The Implementation of Public Transport Data Models in Hungary

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Abstract: The article focuses on the reasons behind the recent nationwide implementation of the European reference data model for public transport, TRANSMODEL and the service interface for real time information, SIRI in Hungary. It analyses the operational and institutional background, presents a brief introduction and their role in public transport management with application examples, particularly the liaison between TRANSMODEL and the location identification and coding rules of ELEKTRA Hungaria, the national chip card system.

Keywords: transmodel, siri, elektra, data model, geodatabase, transport, network

1. Introduction

The New Széchenyi Plan identifies the development of transport as an outboukening direction and within it “the reorganisation of public transport system, the modernisation of its structure and financing” is a stressed horizontal issue. [1.] The key to the successful implementation of these measures is the development of coherent public transport systems and databases, built with unified terms, logic and content in the bottom line of mind. The preparatory works and the supervision of the development are the duties of the Ministry.

Understanding the importance of the standards and reasons behind their application the use of these standards is a definite requirement in the Regional Operational Programmes. [2.]

In the early stage of their implementation a number of questions were raised in connection with the standards forming some concerns of the adequacy and use. Behind the question a number of reasons can be identified among which the following should be listed:

- the implementation of the standards is a tool and not a goal, thus the call writers did not devote too much explanation to the exploitation of the data models;
- the applicants understood the implementation of the standards as a challenge in informatics however the real goal was to support traffic management processes;
• for a long time the national traffic management and planning system were common in refusing the spatial representation and modelling of the network in spite of the fact that the know-how was available since 1980’s also in Hungary;
• the translation and the transposition of the standards did not happen in the past, since the demand for that became clear just during the recent implementation works.

The goal of this article is not to give an in-depth introduction of the standards, which wouldn’t make sense in such extent anyway, but stressing the key role of standards in traffic management, operational planning, passenger information, ticket selling and network planning.

Definitions of database

Before going in details it is important to clarify some misunderstandings and misconceptions – that do exist according to the present practice. The easiest way of doing this is to give exact definitions.

The definitions of the following terms are necessary:

• Data: Refers to factual figures with definition and unit that are measured or recorded during the operation of public transport.
• Jumble of data: The electronic storage place of data, typically arrange into datatables.
• Database: Data of a common nature and collected in a common logical system.
• Relational database: The structured, logically managed and connected storage architecture of data, of which information (knowledge!) can be derived.
• Geodatabase: A database in which the data have spatial reference and the geographic and describing attributes and their logical connections – including spatial ones (like adjacency) – are recorded together and managed commonly. Its key benefit is the redundancy free data storage.
• Data model: The relational and interpretation system that defines the logical description of the database, containing constructional and operational elements.

Giving a practical example: the departure time of a given public transport service is a datum (transferring to the passengers is information); the datasheet containing all departures of a day is a jumble of data (the timetable is a logical term!); in a relation database this data sheet is a table interpreted in a connection system; in a geodatabase these departures have spatial references (can be presented on a map and spatially analysed). In most cases the mixture of the above terms is typical; e.g. the collection of Excel data sheets is called database. A similar mistake is to say geodatabase when we have only a table in the database containing the stop coordinates or even the vertex coordinates and we can have a plot of the services.

It is important to emphasise that data model does exist in any database independently from its direct presentation during software planning and from having a conscious design with users.

The data connection model called data block diagram can be derived from an existing database as well (reverse engineering).
The base of the state-of-the-art software design is the establishment of a data model, in which the logical model, the data connections and external references of the stored data as well as the operational rules are defined. It is forbidden to mix these later ones with the physical database operations like insert or delete.

The present practice says that in spite of the fact that the transport and its connected processes (like trip or journey) and events (like departure) are heavily connected to spatial description and movements the geodatabase and the systems that can handle spatial connections and operations are quite rare (they are preliminary at planning institutions). This poor availability of spatial management caused and still causes clear decrease in service efficiency and quality (it is enough to mention the poor handling of changing – if the name of the stops are different the systems usually do not recognise the possible changes).

Interpreting the abovementioned definitions the standards that were put as requirement in the calls of the regional operational programs is not more just the clear definition and demand on the common terminology and data model. Additionally it takes the duty and costs of one of the most important design phases which require the broadest knowledge in transport operation – therefore causing the most troubles handling it as a simple software definition task. This is extremely important since it not just a financial tool for software development but a chance for a quality upgrades: the recent traffic operation and management can be supported with spatial domains – since typically the ground vehicles will be equipped with GIS; this inevitably leads to new data models at those companies that had lack of spatial database.

