



BSI Standards Publication

Public transport — Reference data model

Part 7: Driver management

National foreword

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Partie 7 : Gestion des conducteurs

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European foreword

This document (EN 12896-7:2019) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2020, and conflicting national standards shall be withdrawn at the latest by March 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

The series is composed with the following documents:

- *Public transport – Reference data mode – Part 1: Common concepts;*
- *Public transport – Reference data mode – Part 2: Public transport network;*
- *Public transport – Reference data mode – Part 3: Timing information and vehicle scheduling;*
- *Public transport – Reference data mode – Part 4: Operations monitoring and control;*
- *Public transport – Reference data mode – Part 5: Fare management;*
- *Public transport – Reference data mode – Part 6: Passenger information;*
- *Public transport – Reference data mode – Part 7: Driver management;*
- *Public transport – Reference data mode – Part 8: Management information & statistics; and*
- *Public transport – Reference data mode – Part 9: Informative documentation [CEN/TR].*

Together these create version 6 of the European Standard EN 12896, known as “Transmodel”, and thus replace EN 12896:2006, known as “Transmodel v5.1”.

In comparison with EN 12896:2006, the technical modifications made are presented in CEN/TR 12896-9, *Public transport – Reference data model – Part 9: Informative documentation*.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Part 1 of this European Standard presents the following items:

- Rationale for the Transmodel Standard;
- Use of the Transmodel Standard;
- Applicability of the Transmodel Standard;
- Conformance Statement;
- Transmodel Origins;
- Reference to the Previous Version and Other Documents.

The data structures represented in Part 1 are generic patterns that are referenced by different other parts.

Part 2 of this European Standard presents space-related data structures.

Part 3 presents time-related data structures and replaces the sections of EN 12896:2006 referring to the time-related Tactical Planning Components and to Vehicle Scheduling.

Part 4 presents data referring to daily operations (i.e. to operational days), different from those planned for day types (space-related data structures and tactical planning components) and including operational raw data referring to operations follow-up.

Part 5 presents fares structures including sales, validation and control.

Part 6 presents Passenger Information (planned and real-time).

Part 7 (this part) presents Driver Management including Driver Scheduling (day-type related driver schedules), Rostering (ordering of driver duties into sequences according to some chosen methods) and Driving Personnel Disposition (assignment of logical drivers to physical drivers and recording of driver performance).

Part 8 presents Management Information and Statistics.

1 Scope

1.1 General Scope of the Standard

The main objective of the present standard is to present the Reference Data Model for Public Transport, based on:

- the Reference Data Model, EN 12896, known as Transmodel V5.1;
- EN 28701:2012, *Intelligent transport systems – Public transport – Identification of Fixed Objects in Public Transport (IFOPT)*, although note that this particular standard has been withdrawn as it is now included within Parts 1 and 2 of this European Standard (EN 12896-1:2016 and EN 12896-2:2016) following their successful publication;

incorporating the requirements of:

- EN 15531-1 to -3 and CEN/TS 15531-4 and -5: *Public transport – Service interface for real-time information relating to public transport operations (SIRI)*;
- CEN/TS 16614-1 and -2: *Public transport – Network and Timetable Exchange (NeTEx)*, in particular the specific needs for long distance train operation.

Particular attention is drawn to the data model structure and methodology:

- the data model is described in a modular form in order to facilitate the understanding and the use of the model;
- the data model is entirely described in UML.

The following functional domains are considered:

- Network Description: routes, lines, journey patterns, timing patterns, service patterns, scheduled stop points and stop places;
- Timing Information and Vehicle Scheduling (runtimes, vehicle journeys, day type-related vehicle schedules);
- Passenger Information (planned and real-time);
- Fare Management (fare structure, sales, validation, control);
- Operations Monitoring and Control: operating day-related data, vehicle follow-up, control actions;
- Driver Management:
 - Driver Scheduling (day-type related driver schedules),
 - Rostering (ordering of driver duties into sequences according to some chosen methods),
 - Driving Personnel Disposition (assignment of logical drivers to physical drivers and recording of driver performance);

- Management Information and Statistics (including data dedicated to service performance indicators).

The data modules dedicated to cover most functions of the above domains will be specified.

Several concepts are shared by the different functional domains. This data domain is called “Common Concepts”.

1.2 Functional Domain Description

The different functional domains (enumerated above) taken into account in the present document, and of which the data have been represented as the reference model, are described in EN 12896-1, *Public transport – Reference data model – Part 1: Common concepts*.

1.3 Particular Scope of this Document

The present document entitled *Public transport – Reference data model – Part 7: Driver management* incorporates the following data packages:

- Driver Scheduling;
- Rostering;
- Personnel Disposition;
- Driver Control Actions.

This document itself is composed of the following parts:

- Main document (normative) presenting the data model for the concepts shared by the different domains covered by Transmodel,
- Annex A (normative), containing the data dictionary, i.e. the list of all the concepts and attribute tables present in the main document together with the definitions,
- Annex B (normative), providing a complement to EN 12896-1:2016, particularly useful for Parts 4 to 8 of the Public Transport Reference Data Model; and
- Annex C (informative), indicating the data model evolutions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12896-1:2016, *Public transport — Reference data model — Part 1: Common concepts*

EN 12896-2:2016, *Public transport — Reference data model — Part 2: Public transport network*

EN 12896-3:2016, *Public transport — Reference data model — Part 3: Timing information and vehicle scheduling*

EN 12896-4:2019, *Public transport — Reference data model — Part 4: Operations monitoring and control*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 General Terms and Definitions:

NOTE The following generic terms are used.

3.1.1

attribute

property of an entity

3.1.2

conceptual data model

description of a real-world domain in terms of entities, relationships and attributes in an implementation independent manner in order to provide a structure on which the rest of the development of an application system can be based

3.1.3

conceptual level

<data modelling> conceptual data model

3.1.4

database

collection of data

Note 1 to entry: Often used in the sense of the physical implementation of a data model.

3.1.5

data domain

data structure (which is, in this European Standard, a part of the Reference Data Model for Public Transport) made up of data related to each other, through the fact that there is a functional area or group of functions using this data set as a whole

3.1.6

data model

description of a real-world domain in terms of data and relationships

3.1.7

entity

object (data) that has its own existence (as opposed to an attribute)

3.1.8

fare management

all activities related to the collection of money from passengers

3.1.9

function

activity

Note 1 to entry: In this European Standard, sub-activity of a functional area.

3.1.10

functional area

arbitrarily defined set of activities, used, in this European Standard, to define the objectives and limits of the data model

3.1.11

interoperability

ability of (sub)systems to interact with other (sub)systems according to a set of predefined rules (interface)

3.1.12

logical data model

data design that takes into account the type of database to be used but which does not consider means of utilization of space or access

3.1.13

logical denormalized model

relational data model that is not fully normalized, i.e. does not completely follow the normalization rules and thus may be redundant

3.1.14

logical level

<data modelling> logical data model

3.1.15

management information

all activities allowing the company management to collect the information necessary to meet problem-solving needs

3.1.16

object-oriented data model

data structure expressed according to principles that allow for a direct implementation as an object-oriented database, where information is represented in form of objects, i.e. respecting the principle of encapsulation meaning in particular that each data is accessed or modified through operations (methods) belonging to it

3.1.17

operations monitoring and control

all activities related to the transportation process, i.e. real-time functions related to the driving and transportation of passengers according to given instructions, including the monitoring of the driving process and its control in case of deviations, as well as all activities that support the driving process such as traffic light priority, track switching, bay selection, advance/delay advice, etc.

3.1.18

passenger information

all activities related to informing the users either on the planned or on the actual transportation services

3.1.19**personnel disposition**

all activities related to the mid-term and short-term management of drivers

3.1.20**real-time control**

see Operations monitoring and control

3.1.21**relational data model**

type of logical data model giving the information as series of tables (relations) and attributes, and possessing the following characteristics:

- a) all attribute values are atomic;
- b) all "tuples" (rows/occurrences) are distinct;
- c) no part of the primary key may be null; and
- d) foreign key values must correspond to an existing primary key in another relation or be null

3.1.22**scheduling**

see Tactical Planning

3.1.23**tactical planning**

all activities related to the tactical planning of transportation, splitting into vehicle scheduling, driver scheduling, rostering

3.2 Domain-Specific Terms and Definitions:

NOTE The following terms specific to the driver management domain are used. Terms which are also data entity names are defined in the data dictionary in Annex A and are not repeated here.

3.2.1**relief**

person taking the place of another person as responsible for a certain task (such as driving a bus)

3.2.2**roster**

plan showing turns of duty or leave for individuals in an organization

4 Symbols and Abbreviations

IFOPT	Identification of Fixed Objects in Public Transport (EN 28701:2012)
ISO	International Organization for Standardization
IT	Information Technology
NeTEx	Network and Timetable Exchange (CEN/TS 16614 series)
PT	Public Transport

PTO	Public Transport Operator
SIRI	Service Interface for Real-time Information (EN 15531 (all parts) and CEN/TS 15531 (all parts))
SIRI-FM	Service Interface for Real-time Information Facility Monitoring (CEN/TS 15531-4)
SIRI-SX	Service Interface for Real-time Information Situation Exchange (CEN/TS 15531-5)
UML	Unified Modelling Language
URI	Uniform Resource Identifier
URL	Universal Resource Locator

5 Driver Management

5.1 Introduction

The description of driver management is divided into three main parts. The first major part concerns *driver scheduling*, in essence creating the day-type related driver schedules where the required work is divided into duties that represents a set of work to be performed by one driver on one day.

The next major part concerns *rostering*, describing how the driver duties are ordered into sequences, according to some chosen method, to obtain a starting point for a balanced work share among the personnel over the planning period.

The final major part is the *personnel disposition*, describing how physical drivers are assigned to do the work of a logical driver. This part also covers the recording of driver performance.

Additionally, there are clauses concerning *driver*, *driver trip* and *driver control actions*.

5.2 Driver

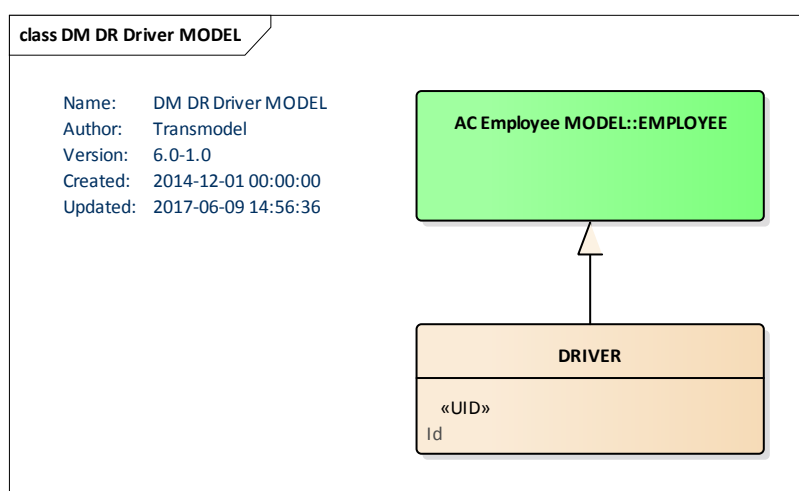


Figure 1 — Driver MODEL

The DRIVER entity describes a physical driver, who is an EMPLOYEE (see EN 12896-1) of the public transport company.

Note that in the first stages of the planning process there are no direct references to the DRIVER (i.e. the physical driver). Instead a theoretical LOGICAL DRIVER is used during planning, and later on there will be a separate assignment of which DRIVER (physical driver) that shall perform the duties specified for a certain LOGICAL DRIVER.

5.3 Driver Scheduling

5.3.1 General Remarks

Driver scheduling involves the construction of driver DUTies to cover the scheduled SERVICE JOURNEYS (see EN 12896-3) at minimum cost. This process shall also give DRIVERS fair workloads, which comply with the law and with the agreements made between the company and, for example, driver unions. There are numerous parameters, such as maximum length of driving time allowed without a break, which will be essential input for the driver scheduling algorithm. These are not included in the reference model, because they do not have a complex structure or relationships to the data model entities but are simple values.

