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Information System KANGO and Track Status Tables

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Abstract: *Standalone module KANGO TTP as a part of IS KANGO was designed for creating, updating and publishing of track status tables. This module uses consistent data description of railway infrastructure provided by another part of IS KANGO called KANGO-Kmen. These data are used by other information systems of Czech railway infrastructure manager (SZDC). KANGO TTP allows to update TTP and meets all the specific TTP agenda requirements in the regular two-week cycle. At the same time it is ready for data communication with external information systems, especially the ETD.*

Keywords: *KANGO-Kmen, track status table, timetable, editor, database.*

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I. INTRODUCTION

KANGO is a comprehensive multi-layered distributed information system designed to create timetables working in on-line mode. It supports a new flexible concept of railway timetable creation and provides the integration platform to another systems used in the planning, management and operation of railwaytraffic. It is assembledfrom several specific aimed modules. One of its components is the KANGO-Kmen module, which is an online graphic editor of the so-called primary data (railway network, locomotives etc.). Although it primarily provides data preparation for KANGO's internal modules, it has become an important and indispensable resource for many other external systems after the creation of a large database. On the contrary,the requirements of external systems influenced and have influenced the development of the KANGO-Kmen module in several ways:

- Functionality, data view creation based on new requirements
- Modifying the structure of the database
- Extending database with new data entities and their integration into the data and business model of the KANGO-Kmen system.

1 Why the Integration of KANGO-Kmen andTrack Status Tables

The idea of integrating processing and management of track status tables into the KANGO-Kmen system was created as soon as the system was put into real operation. The main reasons and prerequisites for integration of track status table processing into KANGO-Kmen emerged from the current state of the overall track status table processing system. They can be summarized in a few basic points:

- Both systems describe the infrastructure of the railway network, although the structure of the description and the nature of the target applications is different
- KANGO-Kmen data model includes, not a whole but significant,data subset applicable to track status table processing
- The inconsistency of the track status table data entered from thepoint of view of both the structure and the content, resulting particularly from the tool in which the track status tablesare currently being processed - Excel spreadsheet environment
- The lack of data verification and their consistency check in relation to other information systems
- The absence and the request of data outputs of track status tables for other information systems (the only output of the current track status table system is document in pdf format).

  The problems mentioned above have been a good reason for integration analysis of both systems. One of the implications of track status table integration is the revision of the track status table regulations

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defining their content and format, so that they adapt to a new way of creation and, in particular, remove many content and format ambiguities and inconsistencies that have arisen in the Excel environment.

1.1 Conditions, Limitations and Requirements for the Integration of KANGO-Kmen and Track Status Table Processing

The first phase of the KANGO-Kmen and track status table processing was to analyze whether such integration can be achieved at all, and what it will require not only on the KANGO-Kmen side as a target system but also on the track status tableprocessing side as a source system. The analysis of data models and business processes of data processing, which took about a year, resulted in a specification of tasks and requirements that need to be addressed in case of integration. Although there were significantly more issues, all resultedfrom two elementary problems:

- Extending KANGO-Kmen data model by adding entities requested by the track status table data.Of course, this primary requirement implies a number of successive tasks, starting with modifying the business model and ending with user interface modifications
- Differences in the KANGO-Kmen and track status tabledata preparation time schedule, and the need to keep changes in pending time

The first problem, even it is time-consuming due to a wider intervention in the data model, is not so complex from the point of view of the solution and implementation.

The second problem appeared to be more complicated because the data processing schedules in the KANGO-Kmen and track status table preparations seemed to be absolutely incompatible. The KANGO-Kmen works primarily with so-called future data, in basic form with a one-year advance (in order to be able to prepare train graphics in advance), and no significant changes are made to the data. Track status tables unlike KANGO-Kmen, primarily work with the so-called current data that are valid at the current time and the necessary changes reach with a maximum of 14 days in advance.

1.2 KANGO-Kmen and Track Status Table Data Models

It was necessary to design track status table data links to data managed by the KANGO-Kmen system in the first phase of the solution and implement the necessary data extensionsand their bindings. The integration of the track status table data model into the KANGO-Kmen required the addition of about 60 new data entities and their integration into the already existing data structure which represents the most extensive change of model since the origin of KANGO-Kmen. At the same time it was necessary to add new attributes to existing data entities. Subsequently, based on the entire extension, the process and scenario of editing these data was modified according to the existing KANGO-Kmen user characteristics. The user interface has to be split into two branches, where one branch is designed to prepare the basic version of the track status table data. The second branch, designed for the operative editing of requested data changes and which was required by a different work schedule, had to be designed and implemented from the start. This interface for the track status table processing together with the integrated data entities creates the KANGO-TTP module.

