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Standards updates
proposal



Deliverable 3.4- Standards update proposal (M24)

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EXECUTIVE SUMMARY

Standards updates proposal consists of the presentation and analysis of potential updates on Transmodel ecosystem standards. On the one hand, the objective of this report is to gather and bring to light the issues and additional needs already raised by the stakeholders who use and want to implement the standards. On the other hand, it aims to systematise the management of relevant change requests and establish a process of grouping and prioritisation for enabling next steps. In both cases, final recipient of this report is considered CEN and the relevant standardisation working groups who can put into effect the proposed changes.

Standard proposed updates are split in three (3) main categories. The first one refers to functional gaps that will potentially lead to functional enhancement of the data model and data exchange format. The second one refers to updates on the documentation with the aim to facilitate the reading and the understanding of the specifications. The third category refers to technology gaps that are possible obstacles for the smooth implementation of the standards. Updates in this respect could be leveraged for the creation supportive tools that support deployment and contribute to the acceleration of EU standards adoption.

The updates, included in the report, concern mainly Transmodel and NeTEx. Nevertheless, SIRI and OJP are also mentioned and be considered in the detailed list of proposed changes, added in Annexes.

List of partners

Partner's name	Acronym	Country
Union internationale des transports publics	UITP	Belgium
Information technology for Public Transport,	ITXPT	Belgium
Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie	BMK	Austria
Ministry of the Sea, Transport and Infrastructure	MMPI	Croatia
Centrum dopravního výzkumu, v. v. i.,	CDV	Czech Republic
Trafikstyrelsen (Danish Civil Aviation and Railway Authority)	TS	Denmark
Direction générale des infrastructures, des transports et de la mer	DGITM	France
Ministero delle Infrastrutture e della Mobilità Sostenibili	MIMS	Italy
INSTITUTO DA MOBILIDADE E DOS TRANSPORTES, I.P.,	IMT	Portugal
Republika Slovenija, Ministrstvo za Infrastrukturo	MZI	Slovenia
Trafikverket (Swedish Transport Administration	STA	Sweden

Abbreviations and Acronyms

APIs	Application programming interface
CEN	European Committee for Standardisation
CR or CRs	Change requests
DATEX II	CEN standard for the exchange of traffic related data
EPIP	European Passenger Information NeTEx Profile
GTFS/GBFS	General Transit Feed Specification/Bike
MERITS	Multiple East-West Railways Integrated Timetable Storage
MS	Member States
NeTEx	Network, Timetables and Fare Exchange, CEN TS 16614-1 to 3 (SG9), extended to cover the Alternative Modes (CEN TS 16614-5)
OJP	Open API for distributed journey planning
OpRa	Operational Raw Data and Statistics, under development (SG10)
PI	Passenger Information
PT	Public Transport
SIRI	Service interface for Real-time Information, CEN TS 15531 1-5 (SG7)
Transmodel	Public Transport Reference Data Model" (EN 12896)
TM	Transmodel
UML	Unified Modelling Language
WG	Working Group

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1 INTRODUCTION

One of the roles the DATA4PT experts' team is to identify enhancements to and gaps in the standards while identifying new standardisation work items to be evolved. This paper sets out some initial thoughts on the key considerations and rounds up a number of specific change requests (CRS), known model gaps and issues as a starting point for developing a full list.

The motivations are several-fold:

- To ensure that the existing specific public transport (PT) data exchange formats and conceptual models have the necessary features to support evolving business requirements.
- To evolve a high-level architecture that allows different open-source data sets to be integrated for many different purposes. These may be PT data sets in a different format (e.g., MERITS, GTFS) or other related data sets (e.g., GIS, Parking data from DATEX2, Accessibility data etc.).
- To support the evolution of an ecology of standards and data tools that allow the efficient and economic creation and exchange of PT data, meeting EC objectives.
- To give users confidence that the standards are being maintained and updated effectively so that their investment is protected.

1.1 TRADE-OFFS AND BIGGER QUESTIONS

Any initiative, in the large and complex field of standards, needs to recognize; (a) that resources are finite and, (b) that an evolutionary approach is needed for data and tool continuity. Thus, a key aim of papers such of this is not only to identify and understand the issues but also to establish their respective priorities so that effort can be targeted effectively.

In formulating an overall strategy for standards development, it is also important to bear in mind -- and possibly revisit -- some fundamental questions such as:

- Is it more important to improve usability/support for existing use or to add new function?
- Are there any particular gaps/weaknesses that are undermining uptake?
- Are we using appropriate technologies to design and specify?
- Are the current processes sufficient to keep abreast of new requirements?

1.2 CONCEPTUAL LEVELS

As discussed in Kasia Bouree's earlier paper *A Methodology for Comparing data standards*, standards can apply at different levels of abstraction, ranging from a general Conceptual Model down to that of the concrete exchange formats and APIs in a specific technology. We recap this briefly:

- **Reference / conceptual models** such as Transmodel provide a high-level abstraction of key features of the problem domain, independent of any specific implementation technology. They are generalised to support many different use cases. They have particular value as design tools for specifying, comparing, modularising and relating different concrete standards, but do not of themselves constitute a data format that can actually be used to exchange data. Ideally, we only have one of these giving us a common vocabulary.
- **Concrete exchange format** such as NeTEx provide specific data formats to meet specific use cases. They often include implementation artefacts required by the technology (e.g., keys, data types etc.), denormalizations and simplifications for efficiency. However, they will have a fundamental correspondence to the concepts in the reference model. We may need different formats for different purposes, or to interoperate or harness legacy data.
- **Concrete APIs**, such as SIRI, OJP, provide specific services for real time exchange for data. Such APIs usually involve simplified and highlight optimised views of a small subset of data elements exchanged to meet a specific business case in a specific context as a specific sequence of messages. The data elements can nonetheless be related to the underlying conceptual model and data sets.