In many cases, BLOCKs (see EN 12896-3) will have already been compiled before the start of the driver scheduling process and will be used as input. However, schedulers do not always want to work in that order; the model allows DUTies to be entered into the system before pieces of vehicle work have been assigned to them.

5.3.2 Duties

5.3.2.1 Duty Components

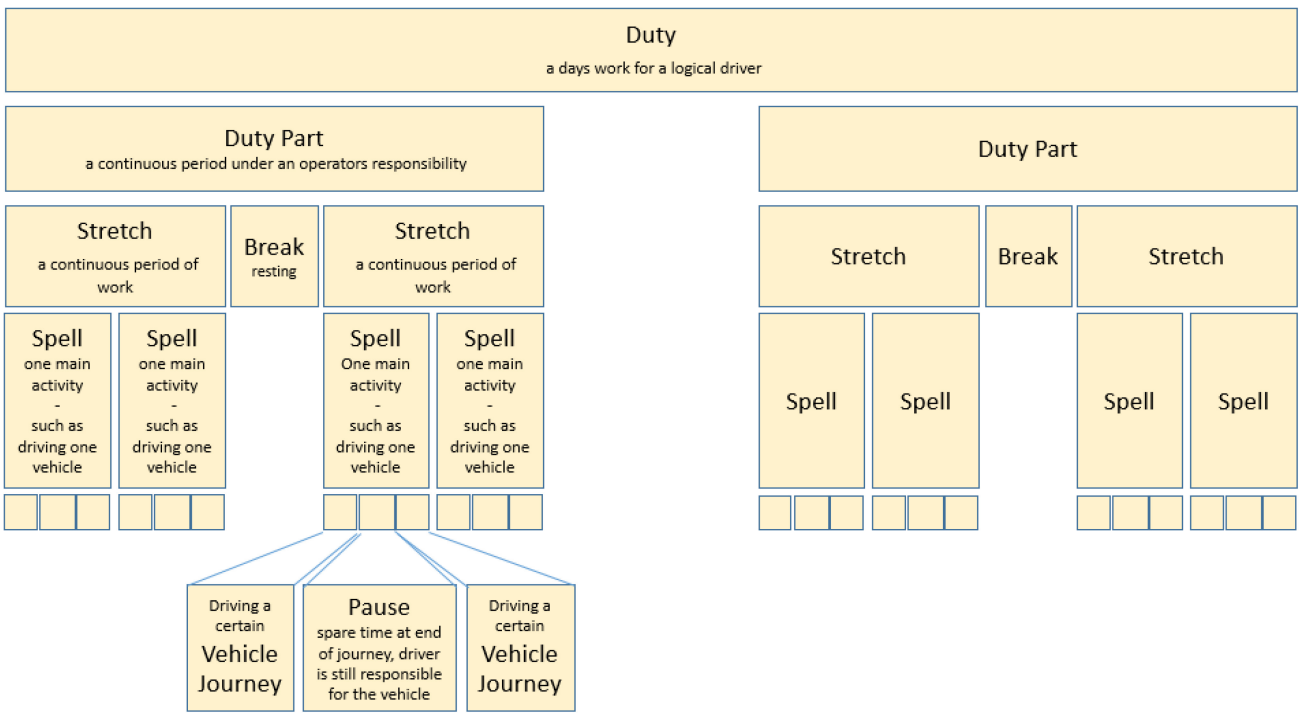


Figure 2 — Simplified overview of the main concepts in a duty in relation to a driver

A DUTY describes a day's work for a LOGICAL DRIVER on one DAY TYPE. A DUTY may be a SPARE DUTY, in which case no specific work has yet been assigned to it, or an ASSIGNED DUTY, which is composed of a hierarchy of components.

Operators and applications use various DUTY component levels. The reference model includes more levels than any one company is likely to want, in order to support these existing ways of structuring the data. Some of these levels may only be used within the driver scheduling package and will not be needed in a company database. They are included in the model because they explain the relationships between entities that will be in such a company database.

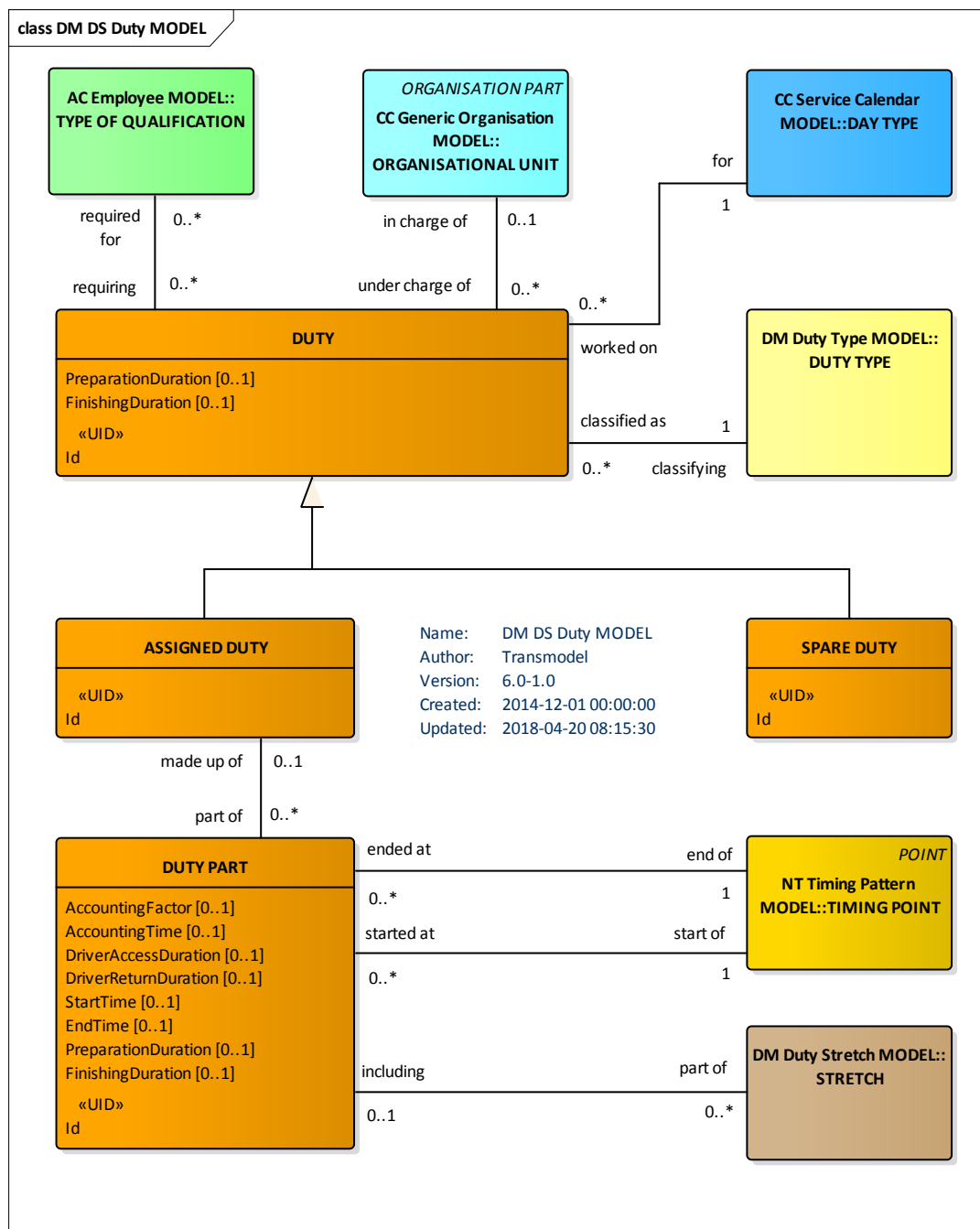


Figure 3 — Duty MODEL

An ASSIGNED DUTY may be divided into one or two (or sometimes even more) DUTY PARTs, which are each bounded by sign on and sign off. A DUTY consisting of two DUTY PARTs is commonly known as a “split” duty. A DUTY PART is a continuous period during which the driver is under the responsibility of the OPERATOR (see EN 12896-1). In many companies, a DUTY PART is therefore a continuous paid period as well.

As a DUTY PART may last a relatively long time, they often include breaks planned for driver resting. Each DUTY PART is composed of one or several STRETCHes, which are continuous period of work not interrupted by any BREAK. A BREAK shall therefore follow a STRETCH and is included in the corresponding DUTY PART.

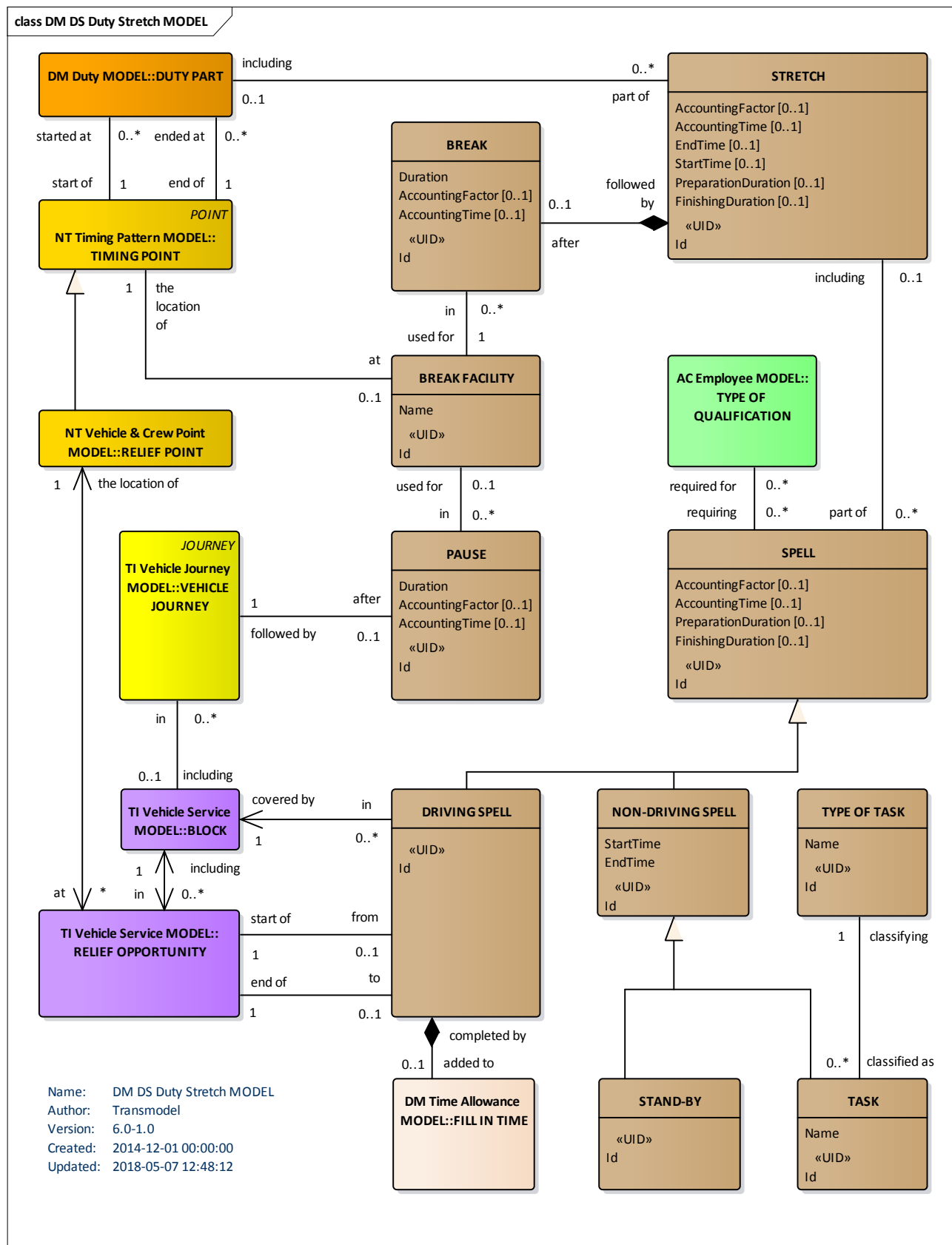


Figure 4 — Duty Stretch MODEL

Each STRETCH is composed of one or several SPELLs. A SPELL describes a period during which the same main activity is to be performed (e.g. driving a vehicle, stand-by period etc.). SPELLs are subdivided into DRIVING SPELLs and NON-DRIVING SPELLs.

