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Journey Patterns and related concepts

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A schematic representation

The figure below represents schematically:

In red: a SERVICE PATTERN and SCHEDULED STOP POINTs (SSP)defining it. The SERVICE PATTERN is defined through the sequence: SSP1 to SSP9

In green: a TIMING PATTERN and TIMING POINTs defining it. The sequence of points TP1 to TP6 defines this TIMING PATTERN.

The sequence TP1, TP2=SSP1, SSP2,SSP3,TP3,SSP4,SSP5,TP4,SSP6, TP5,SSP7,SSP8,SSP9=TP6 defines a JOURNEY PATTERN.

The ROUTE that this particular JOURNEY PATTERN follows is determined through the sequence of points: PoR1 to PoR10 (in blue)
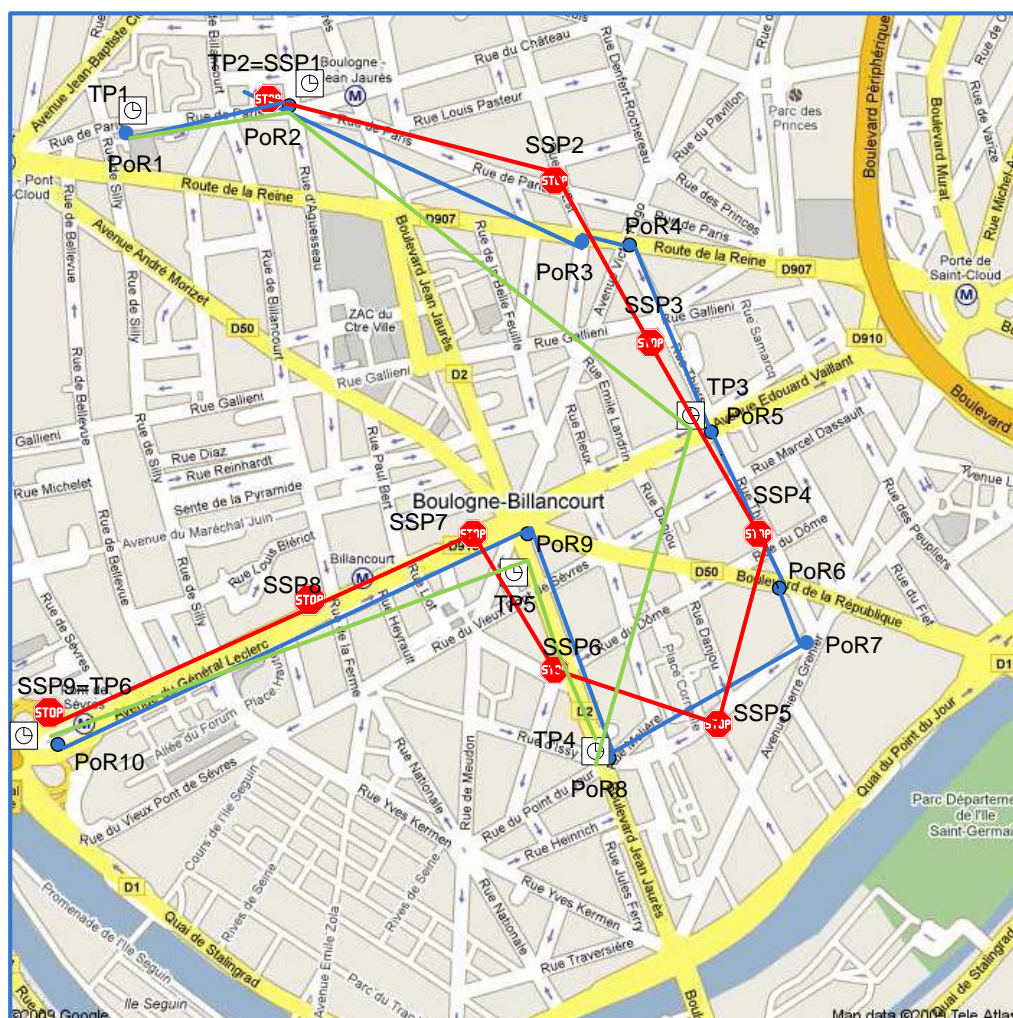