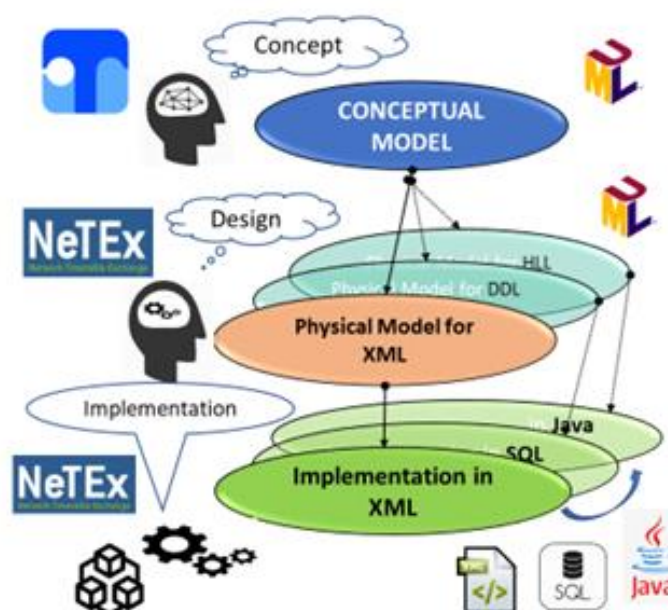


Figure 1 Different levels of data specifications

1.3 DRIVERS OF CHANGE

1.3.1 SOURCE OF NEW REQUIREMENTS FOR FUNCTION

Given the above, new function and new change requirements can thus come from two directions:

- **Bottom up**, from use of a specific format or API to identifying specific attributes or features that need to be added to the standard. These often need to be reviewed carefully so as to make use of existing concepts and terms rather than adding new alternatives but are predominately simple extensions of the existing model.
- **Top down**, from development of the Conceptual model to add new high-level capability. Often this will happen, because a new real-world technology has enabled new capabilities, or a new business area needs to be added. Comparison with other standards also quite often serves to identify missing function in the conceptual model. Sometimes these will require substantial new models.

Examples of both are seen later below.

1.3.1.1 EVOLUTION OF TECHNOLOGIES

A strategy for Standards should also consider developments in the underlying technologies used to design and implement standards, and whether these should be reflected in future plans.

- At the conceptual level this means considering both
 - Improvements to the existing use of UML to represent the representational model.
 - Strategic consideration as to whether developments in other specification technologies, for example ontologies in OWL/RDF are also needed.
 - Possible exploration of the use of tools to generate XML or the documentation of the XML automatically.
 - Consideration of other semantic technologies that allow additional constraints to be specified, such as ontology-based tools (WOLF / RDF etc).
- At the format level this means altogether:

- Considering how to improve use of existing technologies such as XML used for NeTeX etc. and for the integration with programming languages.
- Reviewing whether supporting additional formats (JSON, CVS etc would be useful for some purposes).
- Reviewing where there are better technologies for specifying how data can be validated.

1.3.2 GRANULARITY OF NEW REQUIREMENTS

Gaps in standards vary from the trivial - e.g., a new value for an existing enumeration, or new attributes on an existing element -- to the complex, e.g., adding a new functional submodel or models to the conceptual model and its implementations (such as the recent Alternative Modes support added in Transmodel and NeTeX as new Parts). Substantial additions of function will usually require entire new submodels and some revisions to the existing core model. New submodels require a careful consideration of prerequisites and dependencies:

- Simple changes generally just add to existing data structures and can be done routinely “**bottom up**”, taking suggested changes and adding them to the XML, physical UML and if relevant to the Conceptual UML. Updating the documentation and providing examples. There is now a NeTeX process for flagging items for change. They do not require significant new concepts to be added. A review should be made to ensure that the new attribute cannot be represented by an existing feature.
- Complex changes need a fuller review to ensure they conform to existing designs and are flexible for future change. They are thus best done **top-down** and fully reviewed. Under the CEN process this will typically require a work item.

1.4 NATURE OF CHANGES

Thus, in considering evolving our PT standards we may need to consider any of the following.

- **Gaps in the Conceptual Model for PT (e.g. Transmodel).**
 - Specific CRs for specific small features.
 - Larger functional gaps requiring a new module.
 - Areas where it is important to add features to improve the mapping to other standards, especially if mandated by regulation.
- **Gaps in the Physical Exchange formats for PT (E.g. NeTeX, SIRI etc.).**
 - Specific CRs for specific small features not relevant to the conceptual model.
 - Specific CRs for specific features already described in the conceptual model.
 - Specific CRs for specific features requiring small additions to the conceptual model).
 - Larger Functional gaps requiring a new module based on an enhanced conceptual model.
- **Gaps in the APIS**
 - Missing data elements for existing service request/responses that are not relevant to the conceptual model (e.g., for control).
 - Missing data elements for existing service request/responses that are already described by the conceptual model.
 - Missing data elements for existing service request/responses requiring data elements to be added to the conceptual model.
 - New services whose data elements are already described by the conceptual model.
 - New services requiring data elements to be added to the conceptual model
- **Gaps in the support collateral, documentation, explanations** etc. – it may be more important to improve these than add new function.
- **Gaps in the available profiles.**
- **Gaps in the validation technologies.**
- **New Developments in specification technologies.**

1.4.1 GAPS IN PROFILES

Transmodel and NeTEx already provide a rich set of capabilities covering a wide range of functions. In some cases, the standardisation required is merely to develop a profile – that is, to identify a subset of the existing model suitable for a specific business case and to clarify implementation issues such as identifiers, mandatory minimum content, etc.

- EPIP – European Timetable profile (2020).
- European Accessibility profile – in development (2022).
- European Fare Profile – Work item for development (2022-23).

1.5 PROCESSES

The process for proposing and progressing changes should be visible and documented so that stakeholders can feed their requirements into the system.