5.3.2.2 Driving Spells

A DRIVING SPELL is a SPELL that is performed continuously on the same vehicle (i.e. the same BLOCK). A DRIVING SPELL is bordered by two actual reliefs, which are organized on appropriate RELIEF OPPORTUNITIES (see EN 12896-3). These RELIEF OPPORTUNITIES are points in time and space (at RELIEF POINTs – see EN 12896-2) in the same particular BLOCK.

In principle, the first DRIVING SPELL covering a BLOCK starts with a relief involving only the driver taking charge of the vehicle from the PARKING POINT (EN 12895-2:2016). By contrast, the last DRIVING SPELL covering a BLOCK involves only the last driver. In between, reliefs concern both a relieved driver and a relieving driver.

The RELIEF OPPORTUNITY entity, relating a BLOCK to a DRIVING SPELL, is a crucial concept to associate the work of LOGICAL VEHICLES (vehicle schedules) and the work of LOGICAL DRIVERS (driver schedules). In a real implementation, those RELIEF OPPORTUNITIES that are chosen for actual reliefs may be flagged as being related to an actual DRIVING SPELL. However, other (unused) RELIEF OPPORTUNITIES may remain of interest for real-time control, in case of duty modification.

The VEHICLE JOURNEYS (and SPECIAL SERVICES) to be covered by each DRIVING SPELL can be derived from the other data. A DRIVING SPELL is bounded by two RELIEF OPPORTUNITIES on the same BLOCK. All the VEHICLE JOURNEYS in that BLOCK, between the start and the end RELIEF OPPORTUNITIES, will be driven by the driver who has to work that DRIVING SPELL.

Some relief opportunities are organized during a VEHICLE JOURNEY, at an intermediate RELIEF POINT. In such a case, only a part of the journey belongs to each (relieved or relieving) DRIVING SPELL. In a real implementation, such characteristics may be implemented using redundant JOURNEY PARTs (EN 12896-3).

DRIVING SPELLs may include PAUSEs planned in the covered BLOCK, after a VEHICLE JOURNEY (EN 12896-3).

5.3.2.3 Breaks and Pauses

Drivers cannot work continuously for long periods of time and shall be given BREAKs. The length of work periods without any BREAK, as well as the length of BREAKs, is a matter of legal requirement and agreement between the company and the unions.

A BREAK is defined as a period of time, during which the driver is still under the responsibility of the company (and normally still paid), devoted only to resting.

BREAKs are identified by the STRETCH of work that they follow. BREAKs shall be arranged at a TIMING POINT (EN 12896-2) where there is a BREAK FACILITY, with toilets and where meals and other refreshments may be available. The place of a BREAK FACILITY is often at a RELIEF POINT where another driver relieves the driver. In some cases, the driver may have to walk to another TIMING POINT, which is near to the RELIEF POINT and is a more suitable place to stay during a BREAK (for example a service centre in a pedestrian zone).

BREAKs are deliberately built into the DUTIES. PAUSEs, on the contrary, are spare times at the end of VEHICLE JOURNEYS which usually arise as a result of the vehicle scheduling process, but which may also be used as rest or refreshment time by drivers. A PAUSE can be organized if, for instance, the

VEHICLE (EN 12896-1) has a planned long waiting time at a PARKING POINT far from the centre of the city. In such a case, it is wiser to plan a PAUSE than to organize a relief. In some cases, PAUSES may also be planned deliberately. They may be taken in a BREAK FACILITY, but the driver remains responsible for the VEHICLE during the PAUSE.

5.3.2.4 Time Allowances and Fill-in Times

At the beginning or at the end of a DUTY, a DUTY PART, a STRETCH or a SPELL, a fixed time may be allowed to perform certain activities to prepare for, or to complete the work regularly assigned to this element. These activities may include signing on or off, controlling the vehicle condition, cleaning or refuelling the vehicle, controlling the amount of cash, etc.

The total duration scheduled for these preparation and finishing activities may be recorded in the corresponding attributes for the said elements, as 'PreparationDuration' and 'FinishingDuration'.

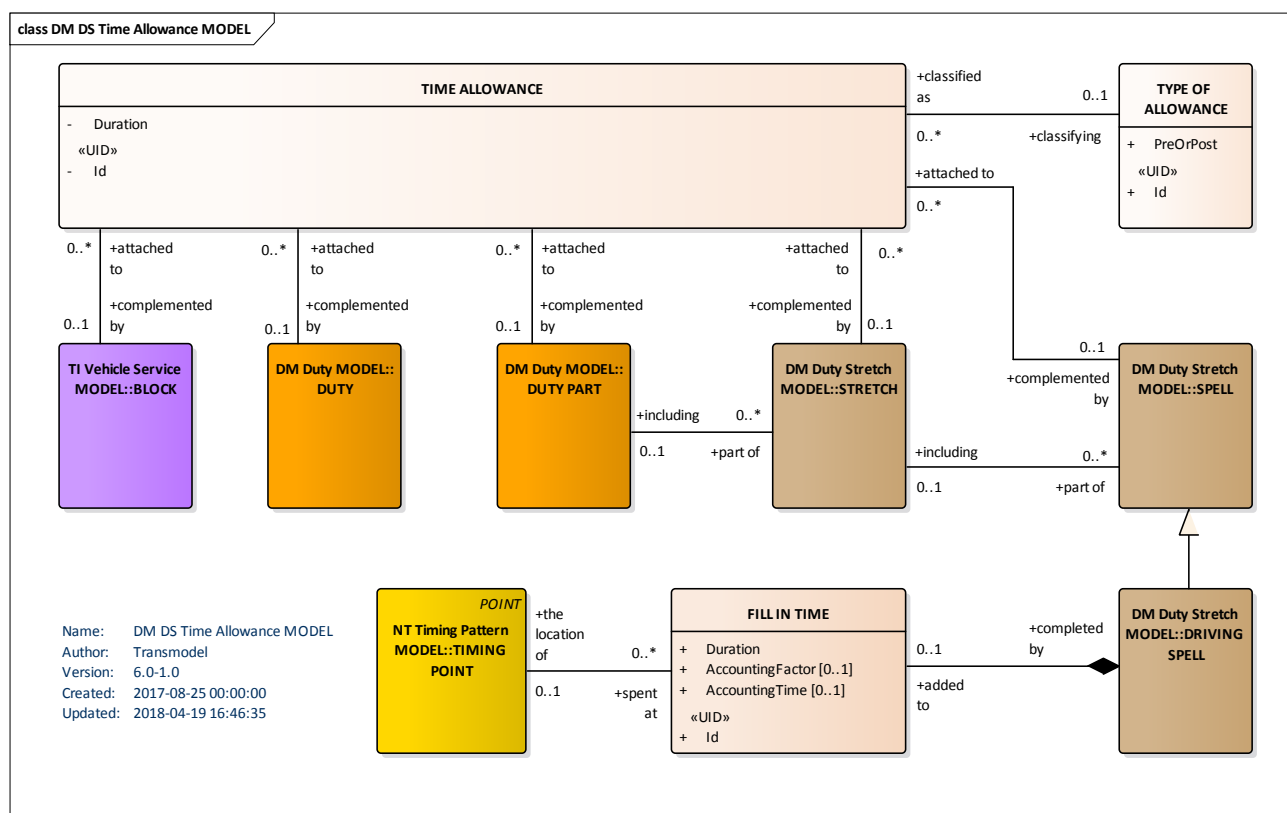


Figure 5 — Time Allowance MODEL

Most operators need to classify such times in a more detailed way. One or several TIME ALLOWANCES may be attached to a DUTY, a DUTY PART, a STRETCH or a SPELL. The TYPE OF ALLOWANCE permits these times to be classified according to the specific local conditions, and to express whether the TIME ALLOWANCE is applied at the beginning or at the end of the considered element.

FILL-IN TIMES are analogous to TIME ALLOWANCES, but do not have any operational meaning. A FILL-IN TIME is a period of time, after a DRIVING SPELL, during which a driver is not assigned to any precise activity. It may be spent at a particular TIMING POINT. Such an extra time is allowed at the end of a SPELL for it to come up to an agreed minimum. It may be also a spare time resulting from the driver scheduling process.

The start and end times of any DUTY component shall embrace any attached 'PreparationDuration', 'FinishingDuration', TIME ALLOWANCE or FILL-IN TIME (see model diagram in subclause 5.3.2.1).

5.3.2.5 Start and End Places of Duty Components

The start and end places of a DRIVING SPELL are RELIEF POINTs, which can be derived from the RELIEF OPPORTUNITIES bordering that DRIVING SPELL.

The place of a NON-DRIVING SPELL is to be specified at a particular TIMING POINT.

A STRETCH starts from the starting TIMING POINT of its first SPELL (a RELIEF POINT in case of DRIVING SPELL). It ends at the finishing TIMING POINT of its last SPELL (except in case of FILL-IN TIME, which may be spent at another TIMING POINT). A BREAK is taken at a POINT where there is a BREAK FACILITY.

The start place and the end place of a DUTY PART may be specified. They are often places where DRIVERS sign on or off (e.g. the CREW BASE). Such places shall be TIMING POINTs, in order to allow the assignment of standard times from or to these places. This may involve a category of TIMING POINTs that are not dealing with vehicle scheduling, but only with driver scheduling. The start TIMING POINT of a DUTY PART may be different from the starting point of its first STRETCH. Similarly, the end TIMING POINT may be different from the point reached in the last STRETCH (or BREAK).

Differences in start and end points of DUTY components may result in necessary DRIVER TRIPs, described in the following sub-clause.

5.3.2.6 Start and End Times

After completion of the driver scheduling, any period of work included in a DUTY PART will be assigned to a precise type of activity, as the pay-roll would likely be based on a classification of activities for the most part. When the driver scheduling is complete, checks shall be operated to ensure that, during a DUTY PART, any time is assigned to only one activity, without any gap or overlapping.

The reference model allows the fixing of start and end times for a STRETCH, for example, before its components have been designed. These provisional times are stored as optional attributes. At the final stage of the design, these times will be identical to the times derived from the component data. This is sometimes a reason to create an arbitrary FILL-IN TIME, to fill a gap if a STRETCH should have a minimum duration.

The start and end times of a DRIVING SPELL can be derived from the times of the RELIEF OPPORTUNITIES, at the start and end of that DRIVING SPELL. Such times represent the production start and end times. The real start and end times are derived from these production times, with the addition of any 'PreparationDuration', 'FinishingDuration' or TIME ALLOWANCE attached to the SPELL, before or after its production period.

The start and end times of NON-DRIVING SPELLs are stored in the 'StartTime' and 'EndTime' mandatory attributes for this entity.

The duration of a FILL-IN TIME is fixed by a mandatory attribute. If the end place of a DRIVING SPELL is the same than the location fixed for the following FILL-IN TIME, the start time of the latter is the end time of the SPELL. If not, the FILL-IN TIME starts at the end of the corresponding DRIVER TRIP.

Within a STRETCH, any period of time between two SPELLs (including, for instance, TIME ALLOWANCES) shall be allocated to a DRIVER TRIP or a FILL-IN TIME.

Start and end times of a STRETCH may be derived from the SPELLs, complemented by a possible FILL-IN TIME at the end of the last SPELL. They shall also include any 'PreparationDuration', 'FinishingDuration' or TIME ALLOWANCE attached to the STRETCH.

The duration of a BREAK is fixed by a mandatory attribute. If the end place of a STRETCH is the same as the location of the BREAK FACILITY, then the start time of the BREAK is the end time of the STRETCH. If not, the BREAK starts at the end of the corresponding DRIVER TRIP.

