.) from the *ControlledZoneSummary* class, the *RoadSign* (4.) class and the attribute *country* (1.) from the *InternationalIdentifier* class.

Traffic Regulations

In this section all traffic regulations of the UVAR are listed. In case multiple traffic regulations apply, the structure described below is repeated.

At first, the type of the traffic regulation is described e.g., an access restriction or a standing/loading or parking restriction.

The traffic regulation(s) that apply for a UVAR are defined by the *TypeOfRegulation* class in the DATEX II model for UVARs.

Location

In this section the location of the UVAR is presented in a visual way, either for web application in a map, where zooming and panning is possible, or as one picture or multiple pictures for different segments, when the template is exported as a PDF.

In the DATEX II model for UVARs locations can be defined at different levels. Locations can be defined for traffic regulation orders, as well as for traffic regulations. For a traffic regulation order, an *implementedLocation* and a *locationByOrder* can be defined corresponding to the overall ordered/implemented location of the zone. Furthermore, each traffic regulation can have one or more locations itself (for example where the scheme extends in phases), which are defined by the *LocationCondition* class from the *Condition* model for traffic regulations, which would also be used in case that the *ControlledZone* is implemented without a traffic regulation order. The model uses the location referencing methods that are included in EN 16157-2:2019.

Hours of operation

This section contains information on the overall time validity of the regulation, including a start/end date or a complex structure of validity periods, or potentially triggering conditions that lead to activation/deactivation. In addition an indication of whether the UVAR is dynamic or static is contained here.

The time validity of the UVAR is defined by the classes *ValidityCondition* (see Figure 5) and *PeriodCondition* in the Condition model for traffic regulations.

Who is affected?

In this section it is described who is affected by the above-described traffic regulations. In most cases this is a statement like e.g. "The traffic regulations apply to all motorized vehicles". If there are multiple conditions for applicability defined these are presented in a bullet point list.

The information on who is affected comes from the *Condition* model of the traffic regulations that are defined for the UVAR. A detailed description of the structure of the *Condition* model is described in section Figure 4.

Who is exempted?

This section lists all exemptions from the traffic regulation. This section will be the most complex and large as there are mostly many exemptions defined for UVARs with rather complex properties. The list of exemptions includes information on exemptions for vehicles with different euro norms, journey purposes, occupations of the driver, usage of the vehicle, retrofitting information, required registrations, permits, etc.

In the DATEX II model for UVARs exemptions to traffic regulations are defined as negated *Condition* instances which then corresponds to e.g. "The condition for a traffic regulation to apply is that the vehicle is not an electric vehicle.". Due to complex exemptions, this condition typically consists of a complex *ConditionSet*.

Penalty

This section contains information on the penalty(s) for violating the traffic regulations that apply in the UVAR.

This information should come from the attributes *amountDue* and *penaltyDescription* from the *Penalty* class.

Tariffs

This section contains information on whether tickets can be purchased to be permitted to enter the zone (e.g., a day pass) and how, when and where they should be purchased (before/after entering the zone, etc.). Furthermore, information on where to place any physical permit should be described.

This information comes from the *Rates* model specified in CEN TS 16157-12, which shall be included in the DATEX II model for UVARs if tariff information is to be provided.

Additional Information

Here, additional information is described including alternative mobility options, URLs for further information on the UVAR, etc.

This information comes from the classes *AlternativeMobilityOptions* and the attribute *urlForFurtherInformation* from the *ControlledZone* class.

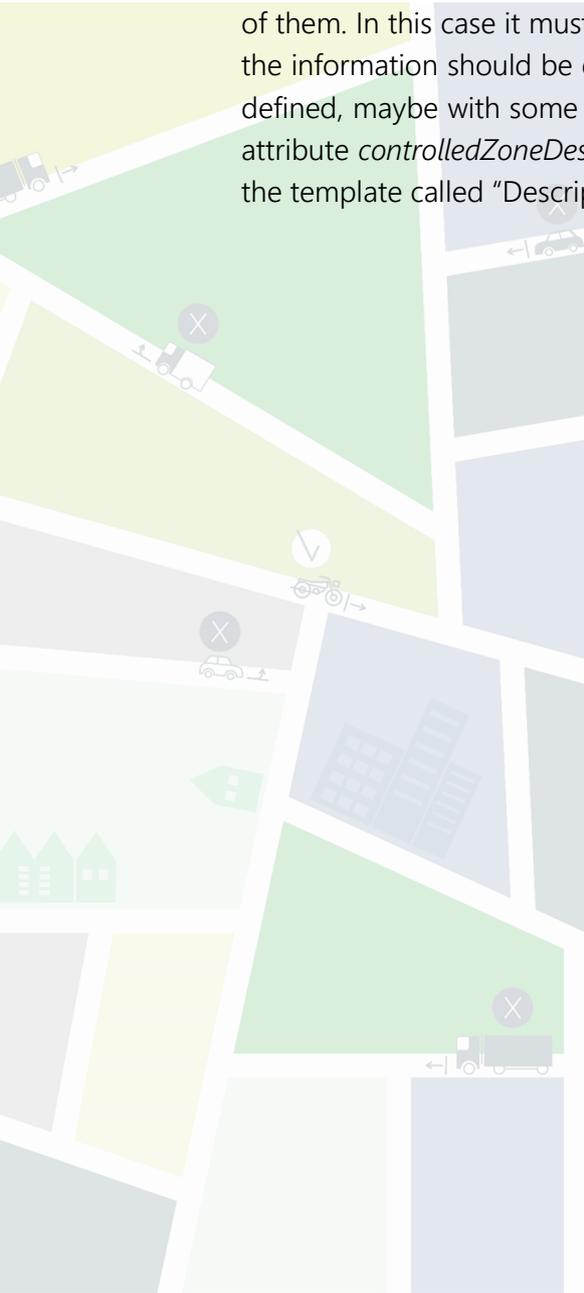
5.2.3 DATEX II model elements in the template

The developed template is designed such that DATEX II messages for UVARs can be automatically filled into the template with the software to be developed. For that different model elements (e.g., Classes, Attributes, Enumeration literals) must be mapped differently to human readable text. The mapping requires the availability of the DATEX II data dictionary in the language to be used for filling the template. This includes in particular the names of attributes, enumeration literals and measures derived from DATEX II datatypes.