Top Down: phased

1. Identify and describe requirements e.g., as draft CR or discussion point.
2. Triage and prioritize outline requirements.
3. For prioritized items, create detailed CR for changes with draft solution and estimate effort.
4. Assign to phase for implementation (I.e, Specifications Version)
5. Implement, document and review (iterative)
 - UML, CEN Specification.
6. Release.

Bottom up: cumulative, continuous (phased documentation)

1. Create issue in GitHub¹.
2. Create proposed enhancement and test case in XML/ in GITHUB.
3. Review, approve and flag any documentation requirements.
4. Release.
5. Estimate documentation effort and assign to phasing version.
6. Update documentation.
 - UML, CEN Specification.
7. Document as rolled up into specific specifications version.

Formally, documenting and reviewing even a small change incurs a significant overhead so practice it is much more efficient to process multiple changes at a time.

¹ <https://github.com/NeTEx-CEN/NeTEx>, <https://github.com/SIRI-CEN/SIRI>,

2 INITIAL ROUNDUP OF GAPS & OTHER POSSIBLE CHANGES

It follows the presentation of two specific types of requests and the achieved outcomes. The first concerns the checking of real-life datasets, provided by MS partners. The second refers to the Italian request to support the Italian initiative to specify national NeTEx profile.

A detailed list of CRs and other specific proposed changes is given as a spreadsheet, including both 'top' down and 'bottom' up input. There are Tabs for different groups of changes (for example, Transmodel function, Transmodel documentation, NeTEx Function, SIRI function etc).

The spreadsheet includes links to specific CRs describing changes where appropriate.

- [Detailed List of Transmodel & NeTEx & Siri candidate changes](#) is provided in the Annexes.

In the following section a narrative description is given of

- (a) Major functional enhancements
- (b) Other areas of possible change

3 TRANSMODEL

This section provides an overview of the proposed updates regarding Transmodel. The collected requests are split into three main categories. The one refers to functional gaps that will potentially lead to functional enhancement of the data model. The second one refers to updates on the documentation with the aim to facilitate the reading and the understanding of the specification. Last, but not least, it is the category referring to technology gaps in the transmodel support. The most significant updates of all categories are described in the following paragraphs, while details are available in (Annex I).

3.1 FUNCTIONAL EXTENSIONS

3.1.1 SEATING PLAN/ SEAT ALLOCATION SUBMODEL

Reservation, Fares and passenger information systems need to be able to indicate the layout of seats (and other facilities) in a carriage/vehicle and the seat numbering system. The available set of seating plans would be part of the “vehicle type” model.

The seating plan model needs to be fully generalised to cover all modes, (i.e. boat decks, train carriages, airplane cabins, coaches etc.). It requires a “Deck plan” that describes the physical layout of a deck, carriage/cabin, just as a Stop Place describes physical fixed locations. Some aspects of a seating plan may be reconfigurable, e.g. seat direction.

The allocation of seats to specific reservations is part of the Fare model. The allocation of specific seats to quotas could also be part of the Fare model.

3.1.2 VEHICLE DOOR SUBMODEL

Some passenger information (PI) systems show which door on which side in each vehicle in the train to use for each boarding position on the platform. Transmodel currently has whole coach (i.e. TRAIN ELEMENT level), but not precise door level modelling. This is of value for accessibility to show wheelchair, etc. friendly exits (in conjunction with the seating plan).

3.1.3 POWER / VEHICLE CHARGING PLAN SUBMODEL

Plan for managing the recharging of Electric PT vehicles at specified points and for specified times along the route. See VDV² specifications for this subject.

3.1.4 CHECK IN / CHECK OUT TIMES

For some services, e.g., international or motorail, check-in / check-out times may be different from arrival times.

3.1.5 DATED VEHICLE JOURNEY IDENTIFICATION

Work in Norway and elsewhere has identified the need to have further means with which to reference specific instances of journeys that may have been modified or replaced close to run time.

² https://www.vdv.de/english_2.aspx

3.1.6 NEW MODE PASSENGER INFORMATION QUERIES

Abstract PI Queries are needed to show how GBFS/TOMP like queries for available vehicles, posted journeys, accepted journeys, etc. map to Transmodel data elements. A range of constraints could be added to facilitate the specification of verification routines. Sales query to show how OSDM like queries map to Transmodel data elements could also be relevant.

3.2 DOCUMENTATION IMPROVEMENTS TO TRANSMODEL SPECIFICATION

3.2.1 CONSOLIDATION OF CEN SPECIFICATION EXTENSIONS FROM ANNEXES

Transmodel 6.0 was published in three initial parts; Part1-(Core), Part2-(Network), and Part3-(Timetables), with other parts added later. Each of the subsequent parts has also added some new concepts to the Part1-Core. Although the changes have been made in the correct UML module (and NeTeX package), currently the specifications describing these additions are dispersed among the respective Part4, Part5, Part6 and Part10 specification appendices (Since CEN rules do not allow the incremental revision of the existing standard). It would be desirable to consolidate these appendices into the correct places in the Part1, Part2, and Part3, modules, but this would require an overall revision of the entire Transmodel documentation to align it with actual modularisation and UML. This is largely an editing and presentation task rather than a technical one.

3.3 TECHNOLOGY GAPS IN THE TRANSMODEL SUPPORT

3.3.1.1 USE OF UML

Transmodel uses only a restricted subset of UML and a number of presentation conventions with which to specify the conceptual model.

There are some further points that could be expressed in UML – for example whether a relationship can or should be implemented by the superclasses, or subclasses (so that it is strongly type), or both (so that a default and an override can be specified).

3.3.1.2 AUTOMATED TRANSFORMS

To create an implementation, a very mechanical transform is done from the Conceptual UML element to the Physical UML, adding in particular attributes to implement the relationships. Would there be any advantage in automating this?