Figure 1: Sketch of business and passenger information systems (Berki [4.])
Additionally, it should be mention that these systems will serve a number of other applications directly connected to public transport operation (e.g. e-ticketing system, see Figure 1) – thus their requirements should be incorporated in the data model, which – regarding the fact that the companies have very limited experience in these fields – practically would mean an infeasible task for software engineers!

2. The role of public transport network representation

It is crucial to consider the following integrated aspects at transport network database building in connection with public transport:

- **planning of the public transport network**: calculation of the passenger demand loads, the optimization of the alignment of the lines with the impact assessment,
- **service planning**: timetable and service calendar planning, making of the crew and vehicle scheduling,
- **assisting traffic control**: assisting operation tasks by involving spatial information and spatial connections, efficient handling of incidents,
- **developing passenger information system**: provision of timetable based route guidance calculated with the real availability of services for several kinds of end-user devices (e.g. internet, mobile equipments),
- **application of electronic chipcards**: the positioning of the different network elements and equipments (e.g. validators); the description of timetable supply according to intended travel relations of passengers for the loading onto the cards,
- **recording and presentation of performances**: for the periodic recording of the passenger-, deployment-, vehicle and staff performances based on network points and lengths and for the reporting on area/line based results.

An information system built with these considerations in mind could assist the complex planning and decision making processes of public transport companies. For these tasks the only common solution is to build a geodatabase.

The transport operation processes that can capitalize on geographic information systems are pretty wide (see Figure 2). The common feature of these processes is that without using localisation we could get only partial information from them, therefore the user should – usually in mind with verbal or tabular information – combine them. In the latter case there are trivial problems; it is enough to mention the liaison between service planning and demand in strategic planning or at passenger information the bundling of the route and validity (e.g.: the route could be different on weekdays and weekend days).

The service data of the operators in a database system are collected in clearly defined logical association groups (categories) of which the following ones are the most crucial:

- identification of line/service patterns/runs;
- defining of routes, stops, route sections and internal junctions;
- the schedule and vehicle type of valid and planned runs.
In brief we can state that the fundamental requirement of a geographic information system is to represent the conceptual range of the operators and be capable to join the data with their validity, including versioning and geodatabase rules.

**Figure 2: Transport operation processes that can capitalize on geographic information systems (Berki)**

3. Standards and business processes

The launching procedure and existence of standards is not an art for art’s sake but they are the keys for successful implementation of the business processes. This fact is further supported by the rapid development of info-communication technologies, since without standards and interfaces these systems never could be linked.

This is true for public transport operation as well. A good example is from the European Bus System of the Future (EBSF) research programme running recently (2008-2012, 47 partners, 26millió EUR budget – Budapest Transport Co is one of the partners). One of the most stressed ideas is [5.]: “One key innovation developed in the project is the concept of integrative approach on information technologies and telematics. EBSF is developing IP communication architecture on the vehicle side as well as standard interface (like SIRI and data model like Transmodel) on the back office side for European buses in 2015. Integration is THE key aspect while speaking about «system» in EBSF.”
The following EU level standards and directives do exist related to public transport data management and data interchange:

- **TRANSMODEL** – the Reference Data Model for Public Transport; including the database schema for network description, versioning, vehicle-driver scheduling and rostering, personnel disposition, operations monitoring and control, passenger information, fare collection and management [6.];
- **SIRI** – Service Interface for Real Time Information; an XML protocol to allow distributed computers to exchange real-time information about public transport services and vehicles [7.].

**TRANSMODEL** is a database data model which is due to be implemented within the Enterprise Resource Planning System of an operator while **SIRI** is supporting the connection of distributed systems.

The national implementation of these standards has been started. As early as 2006 a study dedicated to the passenger information system of Budapest Transport Association (BTA) of TRANSMAN and CDATA has stressed to build the database by applying the TRANSMODEL standard.[8.] Later CDATA-Térképtár built a database for testing purposes for BTA by implementing TRANSMODEL standard’s chapters dealing with network description [9.], and an other one for assisting the national transport count and survey program in 2007-2008. [10.][11.]

4. Network description – The key element

The central element of such databases is the network description. Its fundamentals have been developed in the 80’ies with multi-modal approach in mind. One of the pioneers was Dr. habil János Monigl who summarised these issues in his study about TRANSURS (Transport planning in urban areas) model system. [12.]

