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THE BASIC PARAMETERS OF TSI TAF – ASPECTS OF IMPLEMENTAION ON POLISH RAILWAYS

This paper outlines TSI TAF basic parameters and show examples of implementation used the spatial information coming from satellite navigation systems – GNSS (Global Navigation Satellite System) in railway operation control and interlocking applications.

PARAMETRY BAZOWE WEDŁUG SPECYFIKACJI TSI TAF – WYBRANE ASPEKTY WDROŻENIA W WARUNKACH PKP

W referacie przedstawiono parametry bazowe zdefiniowane dla podsystemu Telematyka w TSI TAF oraz przykłady wdrożeń wykorzystujących informację przestrzenną pochodzącą z systemów nawigacji satelitarnej – GNSS w aplikacjach sterowania i kierowania ruchem kolejowym.

1. INTRODUCTION

The European Rail Industry (e.g. individual Railway Undertakings (RU(n)), individual Infrastructure Managers (IM(m)), private wagon owners and terminal operators) is undergoing significant changes due to liberalisation, open access, purchase/sales contracts, replacement of RIV regulations and Freight Quality Charter.

This and strong market pressure require significant changes in co-operative processes and collaborative data exchange in order to increase rail's competitiveness versus other modes of transport. It was the task of TAF TSI to define and describe these processes and the related messages flow commonly with all partners of the European Rail Industry.

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The scope of TSI Telematic Applications for Freight (Fig.1) covers the information flow required for interoperability[2] within the "Yellow" area (**Inside TSI** Area ...) between IM(m)[3] - IM(p), RU(n)[4] - RU(k), RU(n) - IM(m) and vice versa.

TAF TSI did not cover the information flow between customer and RU(n), for this is an area of individual business to differentiate from competitors. Nevertheless the TAF TSI ensures that the data required by RU(n) to interface with customers is available and of high quality. Planning and post trip processes were excluded, but the interfaces to these processes or to existing projects were taken into account.

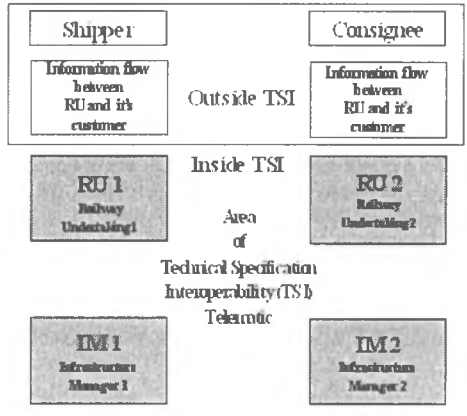

Fig.1. Area of Telematic Applications for Freight of the TSI

[2] Interoperability means efficient interchange of information at all times best adapted, with regard to quality and quantity, to changing requirements so that the transport process may remain as economically viable as possible and that freight transport on rail maintains its hold on the market against the intense competition it has to face. Espcially, it means interoperability between modes of transport, in particular between conventional rail transport and combined rail transport

[3] Infrastructure Manager (IM): means any body or undertaking that is responsible, in particular, for establishing and maintaining railway infrastructure. This may also include the management of infrastructure control and safety systems. The functions of the infrastructure manager on a network or part of a network may be allocated to different bodies or undertakings;

[4] Railway Undertaking (RU) is defined as any public or private undertaking, licensed according to applicable Community legislation, the principal business of which is to provide services for the transport of goods and/or passengers by rail with a requirement that the undertaking must ensure traction; this also includes undertakings which provide traction only.

2. TSI TAF - BASIC PARAMETERS

In light of the essential requirements in Chapter 3 TSI TAF, the functional and technical specifications of the subsystem are as follows:

Consignment Note data

The Consignment Note has to be sent by the Customer to the Lead RU. It must show all the information needed to carry a consignment from the consignor to the consignee. The LRU must supplement this data with additional information. These data, including the additional ones, are for the description of the data Annex C TSI TAF. In the case of Open Access the Lead RU contracting with the customer has all the information after the supplement of the data available. No message exchange is needed with other RUs. These data are also the basis for a path request on short notice, if this is required for the execution of the consignment note. The following messages are for the case of non Open Access. The content of these messages may also be the basis for the path requests on short notice, if required for the execution of the consignment note.

Path request

The Train Path defines the requested, accepted and actual data to be stored concerning the path of a train and the characteristics of the train for each segment of that path. The following description presents the information which must be available to the infrastructure manager. This information must be updated whenever a change occurs.

Train Preparation

This section specifies the messages which must be exchanged during the train preparation phase until the start of the train.

For the preparation of the train, the RU must have access to the actual infrastructure data (infrastructure register), to the dangerous goods reference file, to the technical wagon data and to the current, updated information status on the wagons. This refers to all wagons on the train. At the end the RU sends the train composition to the next RUs and to all IMs with whom he has booked a path section. If the train composition is changed at a location, this message must be exchanged once more with information updated by the RU responsible. At each point e.g. Origin and Interchange Point, where the responsibility changes on the RU side, the start procedure dialogue between IM and RU "Train ready – Train Running Advice" is obligatory.

Train Running Forecast

This section specifies the messages which must be exchanged during the normal running of a train without any interruption. This information exchange between RUs and IMs always takes place between the IM in charge and the RU, who has booked the path on which the train is actually running. In the case of Open Access, which means that the paths for the complete journey are booked by one RU (this RU also operates the train during the complete journey), all messages are sent to this RU. The same is true, if the paths for the journey are booked by one RU via OSS.