Within a DUTY PART, any period of time between two STRETCHes, or between a STRETCH and a BREAK, shall be allocated to a DRIVER TRIP.

The start time of a DUTY PART may be derived from the start time of the first STRETCH, taking into account any 'PreparationDuration' or TIME ALLOWANCE attached to the start of this DUTY PART. It shall also include a possible DRIVER TRIP time, if the TIMING POINT specified for the start of the DUTY PART is different from the start place of the first STRETCH.

The end time of a DUTY PART may be derived from the end time of the last STRETCH, taking into account any 'FinishingDuration' or TIME ALLOWANCE attached to the end of this DUTY PART. It shall also include a possible DRIVER TRIP time, if the TIMING POINT specified for the end of the DUTY PART is different from the end place of the last STRETCH.

In a real implementation, start and end times of all components will probably be specified by attributes, most of them being redundant.

5.3.2.7 Organizational Units

DUTies may be related to ORGANIZATIONAL UNITS (EN 12896-1). The BLOCKs to be covered by these DUTies may also be related to an ORGANIZATIONAL UNIT. Constraints may well be needed; for example, to check that BLOCKs covered by a DUTY are managed by the ORGANIZATIONAL UNIT that is in charge of that DUTY.

5.3.2.8 Tasks

NON-DRIVING SPELLs are either STAND-BYs (tactical reserve) or TASKs, classified as a particular TYPE OF TASK. This covers regular TASKs such as taking buses through a wash, training session, social activity etc.

The short-term planning of drivers usually also requires other additional TYPEs OF TASK.

5.3.2.9 Type of Qualifications

A DUTY may specify certain TYPEs of QUALIFICATIONs (see Annex B) which should be possessed by an assigned DRIVER. These could include a certain number of years of driving experience, special knowledge of a particular part of the network, particular social or demographic characteristics, or other properties which may affect the suitability of a DRIVER for a particular kind of DUTY. Some companies may, for example, want to assure a special suitability for DUTies with school bus operation.

The necessary TYPEs of QUALIFICATIONs may be specified for each SPELL of driver work, taking into account the individual activities included in the SPELL in question, or may be related to the whole DUTY. The first case requires the management of TYPEs of QUALIFICATIONs on a rather detailed level. In the second case, the duty manager will often have a choice among a limited number of defined TYPEs of QUALIFICATIONs to be entered at DUTY level, reflecting the global needs for all activities in the lower-level component parts of the DUTY.

5.3.2.10 Accounting Factor

The work time of drivers may not always be paid evenly at the same rates. If this is the case, input information needs to be recorded for particular component parts of DUTies, which will be needed for wage accounting after the DUTies have actually been worked.

An 'accounting factor' may be defined using a corresponding 'AccountingFactor' attribute of DUTY PART, STRETCH or SPELL. This factor gives the proportion of paid time in the components in question. It will usually range from 0 to 1, and will actually be 1 in most cases. Alternatively, an 'accounting time' duration may be specified instead of a factor, using the 'AccountingTime' attribute, if the company wants to express the modified amount of time to be paid in terms of a lump sum.

The accounting factor is more relevant for BREAKs, PAUSEs and FILL IN TIMEs. These parts of a driver's work time are sometimes paid by a percentage less than 100. A DRIVER TRIP may also be not fully paid in some cases. An accounting factor may therefore also be stored for a DRIVER TRIP.

If accounting factors are specified at different levels of the DUTY components hierarchy, the factor stored against a DUTY PART or STRETCH will override all specifications given at lower levels, but will not override the accounting factor for a BREAK.

Accounting factors are not used to specify an increase of the wages as a result of particular aggravation circumstances during work, or to give an additional bonus for overtime worked by the DRIVER. Entities to describe these factors are introduced in 5.5.3.4.

5.3.2.11 Duty Types

DUTies shall be classified as being of a particular DUTY TYPE, which indicates their time profile for rostering purposes. Rostering algorithms usually make an initial assignment of DUTies to LOGICAL DRIVERS according to the DUTY TYPE, to give a spread of DUTies which is fair or agreed for each DRIVER.

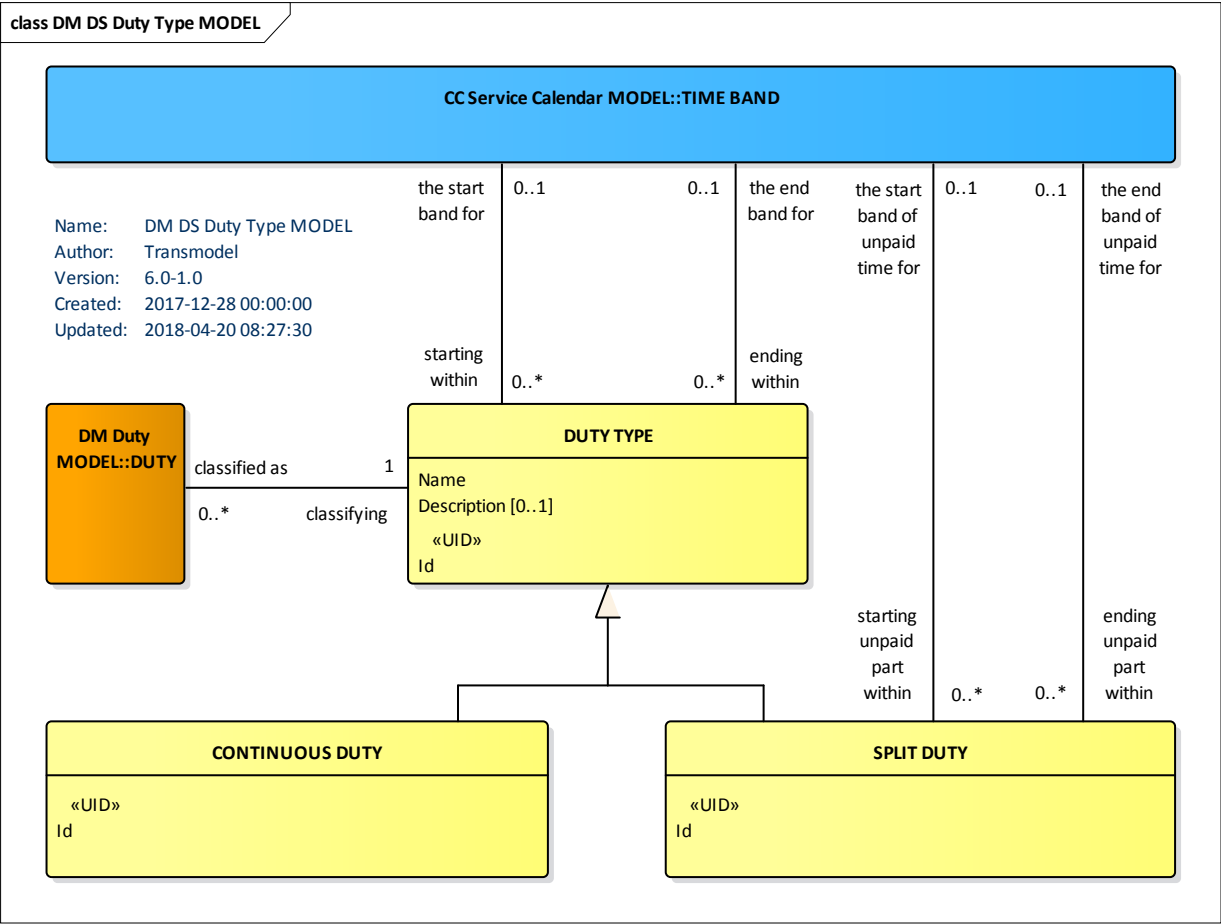


Figure 6 — Duty Type MODEL

SPLIT DUTY and CONTINUOUS DUTY are the main DUTY TYPES. If a DUTY is made up of two DUTY PARTs, then it shall be classified as SPLIT DUTY. If it is made up of only one DUTY PART, then it shall be classified as a CONTINUOUS DUTY. Other DUTY TYPES may be individually defined by a company to meet its own particular needs (e.g. to allow for DUTies made up of three or more DUTY PARTs). In addition, descriptions such as “early” or “late” may classify them. The ranges of start and end times of any DUTY TYPE can be described by relationships to the TIME BAND entity. The time range of the unpaid part of a SPLIT DUTY may be described in the same way.

5.3.3 Driver Trips

The driver scheduling process takes into account the times necessary for drivers to get to the starting point and to return from the finishing point of their spells of work. Such a DRIVER TRIP will often be on foot but may be on a VEHICLE JOURNEY driven by another driver. The time for these trips may depend on the time of day. The entity DRIVER TRIP TIME allows for a set of times for each DRIVER TRIP. This duration depends on a TIME BAND, in principle, but many companies will just store one time per DRIVER TRIP.

A RIDE IN DRIVER TRIP is a part of a DRIVER TRIP corresponding to the theoretical movement of a driver on one and only one public transport vehicle, from one POINT IN JOURNEY PATTERN to another on a JOURNEY PATTERN.

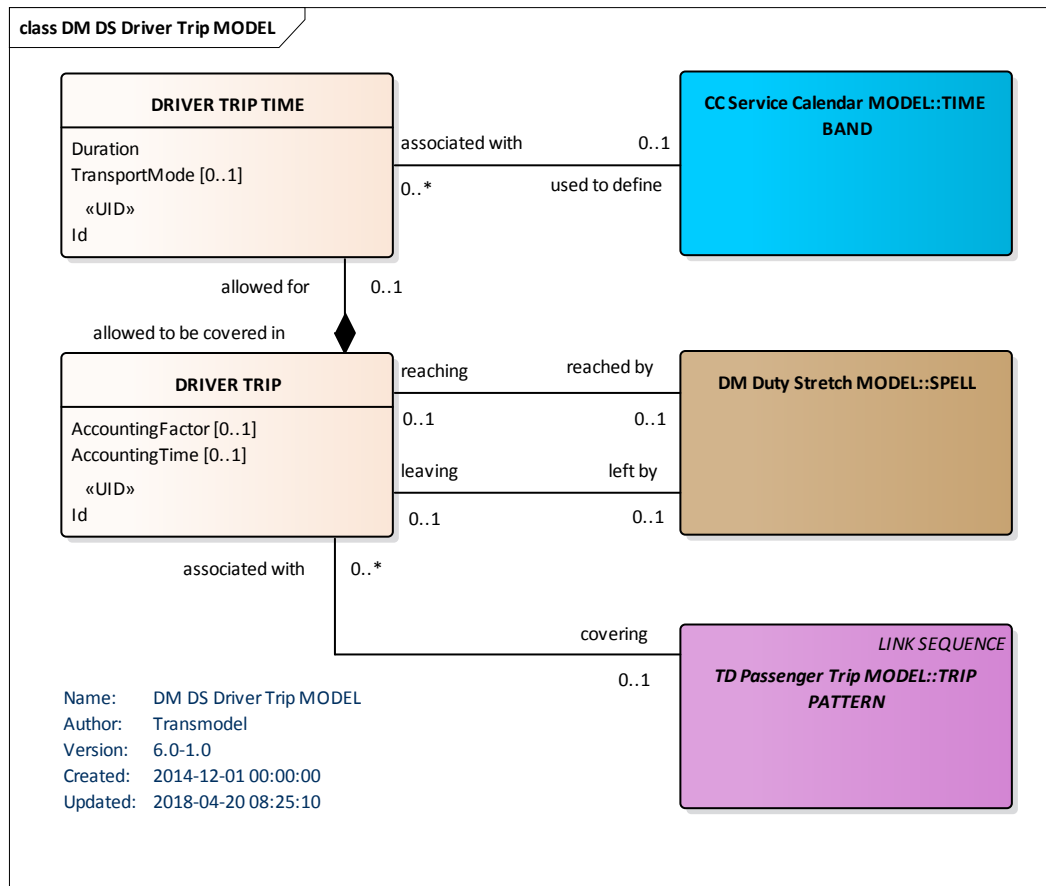


Figure 7 — Driver Trip MODEL

It is possible that a DRIVER TRIP might be complex and might involve waiting for infrequent VEHICLE JOURNEYS. In this case, companies might prefer to assess the time it will take by methods normally used for passenger information queries. For this reason, DRIVER TRIP may be associated with a TRIP PATTERN (see EN 12896-6).