The harmony between the two aspects is evident when we compare the network schema of the two systems:

![Figure 3: The transport network description (TRANSMODEL and TRANSURS)](image-url)
Anyway, this is the fundamental structure of the TRANSURS transport planning software (developed by TRANSMAN) and also PTV VISUM used by TRANSMAN and FOMTERV. 

Thanks to this similarity there was no need to transform the database when we shared a modelling database between these software tools. PTV VISUM is such complex that it can work as a transport database server of a city (e.g. London [13]).

However, TRANSMODEL is only a reference data model. Adding to this a number of coordination actions are needed. Like the preparation of a national identification system and location code tables is the duty of the central government. For example in the UK the National Public Transport Gazetteer (NPTG) provides a topographic database of towns and settlements [14.] and the National Public Transport Access Node (NaPTAN ) is a UK nationwide system for uniquely identifying all the points of access to public transport [15.].

A similar work has been undertaken also in Hungary in connection with the development of the national chipcard system called ELEKTRA Hungaria which was coordinated by TRANSMAN and led by Dr. habil János Monigl [16.]. In that project the author prepared the network database and the network based calculations [17.].

The objective of the underlying work was to provide a unified network and timetable description system which could be filled up directly by an automated manner using the existing databases of recent transport operators and could support the preparatory works of transport associations in planning phase and the operational tasks in a latter phase covering tasks from timetable planning to revenue sharing. In this workflow the role of the spatial database is to support the network description by providing a framework for presenting, querying and spatial analyses (like neighbouring, zone system creation) of the services and support to make a mathematic graph of the transport system suitable for path searching and network calculation (like assignment, tariff calculation). It provides a unique possibility to involve other, non-transport data sources – primarily demand related ones: population, motorisation, etc.

Table 1: The identification and code system of ELEKTRA Hungaria [17.]

<table>
<thead>
<tr>
<th>Nr.</th>
<th>ELEKTRA Data file</th>
<th>File name</th>
<th>Size of ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ELEKTRA issuer identifier</td>
<td>ISSU</td>
<td>1 byte</td>
</tr>
<tr>
<td>2.</td>
<td>ELEKTRA operator identifier</td>
<td>OPER</td>
<td>2 byte</td>
</tr>
<tr>
<td>3.</td>
<td>ELEKTRA card identifier</td>
<td>CARD</td>
<td>1+4 byte</td>
</tr>
<tr>
<td>4.</td>
<td>Card delivery office identifier</td>
<td>OFFI</td>
<td>2+1+2 byte</td>
</tr>
<tr>
<td>5.</td>
<td>Reload device identifier</td>
<td>RELD</td>
<td>2+3 byte</td>
</tr>
<tr>
<td>6.</td>
<td>Validator identifier</td>
<td>VALD</td>
<td>2+1+3 byte</td>
</tr>
<tr>
<td>7.</td>
<td>Controll device identifier</td>
<td>CTRL</td>
<td>2+2 byte</td>
</tr>
<tr>
<td>8.</td>
<td>Display device identifier</td>
<td>DPLY</td>
<td>2+2 byte</td>
</tr>
<tr>
<td>9.</td>
<td>Computer identifier</td>
<td>COMP</td>
<td>2+1+2 byte</td>
</tr>
<tr>
<td>10.</td>
<td>ELEKTRA location identifier</td>
<td>LOCI</td>
<td>2 byte</td>
</tr>
<tr>
<td>11.</td>
<td>ELEKTRA service identifier</td>
<td>SERV</td>
<td>3 byte</td>
</tr>
<tr>
<td>12.</td>
<td>ELEKTRA travel identifier</td>
<td>TRAV</td>
<td>4 byte</td>
</tr>
</tbody>
</table>
The fulfilment of the presented list of requirements seems to be pretty demanding but with the use of geographic information system tools it is quite easy and straightforward.

It should be stressed that the key to the successful implementation is to have a central auditing body to beware of the misinterpretation of the standards. This task was dedicated by the Ministry to the VOLÁN Egyesülés (VOLÁN Professional Association). Its special mission is to keep and strengthen the coherent database of the national road public transport companies. [17.]

References


[2.] National Development Agency – Call and guide for proposers in Regional Operation Programmes supporting Infrastructure Investments to Increase Public Transport Service Level (separate call for each region), 2009., e.g.: http://www.nfu.hu/download/20848/00_DD_Kozossegik%20kozlekedes%20090708.pdf


[14.] NPTG (National Public Transport Gazetteer), http://www.dft.gov.uk/nptg/