Figure 1 : Schematic representation of a ROUTE, a SERVICE PATTERN, a TIMING PATTERN

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⊙ TIMING POINT (TP) or TIMING POINT IN JOURNEY PATTERN (TP IN JP)

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SCHEDULED STOP POINT (SSP) or STOP POINT IN JOURNEY PATTERN (SP IN JP)

🔵 ROUTE POINT (here used as a POINT ON ROUTE - PoR)

Journey Patterns in Transmodel

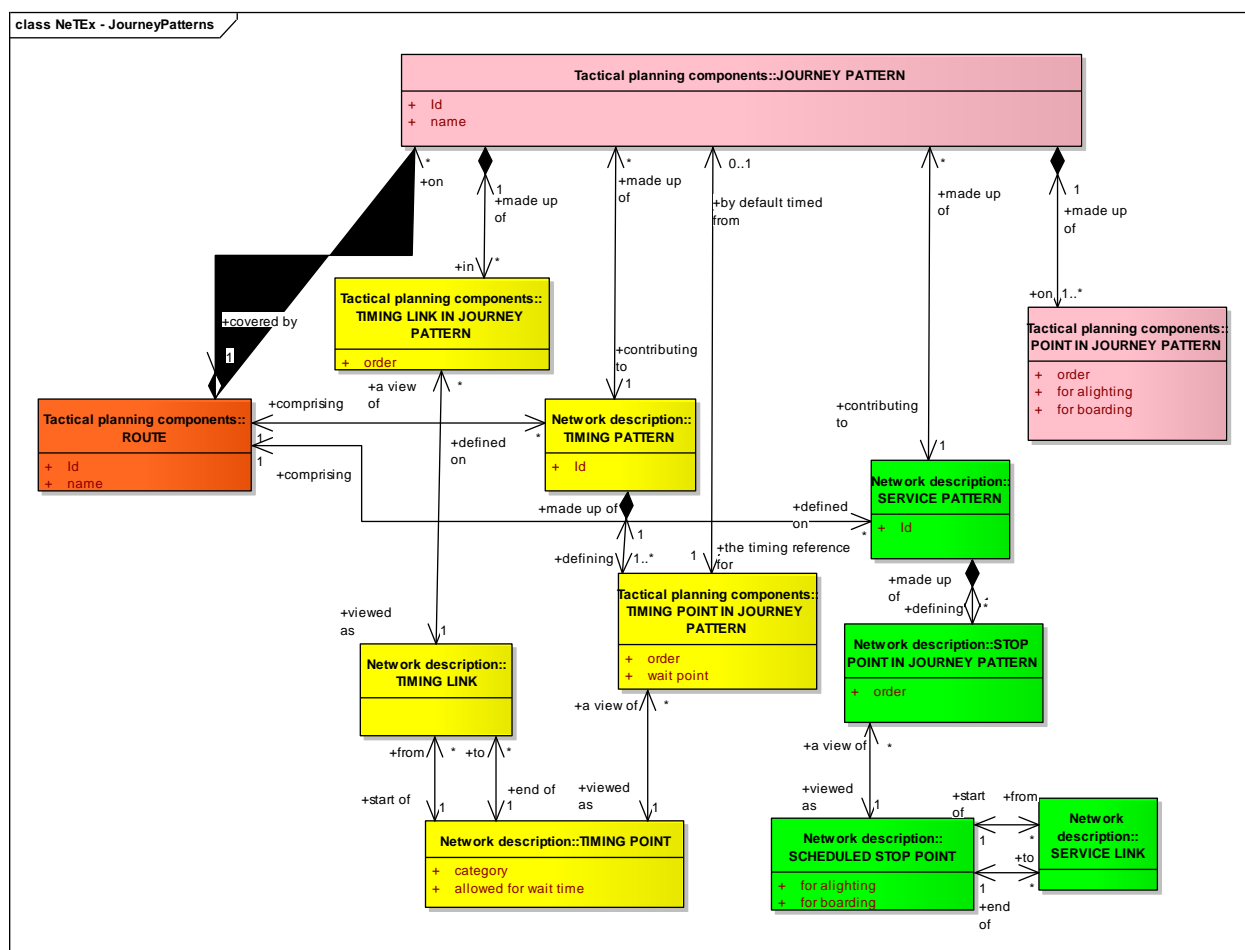The data model that represents the modeling of JOURNEY PATTERNs is as follows :

Figure 2: Reference Data Model fro Public Transport: sub-model for JOURNEY PATTERNs

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Definitions

The definition of a JOURNEY PATTERN is as follows:
An ordered list of STOP POINTs and TIMING POINTs on a single ROUTE, describing the pattern of working for public transport vehicles.
A JOURNEY PATTERN may pass through the same POINT more than once.The first point of a JOURNEY PATTERN is the origin. The last point is the destination.