The inclusion of DRIVER TRIPS within the DUTies may be necessary for various reasons: for example, the starting relief of a DRIVING SPELL may be at a different RELIEF POINT than the end relief of the previous one. The duration of such DRIVER TRIPS shall be included in the work plan of a DUTY. Their values will be calculated according to standard times.

DRIVER TRIPS will be necessary when a driver is required to move:

- between two SPELLS, i.e. from or to RELIEF POINTs (places of RELIEF OPPORTUNITies) or TIMING POINTs (where a NON-DRIVING SPELL takes place);
- from or to the TIMING POINT where a FILL-IN TIME is spent;
- from the end point of a STRETCH (i.e. of a SPELL or of the added FILL-IN TIME) to the TIMING POINT where a BREAK FACILITY is located;
- from a TIMING POINT where a BREAK FACILITY is located to the start of the next STRETCH;
- from the TIMING POINT where a DUTY PART starts (e.g. CREW BASE) to the TIMING POINT where the first STRETCH (i.e. the first SPELL) starts (e.g. GARAGE POINT or another RELIEF POINT);

— from the last TIMING POINT of a STRETCH (e.g. RELIEF POINT) to the TIMING POINT where a DUTY PART ends (assuming that a DUTY PART never ends with a BREAK).

Once the various components are fixed, their start and end places are known, and it is possible to retrieve the required DRIVER TRIPs and their standard duration (DRIVER TRIP TIME).

Some operators may not want to manage standard times for any possible driver trip. Instead, they define a global time used as lump sum for wage accounting to cover these access or return trips. Such a global time may include the time spent by DRIVERS for their movement from home to work and vice versa. To allow for such practices, there are optional attributes 'DriverAccessDuration' and 'DriverReturnDuration' in the DUTY PART entity. This practice is, in principle, separate from explicit DRIVER TRIPs. Therefore, additional attributes to specify for instance the start time of a BREAK after a driver trip shall be added in such a particular implementation.

5.3.4 Driver Schedule Frame

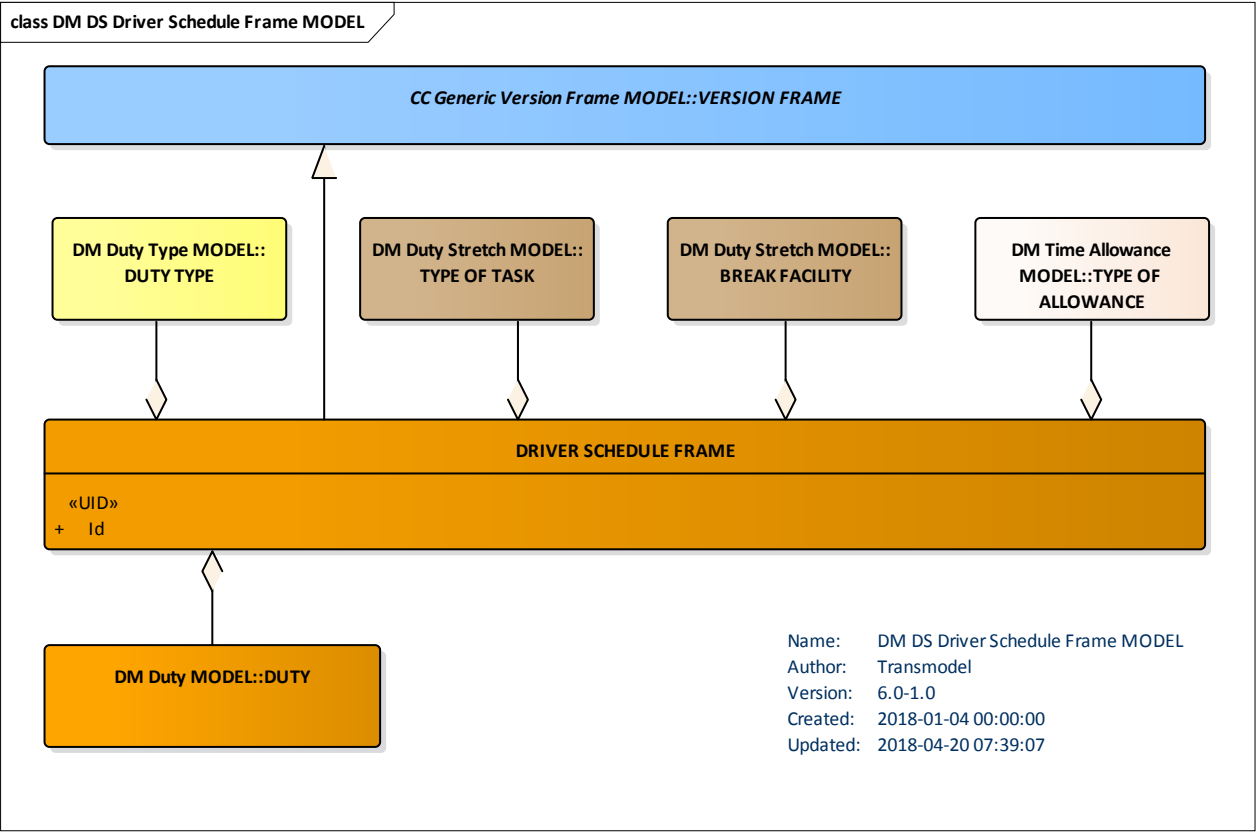


Figure 8 — Driver Schedule Frame MODEL

A DRIVER SCHEDULE FRAME is a coherent set of DUTies to which the same set of VALIDITY CONDITIONS have been assigned. Typically, a DRIVER SCHEDULE FRAME represents the theoretical work of a group of LOGICAL DRIVERS.

5.4 Rostering

5.4.1 General Remarks

After completion of the driver scheduling, most operators carry out a long-term assignment of LOGICAL DRIVERS to DUTies, in order to prepare the assignment of DRIVERS to these DUTies for each day of

operations of a given planning period. Such duty plans are often presented in form of a cyclic matrix, where LOGICAL DRIVERS are assigned in turn to each DUTY of a cycle (hence the term “rostering”). This long-term plan is likely to be modified in the short-term.

The scheduled DUTies have to be assigned to the DRIVERS in a way that meets the legal restrictions and any agreements made between the company and the driver unions. Furthermore, preferences expressed by the DRIVERS themselves may be taken into account to a certain extent. Finally, the rostering process aims at ensuring that, for any day, each DUTY is covered by a DRIVER.

In most cases, this is achieved through the definition of cyclic periods (of a certain number of days) and of driver groups. Sets of daily DUTies are assigned to such a cycle, each set being worked in turn by a DRIVER of a group. This ensures that the workload is distributed equally among DRIVERS, and that no DRIVER works an unacceptable pattern of DUTY TYPES (e.g. only SPLIT DUTies for many subsequent days). A classical method for that distribution is to order the DUTies to be worked by a driver in a specific sequence (driver roster) with respect to their DUTY TYPES.

There are numerous different rostering methods applied in companies over European countries. The principles above apply to some of the most conventional. However, methods of driver management are likely to evolve, including the development of new concepts fundamentally different from any classical rostering schemes. New approaches more able to adapt to modern management principles and differentiated DRIVER preferences will probably be tried and used by public transport companies in the coming years.

The reference model does not look to hinder any innovative development in the field of driver management. The rostering part of the conceptual data model therefore has to be considered as a reference basis for companies working with one of the conventional rostering methods that have been taken into account in the model design. It should only be used for information by users implementing other methods, especially the most advanced.

However, this part of the reference model contains more entities than would ever be needed by any single company using one of the conventional methods addressed by the model. Therefore, each company may choose those parts of the rostering model that would satisfy the needs of the particular rostering method they want to apply.

5.4.2 Roster Matrices

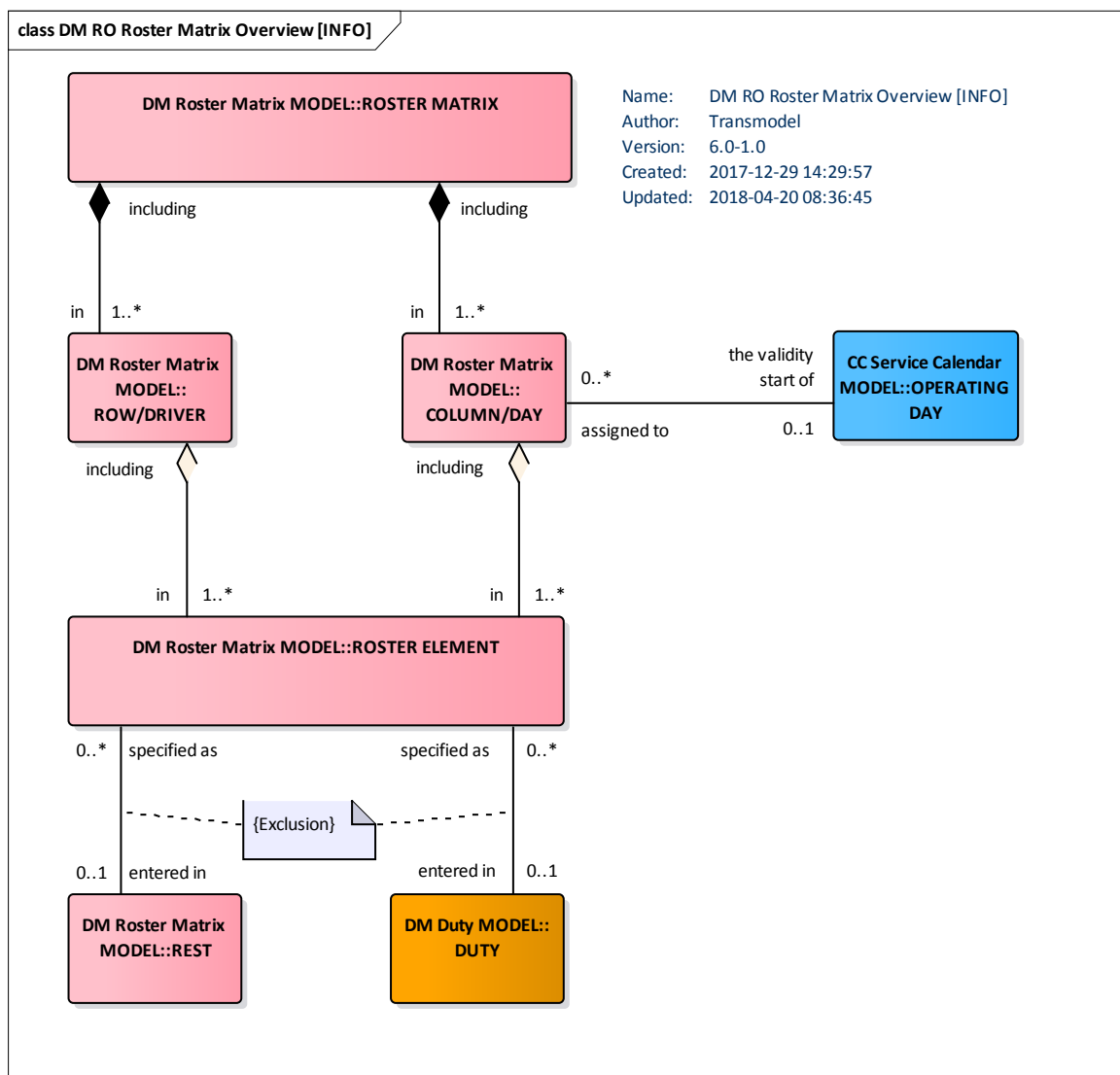


Figure 9 — Roster Matrix Overview

A ROSTER MATRIX is a table showing the duty plan for a certain period of time and for a number of LOGICAL DRIVERS, into which the relevant DUTIES to be worked will be entered.