Transmodel UML → NeTeX UML → NeTeX

Some users would like to create code from the UML. It would be helpful to have documentation indicate the issues (e.g. an intermediate model is usually desirable).

3.3.1.3 USE OF ONTOLOGY TECHNOLOGIES

Are there additional specification languages that would allow for more expressive definition of the model? In particular, Ontologies?

Considerable effort is required to assess the advantages, as well as the strength of the tooling for ontologies (editors, visualisations, validators, etc.) with which to create and manage specifications and create examples. Another area that needs to be assessed is scalability.

Transmodel UML → OWL/RDF generation

Some contacts with the project CONNECTIVE of the Shift2Rail programme show that OWL/RDF is generated out of Transmodel UML. However, as this generation is carried out without a close cooperation with the Transmodel group, the validation of this result (and possibly its extension to the complete Transmodel) should be carried out.

4 NETEX

This section provides an overview of the proposed updates regarding NeTEx. Similarly to Transmodel related updates, the types of change requests concern the functional gaps and relevant extensions, the documentation and technology improvements.

4.1 FUNCTIONAL GAPS IN THE NETEX MODEL REQUIRING TM MODEL

Each of the Transmodel Functional CRs requires a corresponding NeTEx component

- Seating Plan/ Seat Allocation submodel.
- Vehicle door submodel.
- Power / Charging Plan submodel.
- Check in / Check out times.

4.2 PRACTICAL TICKET TYPES

The Transmodel / NeTEx Fare model provides a rich set of low-level components with which to describe almost any type of fare structure and product offering. In practice, only certain combinations of components are found (single trip, day return trip, open return trip, time limited trip, timed pass, day pass, season pass, carnet, sale discount, usage discount, etc.). It would clarify (and allow for further implementation constraints) if some additional abstractions were provided to guide the use of fare definition elements.

4.3 FUNCTIONAL GAPS IN THE NETEX MODEL ALREADY IN TM MODEL

4.3.1 CONTROL AND VALIDATION DATA

Only a subset of the Control and validation data described in Transmodel is currently implemented in NeTEx. In particular, the log entries for the transactions created by use of the system are relevant for recording and describing account-based ticketing events.

4.3.2 IMPLEMENT ROLES

TM identifies a number of roles that are not currently specifically enumerated in NeTEx.

4.3.3 FULLY SELF DESCRIBING CUSTOMER PURCHASE PACKAGE.

With the rapid growth in account based and electronic ticketing, having a rich electronic representation of the purchased product and its validation rules is becoming increasingly important for accounting and validation. The current mechanism for describing a customer's purchase, the CUSTOMER PURCHASE PACKAGE, assumes that certain information needed to fully describe the purchase may be retrieved dynamically from the PRODUCT and SALES OFFER PACKAGE definitions. However, in the real world, electronic tickets often need to be able to be used stand-alone without further recourse to the fare system. Work in Norway has identified a need to be able to hold a local representation of certain parameters as part of the CUSTOMER PURCHASE PACKAGE.

This is primarily an implementation issue that can be addressed conceptually with additional derived views of existing data elements.

4.4 SPECIFIC CRs FOR SMALL FEATURES ADDITIONS TO NETEX

See [CR List](#).

4.5 DOCUMENTATION IMPROVEMENTS TO NETEX SPECIFICATION

4.5.1 UPDATE OF NETEX

The GitHub based XML schema is regularly updated with small revisions to meet developer requirements. These changes need to have been reflected in the next version of the CEN NeTeX Specification (and in a few cases in the Transmodel specification as well).

4.5.2 REMODULARISATION OF CEN SPECIFICATION DOCUMENTS

The NeTeX Part 1, 2, 3 documents were published before Transmodel 6.0, and were broken in three initial parts Parts 1 (Network), 2 (Timing) and 3 (Fares); part 5 was added later (New modes). Part 3 and 5 have added some new concepts to the Part 1-3 core, dispersed among their respective appendices.

This is a different modularisation to Transmodel and is confusing to users. It would be desirable to modularise NeTeX to correspond to Transmodel, and also consolidate changes into the correct place in the Part 1, 2, and 3, modules, but this would require an overall revision of the documentation.

4.5.3 LACK OF SIMPLE ONLINE SPECIFICATION NETEX

GTFS and most modern formats have simple concise online specifications and examples for simple cases providing a handy searchable resource for developers. The lack of such a resource for NeTeX is a significant handicap.

4.6 TECHNOLOGY GAPS IN THE NETEX MODEL

4.6.1 IMPROVING BINDINGS / SIMPLIFYING

The work to create a Microsoft friendly EPIP scheme could be extended to cover support for a fares profile.

4.6.2 SIMPLIFYING THE NETEX SCHEMA

Some elements can be encoded in two or more places, e.g., globally or nested in a parent context, or inline or as references. We could remove some of the alternative encodings in the light of experience (and also revise frame content a bit). For example, Fares could require nesting of USAGE PARAMETERS within a TARIFF (at present they may either be nested or global). A separate PRICE frame would be desirable.

4.6.3 IMPROVING SIMPLIFYING

XML allows only certain constraints to be expressed. Can we standardize additional constraints with any validation technology?

4.6.4 NETEX LITE

GTFS has had widespread success because it is easy to parse a simple CSV file, and a spreadsheet editor such as Excel can be used to create and manipulate basic data sets.

It would similarly be possible to provide mapping of a subset of NeTeX to a set of flat files, and to provide tools to import/export from it. Such an exercise also serves to highlight key gaps in GTFS:

- Establish general principles
- Provide selected mappings (e.g. stops, lines, timetables, common fares etc.).

As CSV possibilities are limited, it is proposed to establish a NeTeX – JSON mapping for a subset of data – e.g. EPIP. JSON, because it allows nested structures which is in many ways more suitable to the complex data found in timetables and fares.

5 SIRI & OJP

5.1 FUNCTIONAL GAPS IN THE SIRI MODEL

See Spreadsheet SIRI Tab (Annex III).