The TIMING POINTs and SCHEDULED STOP POINTs determining a particular JOURNEY PATTERN (JP) they have to be 'viewed as' TIMING POINTs IN JP and STOP POINTs IN JP.

The definition of the concept ROUTE is as follows: An ordered list of located POINTs defining one single path through the road (or rail) network. A ROUTE may pass through the same POINT more than once.

Remark: the ROUTE network does not correspond strictly to the infrastructure network, represented in figure 1 as the 'street network' (made up of ROAD ELEMENTs). However, an obvious correspondence between the ROUTE and ROAD ELEMENT sequences exists: this correspondence describes the exact shape of the ROUTE.

Constraints

This modeling requires some constraints:

- Between each pair of consecutive STOP POINTs IN JP there must be on any JOURNEY PATTERN a valid SERVICE LINK.

- Between two consecutive STOP POINTs IN JP belonging to the same JP there must be not more than one SERVICE LINK.

- This means: if between two SCHEDULED STOP POINTs there are two or more SERVICE LINKs, then they correspond to different ROUTEs

The same thinking applies to the TIMING POINTs IN JP and TIMING LINKs.

This means that the SERVICE LINKs and the TIMING LINKs in a JP follow the shape of the ROUTE on which the JP is defined and that the following mapping exists: the schema from figure 1 (figure 3) becomes as in figure 4.
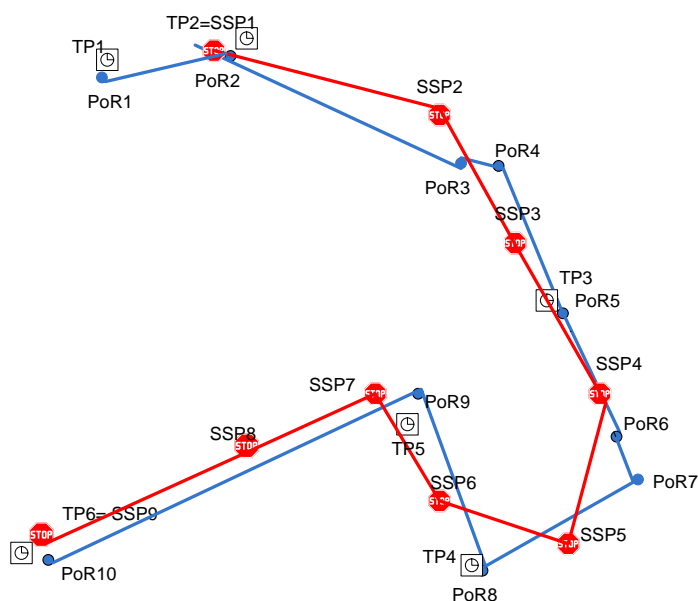
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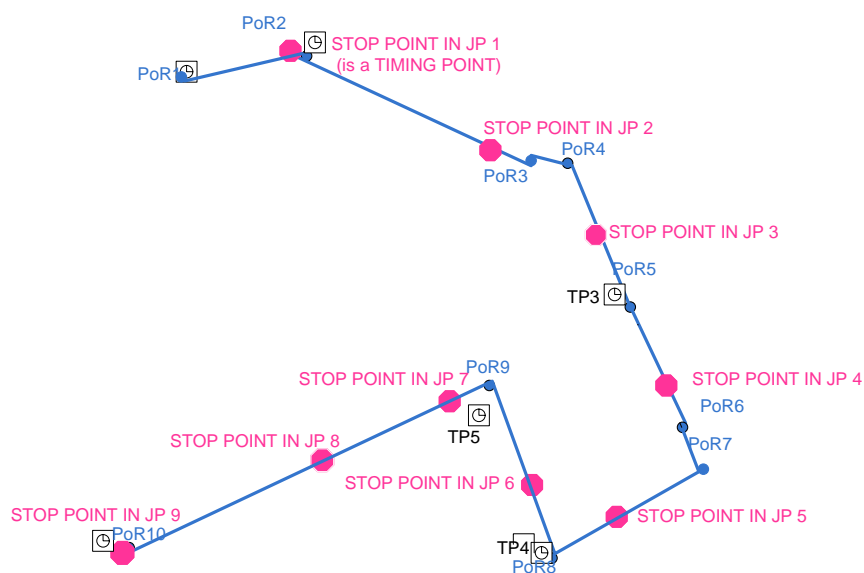Figure 3: Schematic representation of a ROUTE and a SERVICE PATTERN