Contribution of the integration of the individual track status table data entities into the structure of the KANGO-Kmen network is the establishment of the so-called technological dependence into the track status data, i.e. data are entered in those objects where they are really located and so there is automatically introduced so-called technological verification of the exactness of the entered data, to a certain extent, which in the case of editing in the Excel environment is guaranteed only by the data processor without any connection to the network data.

On the other hand, incorporating the track status table data into the KANGO-Kmen expanded the database describing the railway traffic network by additional information that may be provided to other information systems.

An attempt was also made to create a module that would convert existing track status table data from the Excel format into a KANGO-TTP data model. The analysis and implementation of this module has fully demonstrated the inconsistency of the current track status table model where each user could modify the structure of track status tables in an almost unlimited way in the Excel environment. This was also the cause of the impossibility of creating an efficient transformation module and, in essence, further encouraged efforts to integrate track status tables into the KANGO-Kmen.

1.3 Work Schedule

Much bigger problem than the data model extension to be solved was the track status table data preparing business process which has three basic features:

- 14-day track status table data processing interval
- Keeping history changes
- Hierarchical data preparation from the perspective of users

1.4 Interval Data Processing

Interval data processing is solved by using so-called track status table data packages. At any time, system allows to create the data frames needed for processing a track status table data set. Each package is defined within a given time interval and these intervals do not overlap each other. This method also supports the tracking of the history of data changes according to user requirements.

1.5 Hierarchical Data Processing

The KANGO-Kmen system implements the system of user access permissions to data according to the roles of users but this only allowed the extension of the user system and the creation of the role of the track status table processors. It was necessary to add some other features to the system in order the whole module meets the requirements of the track status table hierarchical processing business process.

1.6 Track Status Table Creation Algorithms

Very extension of the network description by track status data table data is only one side of the track status table integration into the KANGO-Kmen.

1.6.1 Data Selection

Although the KANGO-Kmennetwork description model basically comes from from the actual state, it also contains virtual elements that model some relationships between physical objects (e.g. transitions) neededforcreating a railway time schedule. However track status table data are based solely on the description of the real situation of the railway network.

Another problem arises from the different nature of the data.The description of the railway network is at the abstract level represented by a graph (it may not be connected since the description doesnot contain only pure trafficpoints - station stops but also so called control centers - CDP Přerov, CDP Praha which are not connected to the traffic network edges. On the other hand, track status table data is tabular in nature, based on the sequence of selected objects.

Therefore, the first group of algorithms solves the data selection and possibly the mapping of the virtual elements that will be contained in the track status table. The selection is implemented hierarchicallyand the highest level is the so-called track status table track consisting of a sequence of traffic points and track segments which must be defined by the user by selecting the corresponding points and segments from the entire railway network and which is given by the regulations. This subnet does not have to be connected i.e. not all traffic points have to be interconnected by the track segment. This subnet must contain all points and segments whose data are supposed to be a part of the track status table of the particular track. However, defining a track status table track at the level of traffic points and track segments is not enough to create some track status table. In particular the main problems comes from understanding the term segment. While the KANGO-Kmen segment is a segment between the two points (stations), the track status table understands it as the interconnection between the two significant points, so that the track status table segment can consist of several sections as defined in the KANGO-Kmen.

And this was the place where algorithms that can map the network KANGO to the track status table network following the conditions defined by the individual track status tables (which may vary for each table) were to be designed and implemented.

This highest level of selection is only sufficient for some tables. Most tables requiresdefining the sequence of objects at a lower level, specifically at the level of station tracks and segment tracks. And since virtual elements – so called transitions between the individual tracks – are also an integral part of the network description at the track level, these must also be included into this second level of the track status table track description. Since track status table describes the technical parameters of the main tracks (labeled with numbers 1 and 2), the creation of this second level is algorithmized (to some level) and the resulting selections are suitable for most tracks. Only some specific exceptions occurring in some routes need to be addressed interactively.

The last, third, selection level is the selection of specific data for each table type. This level is fully algorithmized, i.e., the selection of data objects takes place without user intervention. It also represents the verification of the data to a certain extent. If the data in the network description is entered correctly then the content of resulting tables will meet the requirements specified by the regulation. The algorithms themselves are not trivial like algorithmsat the second level they solve not only the data collection, but also network model merging and mapping according to the requirements of a particular table.

1.6.2 Data Formatting

Second large group of algorithms solves the data formatting itself according to the requirements specific to table type. This formatting takes place in two phases. First, so-called data formatting is done, i.e. the selected data for a given table is transformed into a shape based on the definition of the contents of that table. Essentially we can say that the result of this algorithm is the matrix containing the arranged data to match as much as possible the definition of the contents of the table given in the regulation. The result represents data source that is published via a web service to an external information systems.