5.2 FUNCTIONAL GAPS IN THE OJP MODEL

Key gaps identified are the following:

- Fares Request (Limited)
- New Modes Services: (GBFS /TOMP equivalents)
 - Ride sharing: offered single journeys, accepted single journeys
- Reservations – Use other APIs?

See Annex I – Transmodel - CHANGE REQUESTS TO TRANSMODEL RESULTING FROM EXTENSIONS OF NTX-SIRI-OJPI.

6 STRATEGIC ALIGNMENTS FOR INTEROPERABILITY

Transmodel/NeTEx is already aligned to varying degrees with certain other standards, some of which have been designated as strategic for EU harmonisation.

There are other standards existing or emerging with which interoperation may be desirable.

In addition, the standards with which there is already a degree of alignment may be enhanced, so some further work is needed to keep full interoperability.

The DATA4PT paper [Methodology for comparing data standards](#), by Kasia Bourée formulates an iterative methodology to first establish high-level equivalences and then, if appropriate develop a detailed mapping and examples.

Alignment of a concrete data exchange format typically identifies a few extra attributes or elements that are best addressed by small additions to NeTEx or SIRI and in some cases to be added to Transmodel as well. In a few cases an entire submodel is needed (e.g. for Seating Plans). Typically, a detailed alignment will be focused on a specific exchange use case and will ignore some features of both standards.

Thus, for each standard an initial analysis to establish a mapping is needed for strategic harmonisation and to enable mapping.

Previous partial alignments to Transmodel/NeTEx have included:

- GDF/ Transmodel [projection layer] (2003)
- TPEG classifications / SIRI [classifications] (2003)
- SIRI SM, ST / TM (2003)
- DATEX classifications/ SIRI (2007)
- GML coordinates / shapes / Netex (2008)
- TAP TSI Timetables / NeTEx (2008)
- TAP TSI B1 B2 B3 Fares / (2013, 2017)
- SIRI SX / TM Part 4 (2016)
- GFTS Timetables /NeTEx (2018)
- Inspire (Transport Network Layer) / TM (2019?)
- OJP / TM (2019?)
- GBFS / NeTEx + SIRI (2021)
- TOMP (Static station data) / NeTEx (2021)

A possible Shortlist for future alignment.

- Rail industry data OSDM
- Rail industry data TAP /TSI 2022
- Rail Operations – RailML
- GFTS Timetables – new features
- GFTS – Fares2
- Parking- APDS

7 WORK PACKAGES

The CEN process imposes a need to group changes into periodic updates, as standards may only be updated at specified intervals. In any case there is an overhead in working with the various technical and documentation artefacts; even a small change may require modifications to the UML, the XML schema, an XML example and updates to the documentation including diagrams, each of which must be version managed. There may also be a need for the preparation of presentation materials to allow for efficient review.

Consequently, the most efficient way of addressing enhancements to the standard is to bundle groups of changes into work packages that can be designed, specified and reviewed together and require only a limited number of version iterations.

The suggested approach is therefore to set separate budgets for work packages for (i) Transmodel, (ii) NeTEx, (iii) A NeTEx Fare profile and (iv) SIRI. This would be used to cover the priority items, and as many further detailed issues as possible.

CONCLUSIONS

This paper highlights the most important and urgent requests for updates that apply both data model (Transmodel) and the relevant exchange formats (NeTEx, SIRI, OJP). It distinguishes the updates into three main categories: a) Functional gaps and further extensions, b) documentation improvements and c) technology improvements. The functional extensions mainly aim to support more passenger information queries and in all transport modes where booking is important parameter (such as railways, coaches, airplanes etc.). Documentation improvement refers to consolidation of CEN specification extensions from annexes, the alignment between the data model specifications and the data exchange formats specifications and other editorial updates that will facilitate the reading and the understanding by the potential users. Technology improvements will enable the development of tools that could allow the use and deployment of standards without requiring particular expertise and advanced IT skills. Therefore, all three categories are foreseen to have significant impact to the wider adoption of the EU related standards.

Besides the change requests and the relevant updates on the standard and formats, the paper proposes some strategic activities in order to achieve alignment with other already utilised formats, specifications or standards. and enable interoperability. These activities encompass mappings (comparison between standards/specifications/formats) according to specific methodology also proposed by DATA4PT project (*Methodology for comparing data standards*).

More importantly, this report highlights the need of a systematic follow- up of the change requests and a mechanism that can address the requests efficiently, replying to stakeholders' expectations. The immediate and efficient coverage of their needs, will ensure the usability and credibility of the standards.