The rows of the matrix are associated with the drivers, and the columns are associated with the days of a specified planning period. There are various ways of presenting a ROSTER MATRIX, and some companies may use this schema with the rows and columns swapped for example, but according to the most common practice the rows of a ROSTER MATRIX are defined as the ROW/DRIVER entity and the columns as the COLUMN/DAY entity.

A ROSTER ELEMENT, defined by one ROW/DRIVER and one COLUMN/DAY, is a cell of the matrix where an individual DUTY will be entered. This DUTY will have to be worked by the driver corresponding to the row, on the day associated with the column of the matrix.

Note that the DRIVER entity describes a physical driver, who is an EMPLOYEE of the public transport company, in contrast to the ROW/DRIVER entity which is a LOGICAL DRIVER in the planning process,

without any individual person attached to it. DRIVERS will be assigned to ROWs/DRIVERS at a later stage.

During the first steps of designing a ROSTER MATRIX, the COLUMNS/DAYS may continue to be qualified just by an order. Before the matrix can be finalized, each COLUMN/DAY should be assigned to an OPERATING DAY. It is necessary to take into account the days where less DUTies are needed. Therefore, the assignment of OPERATING DAYS to DAY TYPEs is preferably shown on the matrix.

All DRIVERS working for the same company are not necessarily managed in the same ROSTER MATRIX. Groups of DRIVERS may be defined, according to various parameters specific to the company. For each group, a separate ROSTER MATRIX will be used for assigning sequences of DUTies to the DRIVERS of this specific group. Thus, there may be more than one ROSTER MATRIX in one company. These may have different structures or include different types of DUTY.

The relationship between the DRIVER and ROSTER MATRIX entities expresses the attachment of DRIVERS to groups of DRIVERS working on the same matrix. The same DRIVER may sometimes be assigned to several ROSTER MATRICES, for instance depending on periods of time.

The grouping of DRIVERS and their assignment to different ROSTER MATRICES may take into account different contractual regulations of work time (e.g. part time work), or individual preferences for certain DUTY TYPEs or patterns of duty sequences. Preferences are often taken into account with regard to the seniority in the company. A ROSTER MATRIX will be constructed in a way that meets the individual constraints of the specified DRIVERS; a group of DRIVERS assigned to it will be composed according to the structure of the matrix.

The responsibility for the rostering process may be subdivided among several ORGANIZATIONAL UNITs of the company. Each ROSTER MATRIX may therefore be owned by a particular ORGANIZATIONAL UNIT. An ORGANIZATIONAL UNIT may have DRIVERS (and other EMPLOYEEs) at its disposal, which may be allocated to the ROSTER MATRICES set up by this ORGANIZATIONAL UNIT.

A ROSTER MATRIX is, in principle, valid for a particular TIMETABLE VERSION.

The most classical rostering practice is to first assign a DUTY TYPE or a rest day to each theoretical day in the components of a ROSTER MATRIX. Two main families of methods for this task are described below. A further stage consists in replacing the broad DUTY TYPEs by the specified DUTies composing the production plans for each day of the planning period in question. This results in a complete ROSTER MATRIX, which can be used for the assignment of DRIVERS to ROWs/DRIVERS (see 5.5.2.1).

Some companies skip the stage of the DUTY TYPE assignment, proceeding directly to the consideration of the actual DUTies. However, the data structures described below may be used as well with such methods.

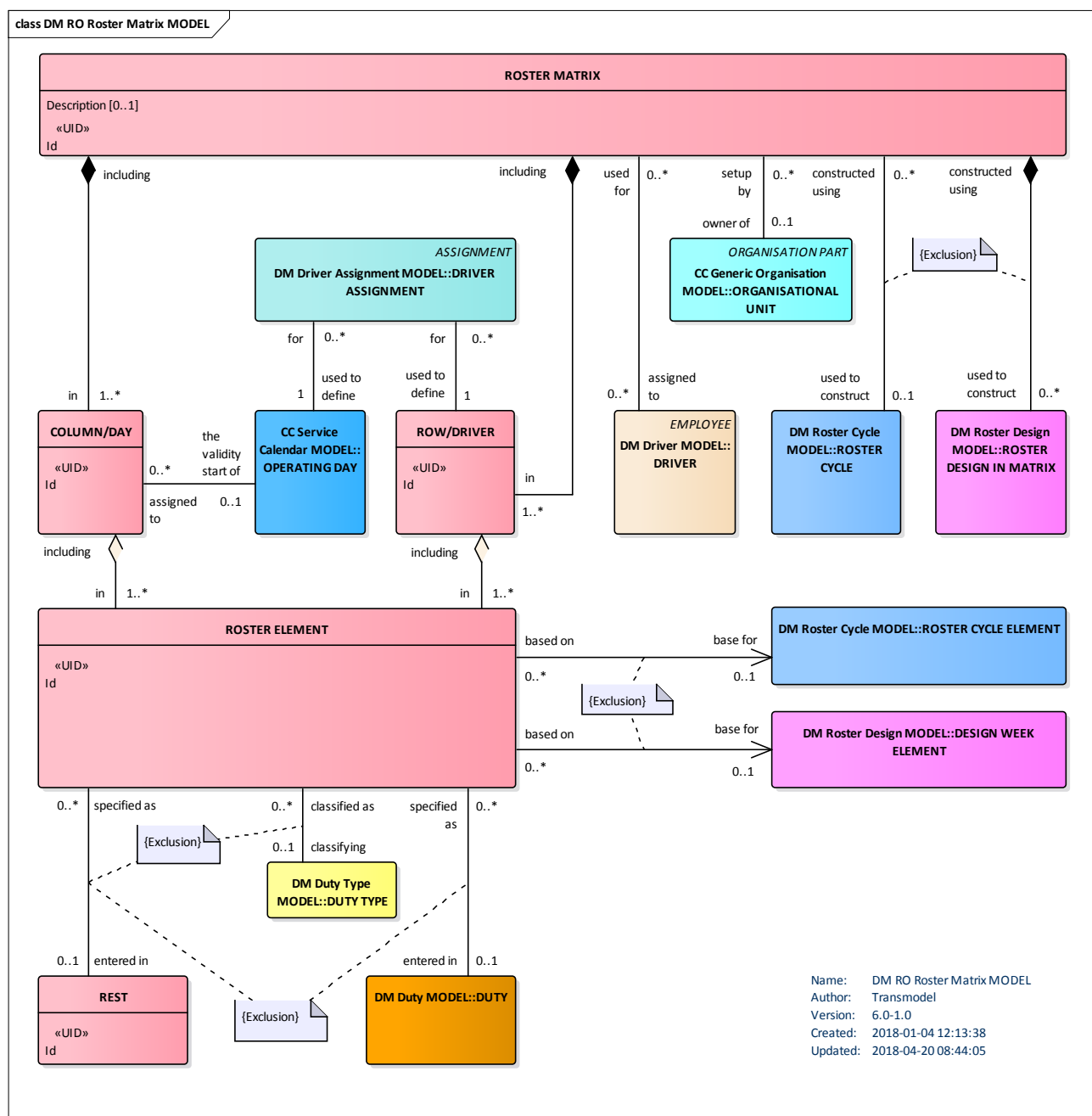


Figure 10 — Roster Matrix MODEL

5.4.3 Roster Cycles

Use of ROSTER CYCLES is one of the possible methods of setting up sequences of DUTY TYPES that will be assigned to the ROWs/DRIVERs in a ROSTER MATRIX. DUTies of these specified types will then be entered into the ROSTER ELEMENTs to provide a suitable order of working times for each driver.

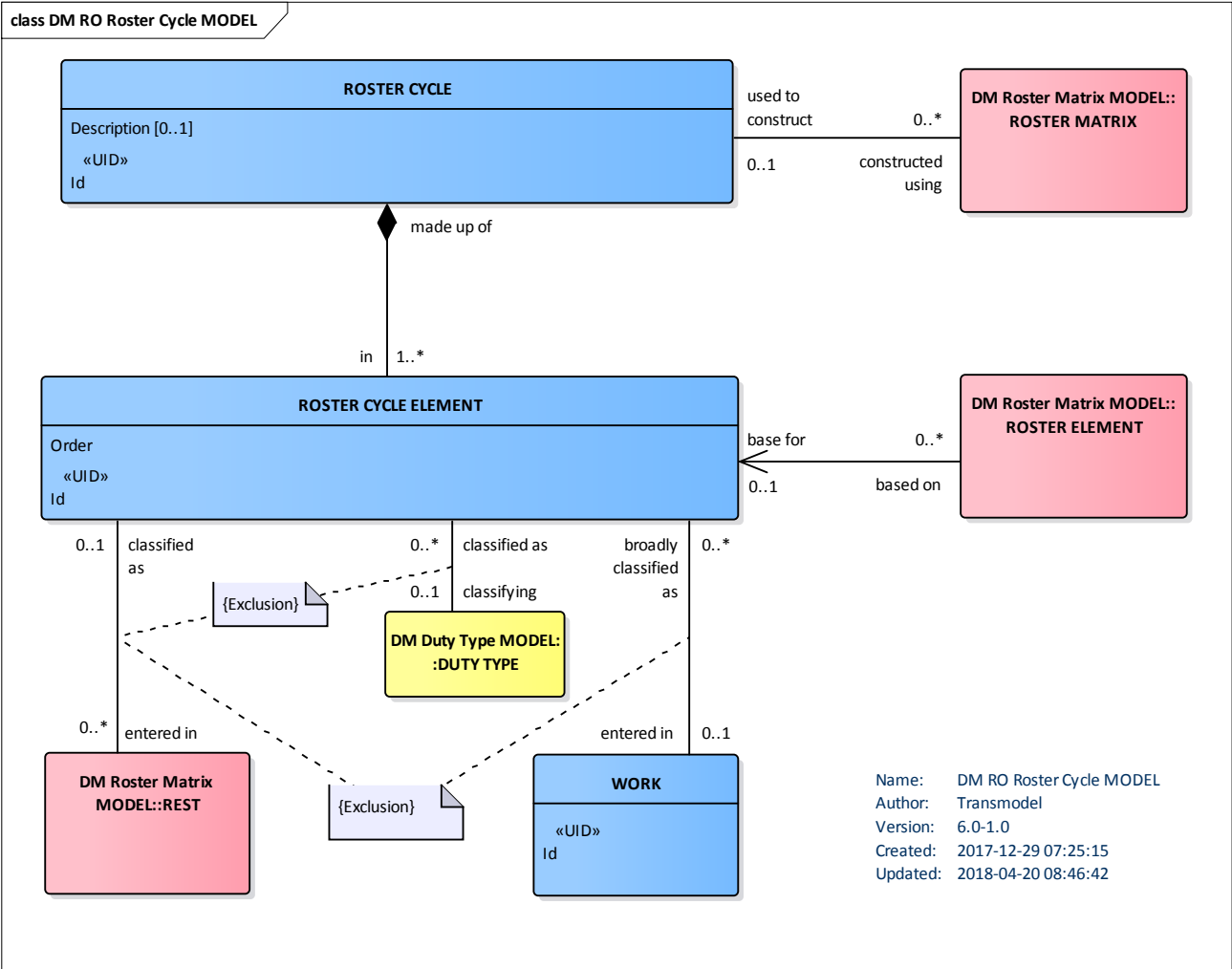


Figure 11 — Roster Cycle MODEL

A ROSTER CYCLE is a period of time, defined as a number of days (e.g. 5 days, 9 days etc.). It is represented by an ordered sequence of the same number of ROSTER CYCLE ELEMENTs, each of which represents a day. In a first step, each ROSTER CYCLE ELEMENT is defined either as a WORK day or a REST day.



Figure 12 — Pattern of WORK days and REST days

The ROSTER CYCLE is thus described as a recurring pattern of WORK days and REST days.

In a second step, work days will be further classified by specifying the DUTY TYPEs. One DUTY TYPE might represent working an early shift and another one may represent working a late shift.



Figure 13 — Pattern of different DUTY TYPEs and REST days

The ROSTER CYCLE now describes a recurring pattern of different DUTY TYPES and REST days.

This ROSTER CYCLE can then be used to fill the ROSTER MATRIX as described below.