Figure 4: Mapping of a SERVICE PATTERN on a ROUTE

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For the TIMING LINKs the thinking is analogous: they should follow the shape of the ROUTE.

This means in particular, that a correspondence between the SERVICE/TIMING PATTERNs determining a particular JOURNEY PATTERN and the corresponding ROUTE must exist.

This correspondence is described in Transmodel through the projection mechanism.

Layers and projections: how to implement JOURNEY PATTERNs?

In a most general case TIMING PATTERNs and SERVICE PATTERNs are determined independently one from the other, JOURNEY PATTERNs are defined as a sequence of TIMING and SCHEDULED STOP POINTs and on the other hand a 'path network' is defined through ROUTEs.
The problem is then is to establish a correspondence between these objects.

On one hand, JOURNEY PATTERNs (SERVICE PATTERNs or TIMING PATTERNs) , on the other hand, ROUTEs describe different functional concerns: the first 3 concepts refer to the description of the work of vehicles, the routes to the description of the physical layout of the network.

To describe this situation Transmodel introduces the concept of a LAYER.
A LAYER ha is a user-defined VERSION FRAME, specified for a particular functional purpose, within a particular DATA SYSTEM, associating data referring to a particular LOCATING SYSTEM. A LAYER may be subject to various VALIDITY CONDITIONs.)

According to what was said above:
- JOURNEY PATTERNs /TIMING PATTERNs/SERVICE PATTERNs and ROUTEs belong to different LAYERs (they could be called here the 'service layer' and the 'path layer' for instance).

- A correspondence between these LAYERs exists (cf. constraints discussion above).

The correspondence between layers is called in Transmodel a PROJECTION.

The PROJECTION from the 'service layer' to the 'path layer' is achieved through the definition of a correspondence between
- each SERVICE LINK and TIMING LINK used for that particular JOURNEY PATTERN and
- the ROUTE, i.e. a LINK SEQUENCE (=ROUTE that is the ROUTE LINK sequence).
This correspondence is called in Transmodel a LINK PROJECTION.

The precise definition of a LINK PROJECTION is:
an oriented correspondence
 - from one LINK of a source layer,
- onto an entity in a target layer: e.g. LINK SEQUENCE, COMPLEX FEATURE,
- within a defined TYPE OF PROJECTION.