ANNEXES

ANNEX I – TRANSMODEL FUNCTIONAL EXTENSIONS

Change requests resulting in Transmodel extensions (additional modelling needed)												
Type	Number	Title	Allocated to	Input	Submitted by	Difficulty	Part N° concerned	Priority (high 1)	nb experts	TM hours	Status	Last Updated
FU	1	Seating Plan/Vehicle door/Passenger space (accessibility)	OSDM (KB), GTFS (NK), ITxPT (UB)	ITxPT, OSDM , long distance, aviation; accessibility for all modes	ERA, GTFS	medium (without harmonisation)	Vehicle Type MODEL - Part 1	1	2	40	draft CR v06	2021.12.02
FU	2	Seat Allocation submodel (allocation of seats at reservation)	NK	attributes in NeTex		medium	Part 5	2	2	40	draft CR v02	2021.12.02
FU	3	Occupancy	UB	ITxPT, SIRI			Part 4	2	2		draft CR v01	2021.12.02
FU	4	Power / Charging Plan submodel (conventional PT, battery powered)	CD		VDV	medium- large	Part 1 (vehicle type) , 3 (management)	3	3	80	draft CR v01	2021.12.06
FU	5	New Mode PI Queries: align the list of queries with the other specifications, like "retrieve trip proposals together with available fare (for the trip proposals)", "preferences of individual travellers", etc. In particular to support OJP	NK, MG	OJP, TPEG, OSDM GBFS, TOMP, IXXI,	internal	large	Part 6, Part 10	3	2	80	partial draft CR	2021.11.17
FU	6	Enhance Customer Purchase Package to be fully self describing.	MG	OSDM	OSDM, SBB		Part 6	4	2	60	TO DEFINE	
FU	7	Include OSDM like request/response	MG	OSDM	OSDM, SBB		Part 5	4			TO DEFINE	
FU	8	Align TM with OJP and propose alignment to OJP		OJP	SBB	medium	Part 6	2	2	80	TO DEFINE	
	9	User profile currently is specified mainly for use in fares (and for Alternative Modes), but we should also support a full UserProfile for general OJP usage, since online services typically need to integrate with Customer Relation Management systems. Such systems are subject to privacy and data protection considerations (i.e. GDPR compliance) so tokenized representations are needed that separate identity from personal preferences for properties such as 'walking speed, maximum walk distance, etc.' s. (only in so far as we need to align OJP)	MG	OJP	SBB	medium	Part 5,6, 10	3	3		TO DEFINE	
FU	10	Current TAP TSI allows a journey specific Required Checkin / Check out Time to be specified at a given stop. This is distinct from the departure PASSING TIME of a vehicle at a POINT IN JOURNEY PATTERN at a SCHEDULED STOP POINT. Transmodel currently allows a duration to be specified for processes such as check in and check out , (done using a CHECK CONSTRAINT and CHECK CONSTRAINT DELAY) and to associate this with a journey, but the resulting time but the resulting time cannot be exchanged directly. It would be useful to be able to do so.				small	Part 2	2	1	15	partial draft CR	24/1/2022
		Alignment for with UIC										
		TOTAL (elaboration of proposal)								240		

ANNEX I – TRANSMODEL- TERMINOLOGY

Change Requests to Transmodel terminology and definitions										
Type	Number	Title	Allocated to	Input	Submitted by	Difficulty	Part N° concerned	Priority	estimated resources (hours)	Status
TE	1	Better names for TYPE OF-types for serialization	nk to add comment		SBB	difficult	all			
TE	2	Location not a suitable name. Should be more aligned with Geo-standards	nk/KB to add comment		SBB	easy	1	low		REJECTED
TE	3	Improve code generation with better naming of packages	nk to add comment		SBB	difficult	all			
TE	4	Amend definition of OPERATING DEPARTMENT			UITP	easy	1	high	2	
TE	5	Amend definition of ORGANISATION			UITP	easy	1	high	2	
TE	6	Amend definition of ORGANISATION PART			UITP	easy	1	high	2	
TE	7	Amend definition of ORGANISATIONAL UNIT			UITP	easy	1	high	2	
TE	8	Amend definition of PARKING PASSENGER ENTRANCE			UITP	easy	2	high	2	
TE	9	Amend definition of PASSENGER CARRYING REQUIREMENT			UITP	easy	1	high	2	
TE	10	Amend definition of TRAIN			UITP	easy	1	high	2	
TE	11	Amend definition of TYPE OF OPERATION			UITP	easy	1	high	2	
TE	12	Amend definition of TYPE OF TICKETING			UITP	easy	1	high	2	
TE	13	Align distribution terms from other standards with the ones e.g. from OSDM, Transmodel etc.			SBB	difficult	5	medium		
		TOTAL							18	

ANNEX I – TRANSMODEL – EDITORIAL CHANGES

Change requests to formal update of Transmodel documentation and Enterprise Architect version										
Type	Number	Title	Allocated to	Input	Submitted by	Difficulty	Part N° concerned	Priority	estimated resources	Status
ED	1	Update of the TM EA UML Model : consolidation of CC (Part 1), update of package split, correction of typos in the DD		ITxPT vocabulary, NeTeX-5, Trm-10	ITxPT , PT0303	medium	all	high	40	
ED	2	Update of the DD : clarification of definitions		ITxPT, UITP, TPEG	ITxPT, UITP, TPEG	difficult	all	high	40	
ED	3	Update of TM Part 1 doc (Common Concepts): consolidate and update according to functional extensions		additional CC + extensions in part 10	internal	medium	1	high	24	
ED	4	Update of TM Part 2 doc (Network): only for conventional PT /add alternative modes?		additional CC (+ extensions in part 10?)	internal	medium	2	high	24	
ED	5	Update of TM Part 3 doc (Timing): only for conventional PT /add alternative modes?		additional CC (+ extensions in part 10?)	internal	medium	3	high	24	
ED	6	Update of TM part 4 doc (Operations) : consolidate and update according to functional extensions and any SIRI changes		additional CC + extensions in part 10	internal	medium	3	high	16	
ED	7	Update of TM Part 5 doc (Fares) : integrate parts of alternative modes?		additional CC (+ extensions in part 10?)	internal	medium		high	24	
ED	8	Update of TM Part 6 (Passenger Info) : queries		from Part 10	internal			medium	30	
ED	9	Update of TM Part 7 (Driver Mgt) - without functional extensions		revise diagrams according to Part 1		easy			12	
ED	10	Update of TM Part 8 (Mgt Info) : additional events& log entries		from Part 10					16	
ED	11	Update of TM Part 10 (Alternative Modes) without functional extensions							24	
ED	12	Update of TM Part 9 (TR) : update of the DD & Package dependencies, model evolution				difficult	9			
ED	13	TRANSMODEL should give guidance to implementers.			SBB		9			
ED	14	Harmonise text/titles with diagrams related to the MODE/SUBMODE		EA file	KB	easy	1	high	30	
		TOTAL							304	