	30/1	31/1	1/2	2/2	3/2	4/2	5/2	6/2	7/2	8/2
Driver 10	Early	Early	Mid	Late	Late	Rest				
Driver 11										
Driver 12										

Figure 14 — An example of starting to fill the first row of the ROSTER MATRIX

The DUTY TYPE / rest day pattern of the ROSTER CYCLE is assigned to the first ROW/DRIVER of the ROSTER MATRIX.

	30/1	31/1	1/2	2/2	3/2	4/2	5/2	6/2	7/2	8/2
Driver 10	Early	Early	Mid	Late	Late	Rest				
Driver 11		Early	Early	Mid	Late	Late	Rest			
Driver 12			Early	Early	Mid	Late	Late	Rest		

Figure 15 — Inserting into the following rows with an offset

The same assignment is made for the following row, but with a lag (usually of one day). This is repeated for all rows of the matrix.

The DUTY TYPE / rest day pattern of the ROSTER CYCLE is then assigned repeatedly for each ROW/DRIVER of the ROSTER MATRIX so that all elements are filled.

	30/1	31/1	1/2	2/2	3/2	4/2	5/2	6/2	7/2	8/2
Driver 10	Early	Early	Mid	Late	Late	Rest	Early	Early	Mid	Late
Driver 11	Rest	Early	Early	Mid	Late	Late	Rest	Early	Early	Mid
Driver 12	Late	Rest	Early	Early	Mid	Late	Late	Rest	Early	Early
Driver 13	Late	Late	Rest	Early	Early	Mid	Late	Late	Rest	Early
Driver 14	Mid	Late	Late	Rest	Early	Early	Mid	Late	Late	Rest
Driver 15	Early	Mid	Late	Late	Rest	Early	Early	Mid	Late	Late

Figure 16 — All matrix elements are filled

As a result, each column now has an equal distribution of REST days and the respective DUTY TYPES. The number of columns of the ROSTER MATRIX is normally a multiple of the ROSTER CYCLE number of days, but this is not mandatory.

In a first step, this assignment is done without respect to the fact that, in most cases, there are fewer DUTies to be worked on weekends (for instance) than during the week. Additional free days (REST days) will then have to be assigned to override the ROSTER CYCLE contents, in order to balance the number of DUTies depending on the variations of the service.

5.4.4 Roster Designs

The concept of ROSTER DESIGN is based on another method for setting up sequences of DUTY TYPES and REST days, which will be used to enter DUTies into the ROSTER MATRIX. This method defines sequences of DUTY TYPES and REST days for a certain number of calendar weeks, taking into account from the beginning the different numbers of DUTies of each type to be worked on the different week days.

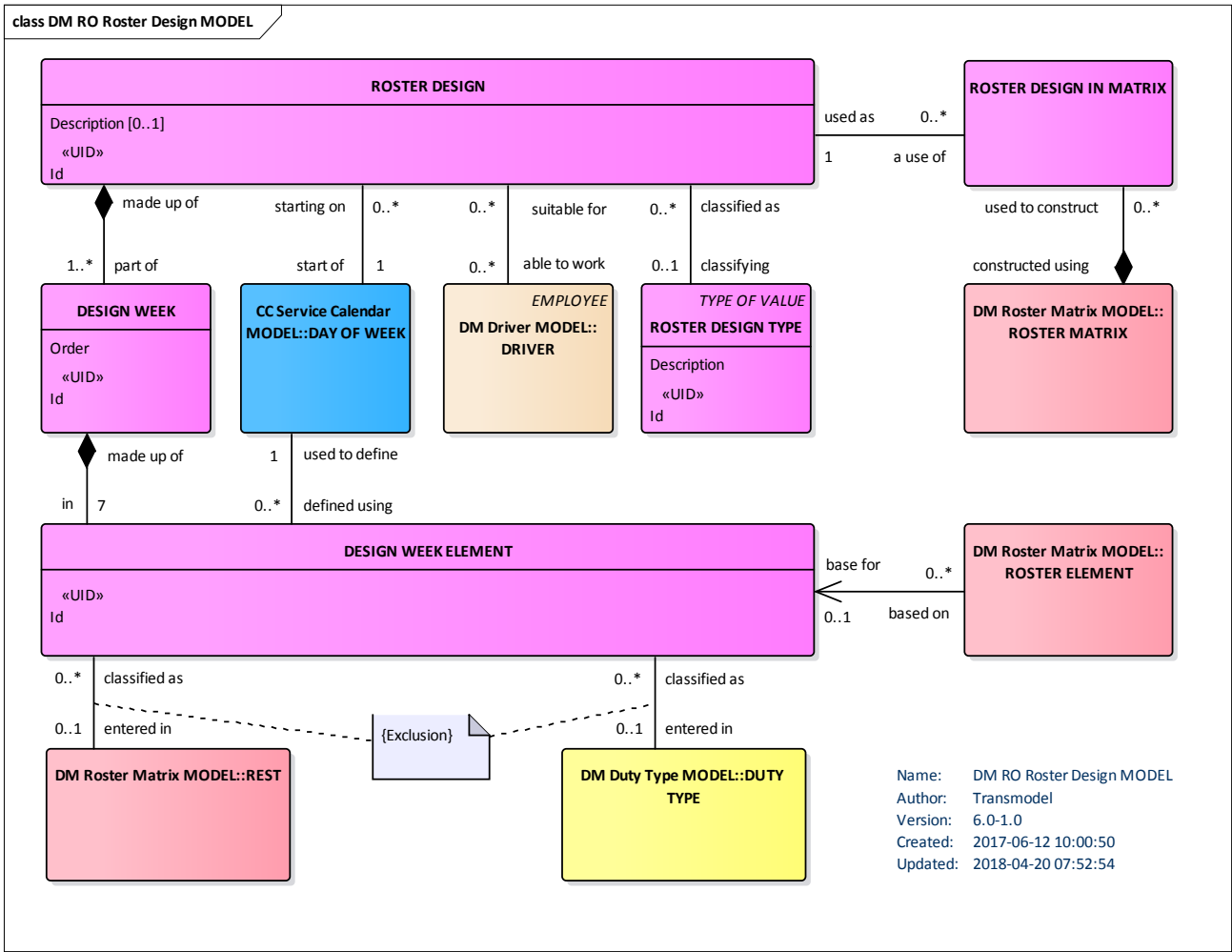


Figure 17 — Roster Design MODEL

A ROSTER DESIGN is a building unit for a ROSTER MATRIX, which is made up of a specified number of DESIGN WEEKs, e.g. 1 week, 4 weeks or 5 weeks. Each DESIGN WEEK consists of seven DESIGN WEEK ELEMENTs, which represent the seven DAYs OF WEEK (e.g. from Monday to Sunday).

A relationship between ROSTER DESIGN and DAY OF WEEK determines which DAY OF WEEK will correspond to the first DESIGN WEEK ELEMENT for any DESIGN WEEK in that ROSTER DESIGN (for example, each DESIGN WEEK will start on a Saturday).

A pattern of DUTY TYPES and REST days may be specified for each DESIGN WEEK of the ROSTER DESIGN. For instance, DUTY TYPES within one DESIGN WEEK may sometimes be chosen as being of the same broad type (e.g. “early working”). For ROSTER DESIGN grouping several DESIGN WEEKs (e.g. 5 weeks), the pattern may be built using a ROSTER CYCLE, as in the previous method. Given a chosen pattern or individually, DUTY TYPES and REST days are represented as DESIGN WEEK ELEMENTs.

The whole ROSTER DESIGN may be classified by a ROSTER DESIGN TYPE. This classification may specify the number of weeks the ROSTER DESIGN covers, the proportion of work days to free days, the broad type of DUTies assigned to certain positions in the ROSTER DESIGN or other defining factors.

Special ROSTER DESIGNS may particularly suit individual work time regulations or personal preferences for a certain group of DRIVERS, while other designs are less favourable for them. According to the individual constraints and preferences, it may be specified which DRIVERS are able to work a ROSTER DESIGN, and which ROSTER DESIGNS are suitable for a given DRIVER.

Once the ROSTER DESIGNS are completed, the ROSTER MATRIX may be built. The matrix uses in general several different ROSTER DESIGNS. For instance, it may last 11 weeks, using a sequence of 4 ROSTER DESIGNS, respectively of 4, 1, 1 and 5 weeks. The same ROSTER DESIGN may be repeated more than once. This sequence is ordered through the entity ROSTER DESIGN IN MATRIX. The number of columns normally complies with the number of weeks specified by the sequence of ROSTER DESIGNS. In the example above, the matrix would have 77 (11 x 7) columns.

The first row of the ROSTER MATRIX is filled with the contents (DUTY TYPE or REST) of the sequence of DESIGN WEEK ELEMENTs, in the order specified by the ROSTER DESIGN IN MATRIX. The following row is filled with the same sequence, with a lag (which is usually of 1 week). This is repeated for all rows of the matrix until its completion.

5.4.5 Roster Assignments

After a decision has been made on how to structure the input for the rostering process (i.e. the DUTies, differentiated by their type), either by means of a ROSTER CYCLE or by ROSTER DESIGNS, and after the design of ROSTER MATRICES, assignment of DUTies will be made. This assignment is aimed at obtaining a satisfying pattern of DUTies for each driver, during the planning period covered by the matrix.

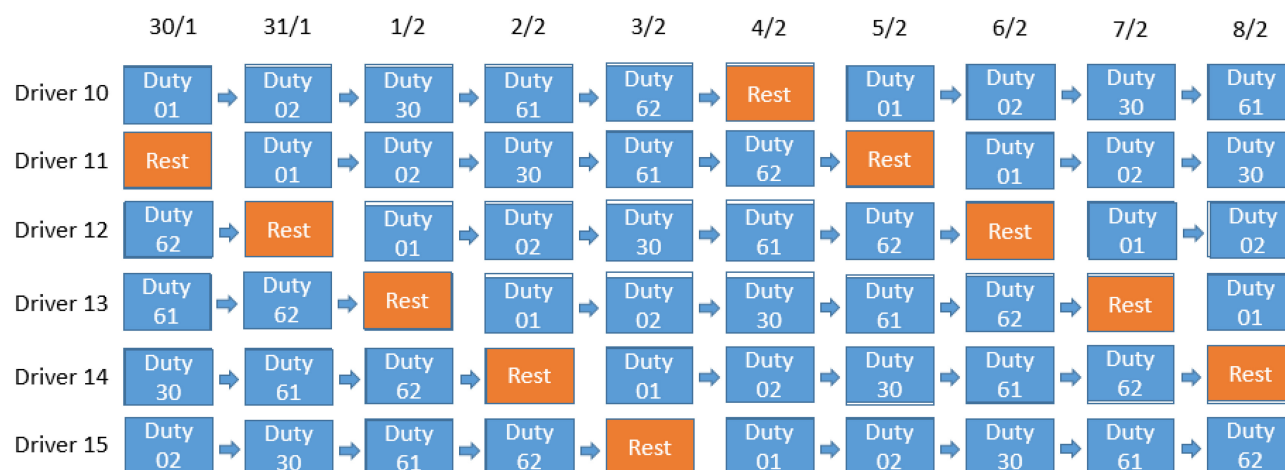


Figure 18 — Assignment of DUTies

This last stage will result in a final assignment of DUTies to the ROSTER ELEMENTs of the ROSTER MATRIX.

The rostering software will use the structure of WORK ROSTER ELEMENTs holding the DUTY TYPEs and the REST ROSTER ELEMENTs representing the rest days to determine the sequence of DUTies for each ROW/DRIVER in the ROSTER MATRIX. It will have to balance and optimize the final assignment of DUTies, according to the number of DUTies to be worked on each DAY TYPE.

This assignment takes into account the agreements made between the company and the driver unions. It also takes into account DRIVER preferences. For instance, rest days may be exchanged between rows of the ROSTER MATRIX, in order to optimize the resulting duty sequences. Typically, this involves prolonging the sequences of consecutive rest days.

The rostering software will use sophisticated algorithms, which optimize the sequence of DUTies for the DRIVERS/ROWS according to a variety of rules, which are not described in the reference model.