At the same time, the resulting data formatting object is an input for so-called graphical formatting, which consists in generating a graphical representation of the table in pdf format, which is also defined in detail by the regulation and it representsrequiredoutput module. Graphical format is currently one of the tools used to control railwaytraffic, specifically for train journey.

1.6.3 Work Administration

As it was already mentioned, the business process of creating track status table data differs from the original KANGO work system significantly. Realization of interval and hierarchical data processing did not only require the addition of new user roles and access to data via track status table data packages but it was necessary to provide hierarchical control of the whole process of creating track status table data. The changes occurred mainly in the following areas:

- Managing users and their permissions
- Managing a specific track status table data package

While user management had to be integrated into an existing KANGO user system, it was necessary to extend the system so that it had no impact on the current work system of the current track status table processors. It was necessary to allow to set access permissions from a topological point of view, in terms of the type of managed data and the state of the track status table data package changes.

For managing a particular track status table data package it was necessary to solve the problem of progressive hierarchical data processing. A track status table package status system was designed with different permissions for different user roles. This system enables administrators to manage the process of creating track status table data in real time. Replacing the original email communication accelerated the process as well as reduced the error rate.

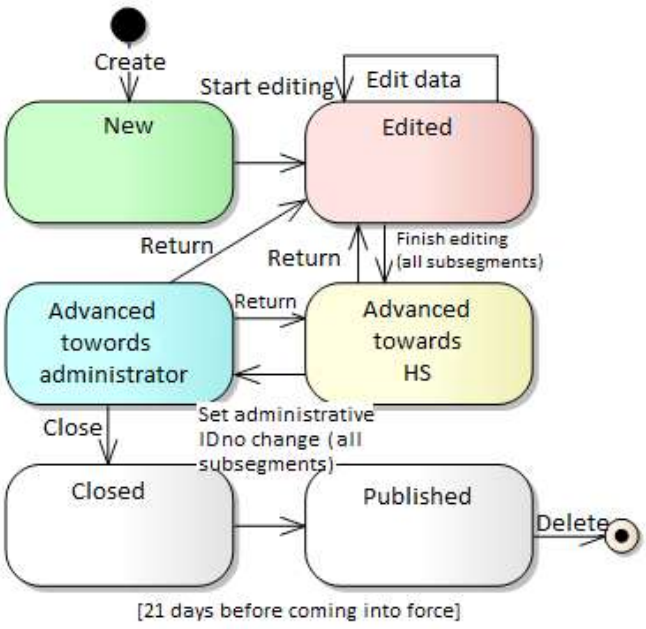

Fig.1 Track status table data package creation process

Significant changes to the track status table data package status are logged and allow both processors and administrators a quick orientation not only at the level of the package as a whole but at the level of individual tables via a text or spreadsheet protocol.

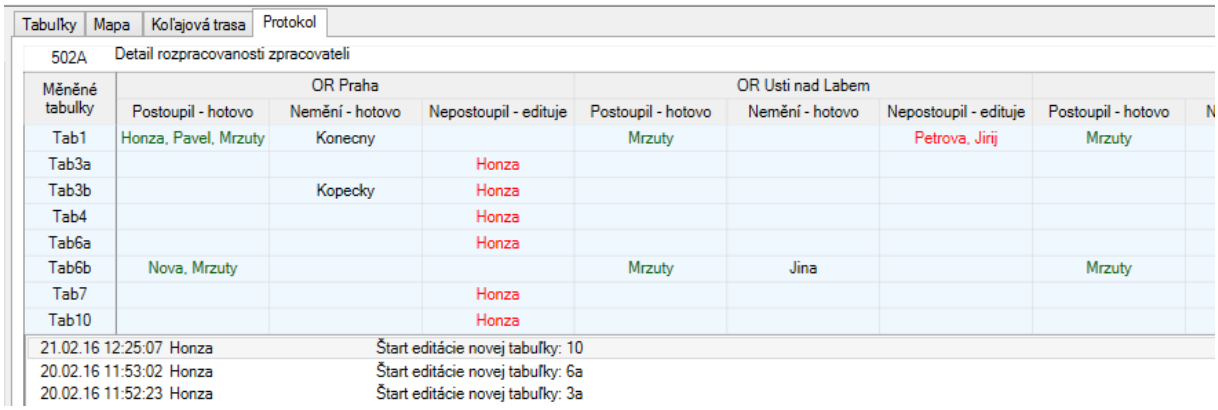

Fig.2 Log sheet of track status table package status changes

1.7 Outputs and Extern System Interface

The only output of current track status table processing is the table in pdf format which is published via the web portal for other information systems. Of course this output format is also generated by the new KANGO-TTP system.

In addition to this read-only output KANGO has incorporated the table data format into a flexible web service allowing external systems to acquire track status table in a data format.

II. CONCLUSION

KANGO TTP Module is used by Czech railways infrastructure manager and now the necessary data are collected.

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