ANNEX I – TRANSMODEL - ATTRIBUTES

Change Requests to Transmodel attributes										
Type	Number	Title	Allocated to	Input	Submitted by	Difficulty	Part N° concerned	Priority	estimated resources (hours)	Status
AT	1	Add Usage to SITE ELEMENT			UITP	easy	2	medium	2	
AT	2	Add minimum width attribute to Manoeuvring Requirement			UITP	easy	1	medium	2	
AT	3	Add attribute to PASSENGER CARRYING REQUIREMENT			UITP	easy	1	medium	2	
AT	4	Others TBD ?							4	
		TOTAL							10	

ANNEX I – TRANSMODEL – TECHNOLOGY & METHODS

Type	Number	Title	Allocated to	Input	Submitted	Difficulty	Part N° concerned	low, postponed)	resources (hours)	Status
TC	1	Name conflicts in inheritance and general id problems		SBB	SBB			postponed		Close?
TC	2	Composite and Aggregate better for automated generation of code (Improve UML Navigability!)		SBB	SBB	medium	all	medium	40	Consider
TC	3	Roles need to be improved		SBB	SBB			medium	40	Consider
TC	4	Aligning to GeoJSON (or another Geo standard)		SBB	SBB			postponed		Closed
TC	5	Remove double typisation by inheritance and type-of		SBB	SBB			easy	16	Some
TC	6	Change_type_of_classes_		SBB	SBB			postponed		Close?
TC	7	Rename_location		SBB	SBB			postponed		rejected
TC	8	Better naming of packages, use of stereotypes		SBB	SBB			medium	40	Some
MT	1	CReat an official OWL Transmodel		KB						
MT	2	Enums should be fully defined in Transmodel für relevant Enums. Relevant Enums are such that we would like to use in NeTeX, Siri, OJP in exactly the same way (e.g. Mode). First identify such enum, then add them directly in Transmodel (or at least tell, who is the master)			SBB			difficult (long)		
		TOTAL							136	

ANNEX I – CHANGE REQUESTS TO TRANSMODEL RESULTING FROM EXTENSIONS OF NTX-SIRI-OJP

Change requests to Transmodel resulting from extensions of NTX-SIRI-OJP												
Type	Number	Title	Add to TM	Add to Ntx Doc	Allocated to	Input	Submitted by	Difficulty	Part N°	Priority	estimated resources (hours)	Status
	CR1	Vehicle type attribute extension (width, height, weight)	To Add	In New Modes		additional attribute	SG9	easy	1			
	CR5	Addition of BookingContact Element into FlexibleServicePropertiesGroup	To Add	To Add		additional attribute	SG9	easy			2	
	CR6	Addition of FlexibleServicePropertiesRef to ServiceJourneyGroup	As relationship			additional relation	SG9	easy			2	
NSO	CR8	Extension of InterchangeRule for multi-line situations =>Multiple interchange rules	Yes			additional attribute	SG9	easy	3		2	
NSO	CR10	Add PositionInTrain to JourneyPart	Not Sure	To Add		additional attribute	SG9	easy	3		2	
NSO	CR15	Addition of an explicit GroupOfStopPlaces	Yes	To Add.		Additional concept	SG9	either add concept either stay with generic grouping	2		8	
NSO	CR18	Add TransportSubmode to GroupOfLines	Yes	To Add.		additional relation	SG9	easy	2		2	
NSO	CR23	Add BookingArrangementsGroup to ScheduledStopPoint (and ServiceJourney)	Yes	To Add.		additional relation	SG9	easy	2,3		4	

Change requests to Transmodel resulting from extensions of NTX-SIRI-OJP				marked								
Type	Number	Title	Add to TM <input type="checkbox"/>	Add to Ntx Doc	Allocated to	Input	Submitted by	Difficulty	Part N°	Priority	estimated resources (hours)	Status
NSO	CR25	Add a secondary destination to Destinationdisplay	Yes	To Add.		additional relation	SG9	easy	2		2	
NSO	CR27	Allow several Authorities for a Line	As relationship	To Add.		additional relation	SG9	easy	2		2	
NSO	CR28	Add accessibility assessment to a VehicleJourney (align XSD and physical Model)	Yes	To Add.		additional relation	SG9	easy (may be already)	3		2	
NSO	CR33	"Formalize a GroupOfTopographicPlaces (May be generalised as GroupOfPlaces so be merged with CR 15)"	Yes	To Add.		Additional concept	SG9	either add concept either stay with generic grouping	2		8	
NSO	CR34	Add human readable instructions to Paths (and non mandatory Legs and Rides)	To Add	To Add		additional attribute	SG9	easy	2		4	
NSO	CR39	Multiple Network per ServiceFrame	Yes	To Add.		Relation multiplicity	SG9	easy (necessary ?)	3		2	
NSO	CR40	Allow links in Common Sections	To Add	New Feature		Model update	SG9	easy	1,2		8	
NSO	CR41	Twice daily travel attribute on FrequencyOfUse	Yes	To Add.		additional attribute	SG9	easy	?		2	
NSO	CR48	Add AirportLinkRail to Modes	Possibly	To Add.		additional enumera	SG9	easy (necessary ?)			0	
NSO	CR50	Add Snow and Ice Modes?	Yes	Done in		additional enumera	SG9	easy (necessary ?)			0	