5.5 Personnel Disposition (informative)

5.5.1 Introduction

The personnel disposition data model covers the following functions:

- plan mid-term assignment of drivers to duties;
- plan short-term assignment of drivers to duties;
- collect and process the driver work data.

A part of the data needed by the personnel disposition functions is already included in other parts of the model. The most relevant for the personnel disposition process is the information on driver scheduling and, particularly, the information on duty rostering, which is the starting point for the management of drivers and has to provide the necessary input for the personnel disposition functions.

The methods applied for driver management, and especially wage calculation, vary between countries and operators. Legal requirements, company rules, agreements and constraints inherent in the different national or local conditions differ substantially. It is therefore difficult to develop data structures covering all the needs that may arise from the various different practices in one single model.

In the future, information output from monitoring systems will probably also be used as input data for personnel disposition and wage accounting systems. In this case, the software for personnel disposition will have to become even more complex than it is today.

The personnel disposition data model, however, is not aimed at dealing with all these aspects. It takes into account only the most conventional methods and is limited to the main data structures needed as input for managing the drivers and preparing the calculation of their wages. This part of the reference model is therefore informative and not normative.

5.5.2 Driver Assignments

5.5.2.1 Assignment of Drivers to Roster Matrix Rows

The rostering process defines patterns of DUTY TYPEs and REST days and, at the next stage, specifies individual DUTies instead of DUTY TYPEs. These assignments are planned long-term, whereas the DUTies entered into the ROSTER ELEMENTs may be subject to optimization or re-planning in the medium-term.

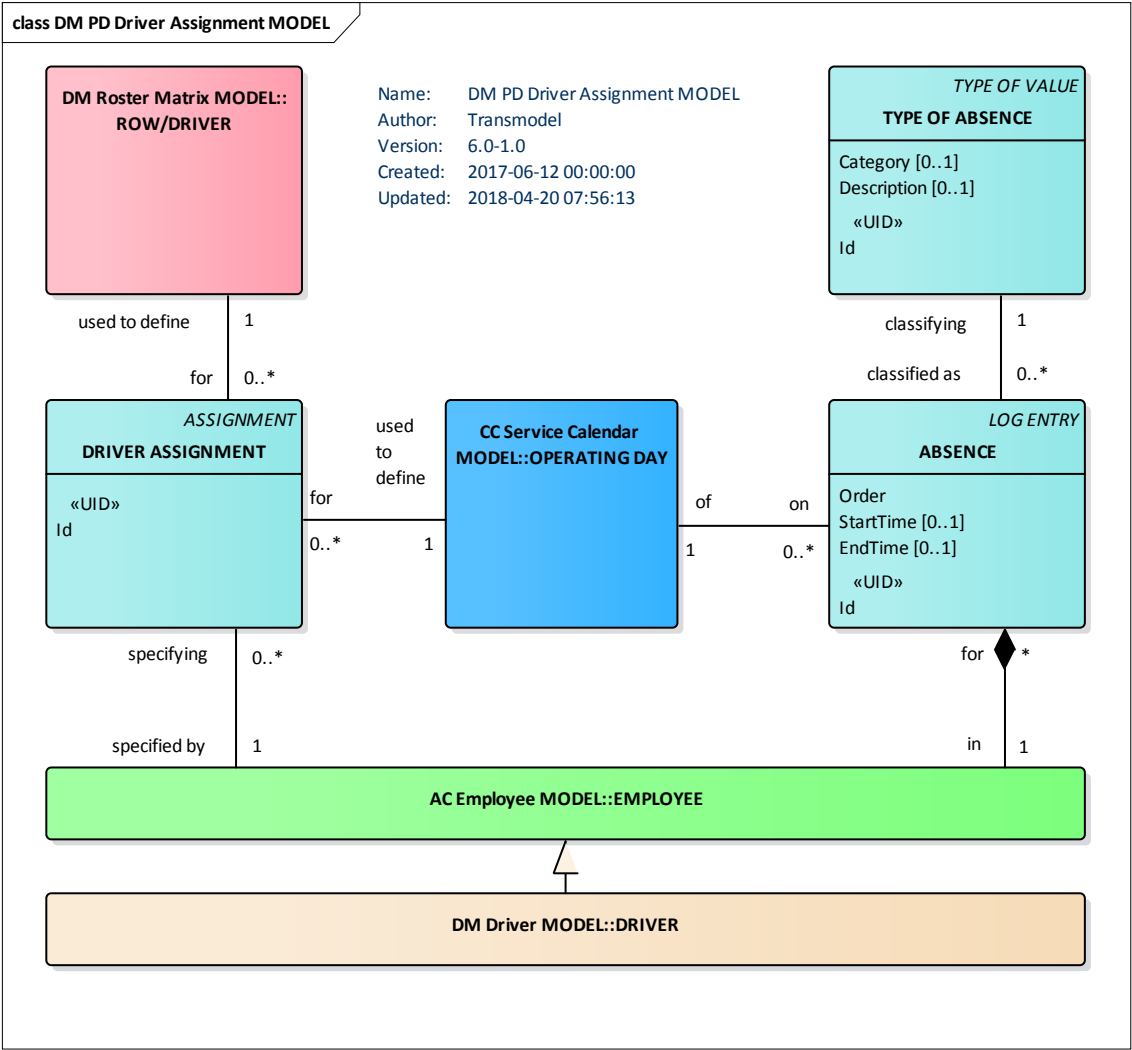


Figure 19 — Driver Assignment MODEL

As the result of the rostering process, DUTies have been assigned to LOGICAL DRIVERS, which are represented by rows in a ROSTER MATRIX. These LOGICAL DRIVERS are modelled by the entity ROW/DRIVER. The total number of LOGICAL DRIVERS on a DAY TYPE is determined by the maximum number of DUTies to be worked on that day.

The number of physical drivers required to cover all the ROWs/DRIVERS of the ROSTER MATRICES is of course higher, because reserves are necessary to balance driver absences, in case of holidays, illness etc. Physical drivers, who are employed by the company to drive buses or other public transport vehicles, are represented in the model by the entity DRIVER. EMPLOYEES other than DRIVERS may sometimes also be needed to cover all the DUTies to be worked on a particular OPERATING DAY.

One of the main tasks of personnel disposition is to define relationships between the LOGICAL DRIVERS, as present in the ROSTER MATRICES, and DRIVERS. It consists of establishing a fixed relationship between EMPLOYEES and ROWs/DRIVERS in a ROSTER MATRIX. As a necessary condition to be satisfied, there should be enough DRIVERS available, with the appropriate qualifications, for the DUTies that have to be worked on each OPERATING DAY.

In practice, the assignment of DRIVERS to LOGICAL DRIVERS can be carried out with different time horizons. Some companies may want a long-term driver assignment made in advance, perhaps for the

whole length of a TIMETABLE VERSION. In such a case, they will probably then have to override some of these assignments, because unforeseeable events will necessitate modifications to the planning. Some other companies will start their driver assignments only on a medium-term basis, specifying them only a number of days in advance. In any case, DRIVERS may become unavailable (e.g. absence due to illness) in the short-term, which will imply modifications to the initial assignment.

In the reference data model, the DRIVER ASSIGNMENT entity is used to specify an assignment for one OPERATING DAY. For this day, it assigns an EMPLOYEE to a ROW/DRIVER of a ROSTER MATRIX. For a ROSTER ELEMENT, defined by this ROW/DRIVER and the COLUMN/DAY associated with that OPERATING DAY, the DUTY entered into this element is to be worked by the assigned EMPLOYEE.

The EMPLOYEE specified by the DUTY assignment will, in most cases, be a DRIVER. However, a company may sometimes fall back on other EMPLOYEES for some duties, for example older staff who were DRIVERS for many years but have taken over other jobs in the company, maintenance staff with a driver's license, etc.

In practice, the assignment of DRIVERS to LOGICAL DRIVERS is done for a number of days in advance. In order to benefit from the balance that the roster is aimed at, the same EMPLOYEE (a DRIVER) will in most cases be assigned to the same ROW/DRIVER in a ROSTER MATRIX, for a number of consecutive OPERATING DAYS and possibly for the whole duration of the matrix. Any long- or medium-term assignment may of course be overridden in the short-term, either due to unexpected absences of DRIVERS from work, changes in the production plan, or as a result of further optimizations or duty exchanges requested by DRIVERS themselves.

Many occasional activities will be included in the operational plan in the short term, in particular all occasional SPECIAL SERVICES as well as a number of TASKS of various types. Many operators will treat such aspects by creating a simplified ROSTER MATRIX, only filled on each COLUMN/DAY with DUTIES composed of such occasional tasks. The ROW/DRIVERS are often assigned to DRIVERS that are not involved in a classical roster.

A possible implementation is to define "dated duties" for each OPERATING DAY. Most dated duties will be composed of normal DUTIES, defined for a DAY TYPE that is applied on the considered OPERATING DAY. These normal dated duties may be subject to modifications, for instance depending on CONTROL ACTIONS made on vehicle schedules. Other dated duties will be extra duties, created only for the relevant OPERATING DAY and composed of occasional tasks. Such an implementation, though, is best implemented using the structures described for vehicle scheduling and disposition (e.g. DATED BLOCKS).

5.5.2.2 Qualifications

The TYPES of QUALIFICATIONS specified for DUTIES or SPELLS will have to be checked by the personnel disposition manager when individual DRIVERS are chosen to actually work the scheduled DUTIES.

A DUTY may require that special TYPES OF QUALIFICATIONS are possessed by the DRIVER, in order to ensure that all the tasks covered by this DUTY can be carried out correctly. The ownership of a bus driver's license will certainly be a TYPE OF QUALIFICATION necessary for each DUTY that covers at least one DRIVING SPELL on a bus or a reserve STAND-BY.

If there are TYPES of QUALIFICATIONS recorded both for the DUTY and for certain of the included SPELLS, the DRIVER must possess QUALIFICATIONS that cover all of those TYPES of QUALIFICATIONS.

The QUALIFICATIONS a driver shall have in order to work a DUTY may additionally also be derived from special TYPES OF QUALIFICATIONS required for the VEHICLE TYPES used for VEHICLE JOURNEYS in the corresponding DRIVING SPELLS in the DUTY.

The assignment of an EMPLOYEE, by a DRIVER ASSIGNMENT, to a ROW/DRIVER and a COLUMN/DAY has to be compatible with all TYPES OF QUALIFICATIONS needed for the DUTY entered in the corresponding ROSTER ELEMENT.

5.5.2.3 Absences

The management of DRIVER absences from work is another task of personnel disposition. Planned as well as unplanned absences will certainly occur in every public transport company.

Planned absences may either be known a long time in advance, e.g. regular annual holidays, or may be announced only a couple of weeks, or even days, before they occur (e.g. stay in a hospital, special holidays for a family celebration, course of further education, etc.). A REST day in the duty sequence entered into the ROSTER MATRIX for a ROW/DRIVER can also be considered as a planned absence.

Unplanned absences may occur e.g. because of unexpected illness, an immediate visit to the doctor etc. They may be known the day before operations, or only a few hours in advance.

The ABSENCE entity in the model is used to record information on planned as well as unplanned absences, as far as it is noticeable for the personnel disposition manager in advance. If an expected DRIVER does not sign on for duty in time, for whatever reason, this kind of absence will be recorded in the activity log (see 5.5.3.3).

An ABSENCE may not last the whole day, therefore 'StartTime' and 'EndTime' are attributes of this entity. As a DRIVER may be absent from work at several periods on the same day, there may be more than one entry recorded in the ABSENCE entity, for one EMPLOYEE and OPERATING DAY. They are identified by an attribute 'Order'.

Each ABSENCE shall be qualified as being of one TYPE OF ABSENCE, which indicates the reason for being absent from work. TYPES OF ABSENCE may be defined referring to the examples mentioned above.

5.5.3 Driver Accounting

5.5.3.1 General

Another important task of personnel disposition is the preparation of DUTY and DRIVER data as input for accounting functions within a company so that the correct DRIVER payments can be calculated and attributed to relevant COST CENTRES.