In the example discussed here the LINK PROJECTION is of a of a type where the target is a LINK SEQUENCE.
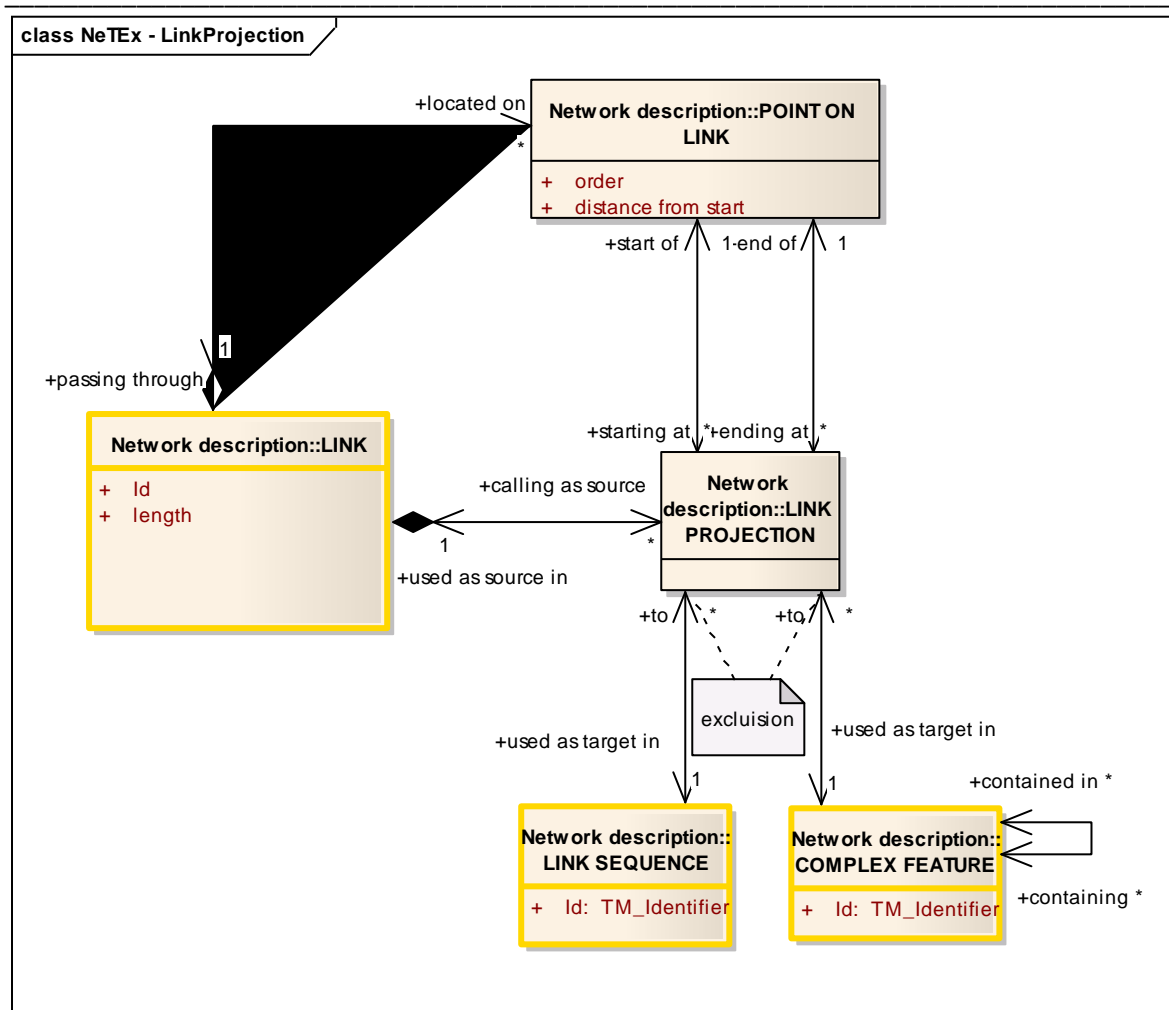
Figure 5. Transmodel LINK PROJECTION

Also a POINT PROJECTION is defined in Transmodel as:
an oriented correspondence
- from one POINT of a source layer,
- onto a entity in a target layer: e.g. POINT, LINK, LINK SEQUENCE, COMPLEX FEATURE,
- within a defined TYPE OF PROJECTION.

Figure 6. Transmodel POINT PROJECTION

Figures 3 and 4 show, that in reality in order to establish a correspondence between SERVICE PATTERNs/TIMING PATTERNs and the ROUTE:

1. there is a POINT PROJECTION:
- from the SCHEDULED STOP POINTs (and TIMING POINTs) start and end of each SERVICE LINK (TIMING LINK)
- to POINTs ON LINK (target is here a POINT),

using the distance from the start of the LINK SEQUENCE (= ROUTE) to locate the obtained points (which are actually POINTs IN JOURNEY PATTERN) on the ROUTE;

2. There is a correspondence between the obtained links (their start and end are the projected points from the previous projection) and the ROUTE. In other words this is achieved through LINK PROJECTIONs (source: links in the JP, i.e. links between two POINTs ON LINK - points on route link - and target: LINK SEQUENCE = ROUTE).

In analogy, a ROUTE may be mapped to the 'infractructure layer' in order to get the correspondence with the spacial geographic features.