A “Class” groups attributes in a similar context, which then contain the concrete information. Therefore, the relevant information comes from the attributes themselves. An attribute always has a datatype, which can be a Boolean (true or false), an enumeration with enumeration literals, a numerical value or string attribute (e.g., a URL). The different datatypes need to be treated differently when filling the template with information from the DATEX II message.

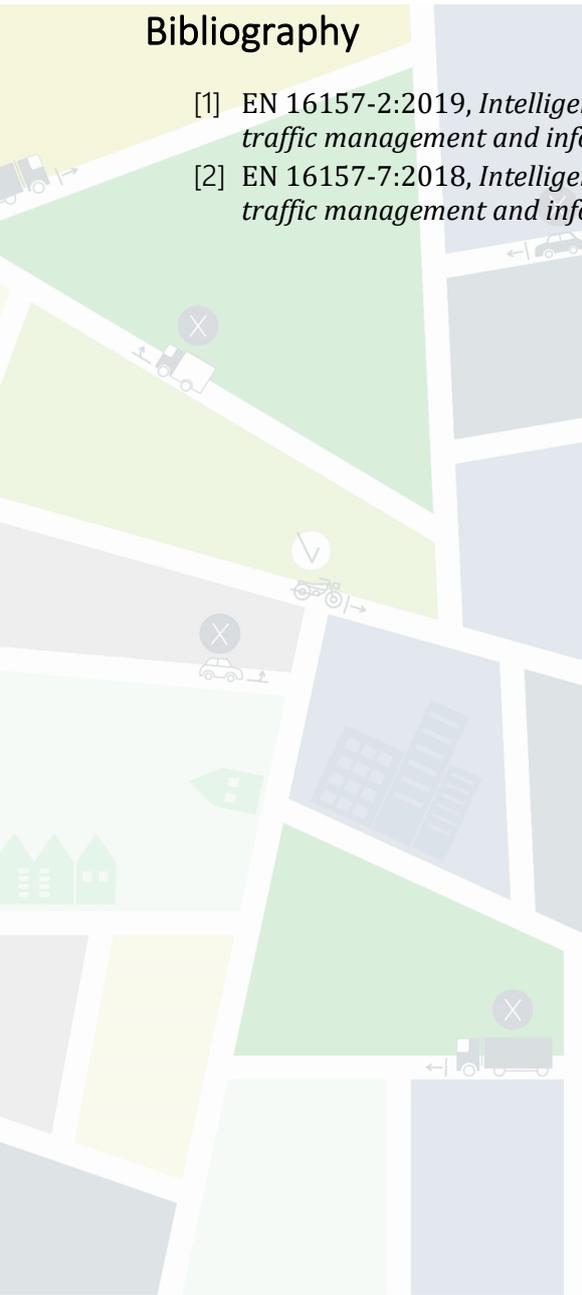
- **Boolean:** A Boolean is used when there is something that can either be true or false. When including this in the template, this information needs to be phrased such that the statement represents the Boolean value, e.g., when the attribute *applicableToForeignVehicle* is set to “true” the corresponding statement in the template should be “The regulations of the UVAR are applicable to foreign vehicles” and vice versa.
- **Enumeration:** The mapping of an enumeration literal to a human readable text is rather straight forward. The context is given by the name of the Enumeration (e.g., *VehicleTypeEnum*) or if that is not sufficient, the definition of the Enumeration. This information should be used to create a sentence or bullet point in which the enumeration literal can be combined with a word or sentence that describes the context. For example, for *vehicleType*="diesel" a corresponding bullet point would be “diesel vehicles” or for *emissionType*="euro4" the corresponding statement could be “Vehicles with emission standard euro4.”.
- **Numerical values:** For numerical values it is important to take the unit of the value into account when translating it into a textual representation. For example, for a speed limit with attribute *maxValue*="30" and *unitOfSpeed*="kilometresPerHour" the corresponding text could be “A maximum speed limit of 30 kilometres per hour applies.”. For numerical values where there is no separate attribute for the enumeration, the data type of the attribute may contain this information, e.g., for the attribute *yearOfFirstRegistration* the datatype is *Year*, which shows that the given value corresponds to a year.
- **String values:** String values are mostly used for names or descriptions. A special case is the *MultilingualString* datatype which can contain multiple strings with a language attribute for each

of them. In this case it must be examined, which languages are available and in which language the information should be displayed on the SDG. In general, strings should be used as they are defined, maybe with some heading stating the context of the string (e.g., the *MultilingualString* attribute *controlledZoneDescription* in the class *ControlledZone* could be used in a paragraph of the template called "Description of the UVAR".



Bibliography

- [1] EN 16157-2:2019, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 2: Location referencing*
- [2] EN 16157-7:2018, *Intelligent transport systems — DATEX II data exchange specifications for traffic management and information — Part 7: Common data elements*



Template version and print date

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