Change requests to Transmodel resulting from extensions of NTX-SIRI-OJP												
Type	Number	Title	Add to TM	Add to Ntx Doc	Allocated to	Input	Submitted by	Difficulty	Part N°	Priority	estimated resources (hours)	Status
NSO	CR51	Dynamic Stop Assignment	Yes	To Add.		additional relation	SG9	easy	2		2	
NSO	CR56	Add Seat Reservation Number	To Add - See Seat Allocation	Ok		additional attribute	SG9	easy	5?		2	
NSO	NA	Charging station operation (from VDV request)	Yes	To Add.		Model update	VDV	difficult	?			
NSO	NA	Explicit link between Path Link and Equipment	Yes	To Add.		Additional relations	SG9	easy	2		3	
NSO	CR60 + Github PR144	group TariffZones enabling a reference to the group in e.g. parameter assignments for products/fares				Additional concept and associated relations	ENTUR	easy	All		8	
NSO	??	AvailabilityRequest/Response	PI Query			Model update	SBB	medium			8	
NSO	??	FQ Stop Fare Query Model is rather empty (is this for Parking and the like?)				Model update	SBB	difficult				
	??	Path-Model limits of Transmodel: to be defined (railway operators have the path as a special construct). I think this is not fully supported in Transmodel and probably should not be. But we must be clear about that.	Doc	To Add		Clarification	SBB	easy			2	
	Github PR255	Allow multiple gml:Polygons associated to a Zone	To Add	To Add		Implementation of	SBB	implementation specific (not necessary in TM)			4	

Change requests to Transmodel resulting from extensions of NTX-SIRI-OJP												
Type	Number	Title	Add to TM	Add to Ntx Doc	Allocated to	Input	Submitted by	Difficulty	Part N°	Priority	estimated resources (hours)	Status
	Github PR255	Allow multiple gml:Polygons associated to a Zone	To Add	To Add		Implementation of	SBB	implementation specific (not necessary in TM)			4	
	Github PR250	Added the missing CR from Adrian as PullRequest to next : complement equipment Place	Not SURE	To Add		nothing (NeTex Bus)	SBB	NA			4	
	Github PR249	Not sure anymore what it is (Matthias ?)	Not SURE	To Add		??		??				
	Github PR228	Added AccommodationFacility foldingSeat	No (Attributed value)	To Add		additional enumara	ENTUR	implementation specific (not necessary in TM)			2	
	Github PR214	Adding a possibility that the driver should be informed	Yes	To Add		additional enumara	ENTUR	implementation specific (not necessary in TM)			2	
	Github PR137	Add support for CUSTOMER ACCOUNT LOG ENTRIES on a CUSTOMER ACCOUNT	To Add As Rel	To Add		Additional relation	ENTUR	Middle	5		2	
		Total									161	

ANNEX II – NeTeX – FUNCTIONAL EXTENSIONS

Change requests to NeTeX											
Number	Title	Allocated	Input	Submitted	Difficulty	Part N° concerned	Priority (high, low, postponed)	nb experts	NeTeX XML hours	NeTeX DOC (hours)	Status
1	Seating Plan/Vehicle door/Passenger space (accessibility)		TM 6.2	ERA, GTFS	medium	Vehicle Type MODEL - v1. Part 1	high		40	20	TM CR
2	Seat Allocation submodel (allocation of seats at reservation)		TM 6.2 attributes in NeTeX Part3		medium	v1. Part 5	medium		24	16	TM CR
3	Occupancy		TM 6.2		medium	v1.part1	medium		40	20	TM CR
4	Power / Charging Plan submodel (conventional PT, battery powered)		TM 6.2	VDV	medium- large	Part 1 (vehicle type) , 3 (management)	low		80	40	TM CR
5	Align TPEG attribute types with TM Semantics		TPEG Group	TPEG	medium		high				TODO
6	Define a European Fare Profile		France, UK	France	medium- large	Part3	high				WIP
7	Implement Control Log ENtries and Validation data elements from TM.		Norway	Norway	medium	Part3	medium		40	20	TM
8	Make CUSTOMER PURCHASE PACKAGES standaloen descriptions		Norway	Norway	medium- large	Part3	medium		80	40	
9	Support check in /checkout times		TAP TSI	ERA, GTFS	medium	Part2	medium		40	20	TM CR
	TOTAL								184	96	

ANNEX II – NeTeX – EDITORIAL UPDATES

Change requests to NeTeX documentation										
Number	Title	Allocated to	Input	Submitted by	Difficulty	Part N° concerned	Priority (high, low, postponed)	nb experts	hours	Status
1	Update of the NetEX EA UML model & Specification with changes from GITHUB		NetEx GITHUB		low		high	1	40	
2	Update of the NetEX EA UML Model . Split packages to match TM 1,2,3,5,6		As decided by TM	ITxPT , PT0303	medium	all	high	1	24	
3	Update of the NeTeX DD : clarification of definitions		As decided by TM	ITxPT, UITP, TPE	difficult	all	high	1	24	
4	Update of NTX v2 Part 1 doc (Common Concepts): consolidate and update according to functional extensions from NTX V1, Part3 and NTX V1 Part 5.		additional CC + extensions in part 10	internal	medium	1	high	1	16	
5	Update of NTX V2, Part 2 doc (Network): PT /add alternative modes?		additional CC (+ extensions in part 10?)	internal	medium	2	high	1	16	
6	Split out as new NTX V2.Part3 doc (Timing): (From as NTX V1.Part2 Doc. /add alternative modes?		additional CC (+ extensions in part 10?)	internal	medium	3	high	1	40	
7	[Split out a new NTXV2. part 4 doc (Operations)? : consolidate and update according to functional extensions		additional CC + extensions in part 10		medium		low	1	60	
8	Update NTX v2. Part 5 doc (Fares) : From Old NTX v1. part3 minus CC integrate parts of alternative modes?		additional CC (+ extensions in part 10?)					1	40	
9	Split a new NTX v2.Part 6 (Passenger Info) : queries document, update for TM 6 changes		from Part 10	internal	medium		low			
10	Update of NTX v2. Part 10 (New Modes) Move part: additional events& log entries		from Part 10			3	high		40	
	TOTAL								300	

ANNEX III – SIRI- FUNCTIONAL EXTENSIONS

Number	Title	Allocated to	Input	Submitted	Difficulty	Part N° concerned	Priority (high, low, postponed)	nb experts	NeTEX XML hours	NeTEX DOC (hours)	Status
1	Occupancy		TM		medium		high	2			TM CR
1	Vehicle Stopping : doors/platform		TM		medium		high	2	40		TM CR