Service Disruption Information

When the RU learns about a service disruption during the train running operation for which it is responsible, it immediately informs the IM (no IT-Message e.g. from the driver) which is in charge to keep the track free. If necessary the RU updates the rolling stock register and / or the Wagon Movement Database. If necessary the IM updates the Infrastructure Register and / or the path, respectively the train database. If the delay exceeds x minutes (This value must be defined in the contract between RU and IM) the IM concerned must send to the RU a train running forecast message relating to the next reporting point. If the train is cancelled, the IM sends a train running interrupted message as specified below. In the cases of exceptions where the RU or the IM is not able to run the train at the forecasted time, a new path.

Train Location

This section specifies the tracing possibility to get information about train location. The RU may send an enquiry to the IM about its trains at any time. The RU may enquire about:

- The running of the train (last recorded location, delays, delay reasons)
- A train's performance (delays, delay reasons, delay locations)
- All identifiers of a specified train
- Train forecast at a specified location
- All train running forecasts for a specified location

The access to this information must be independent from the communication relation RU / IM during the train running, which means that the RU must have a single access address to this information. The information is based mainly on the stored message exchange as mentioned above.

Shipment ETI / ETA

The BP`s: "Path Request", "Train Preparation", ... to "Train Location" have mainly described the communication between the RU and the IM. Since the task of the Infrastructure Manager is the monitoring and control of the trains the key element for this communication is the train identifier. The wagon information part of the train composition message is only relevant for checking the train composition against the IM/RU path-contract and in cases of exceptions. The individual monitoring of wagons or Intermodal units is not covered by this information exchange.

Wagon Movement

For the reporting of the movement of a wagon, the following data must be stored and electronically accessible, They must be also exchanged within message on contractual base to authorised parties. The detailed formats are defined in TSI TAF Annex B.

Interchange Reporting

The Interchange reporting describes the messages attached to the transfer of responsibility for a wagon between two Railway Undertakings, which occurs at interchange points. It also commands the new RU to make an ETI calculation and to follow the process as described in BP "Shipment ETI/ETA". The following messages must be exchanged:

- Wagon interchange notice
- Wagon received at Interchange
- Wagon refused at Interchange

The information data of these messages must be stored in the wagon movement database. In case of any exceptions a new ETI / ETA must be generated and communicated according to the process described in BP „Shipment ETI/ETA".

Data Exchange for Quality Improvement

To be competitive the European Railway Industry must deliver service quality to its customers (see also Annex III, Article 2.7.1 to the Directive 2001/16/EC). A measurement process is an essential post trip process to support quality improvements.In addition to measuring the service delivered to the customer, LRUs, RUs and IMs must measure the quality of the service components that in total make up the product delivered to the customer.To measure quality the already defined messages can be used .

The process involves the IMs and the RUs (especially if they are Lead RUs) selecting an individual quality parameter, a route or location and a measurement period in which actual results are to be measured against predetermined criteria and which normally have been set out in a contract.

The results of the measurement process must clearly show the achievement level against the target which has been agreed upon between the contracting parties.

The measurement reports must be able to access sufficient detail to allow an analysis to indicate the location and apparent cause of reductions in quality e.g. delays. Root cause analysis must then be carried out on repetitive, quality failures, so that corrective action can be determined by the contracting parties.

It is the obligation of an IM and an RU to provide data, participate in root cause analysis, also with third parties, and to implement any corrective action which has been agreed to.

Infrastructure and Rolling Stock Register

In accordance with Article 24(1) of Directive 2001/16/EC, each TSI shall indicate precisely the information that must be included in the Infrastructure and Rolling Stock Registers. The Information that must be included in the infrastructure and Rolling Stock Registers is described in detail in TSI TAF Annex A.

Different Reference Files

For the operation of freight trains on the European network the following reference files must be available and accessible to all Service Providers (IMs, RUs, Logistic providers and Fleet managers). The data must represent the actual status at all times.

- Reference File of the numerical Coding for all IM', RUs, Service provider companies
- Reference File of the numerical Coding for Transport Customers
- Reference File of the Numerical Coding of Locations (Primary, subsidiary and zone-track-spot)
- Reference File of the numerical Coding for customer locations.
- Reference File of all existing train control systems
- Reference File of Hazardous goods, UN and RID numbers
- Reference File of all different locomotive types
- Reference File of all CN and HS codes for goods
- Reference File of the emergency services, correlated to type of hazardous goods
- Reference File of all European maintenance workshops
- Reference File of all European audit bodies
- Reference File of all European accredited operators

Electronic Transmission of Documents

BP "Networking & Communication" presents the communication network to be used for data exchange. This network and the described security handling make it possible for any type of network transmission, such as email, file transfer (ftp, http), etc. The type to choose can then be decided upon by the parties involved in the information exchange, which means, that the electronic transmission of documents, for example, via ftp is given

Networking & Communication

The TSI will see, over time, the growth and interaction of a large and complex telematic rail interoperability community with hundreds of participating actors (RUs, IMs, ...), which will compete and/or co-operate in serving the market's needs.

The Network & Communication infrastructure supporting such rail interoperability community will be based on a common Information Exchange Architecture, known and adopted by all participating actors.

3. EXAMPLES OF IMPLENETATION BP TSI TAF – USING GLOBAL NAVIGATION SATTELITE SYSTEMS – ONCE OVER PROJECT

Works connected with the possibility of using GNSS systems in transport applications are mailny inspired by European Commission and European Space Agency. While observing current state of activities mentioned, you can state that they concentrate on the fields of this sector as follows:

- Train or infrastructrure units control systems: gathering data about the position of vehicles, braking and speed monitoring, and other.
- Information for passengers and carriers – telematic applications,
- Information management systems: management of engine stock and rolling stock fleet, shipment monitoring (TSI TAF – Technical Specyfication for Interoperability – Telematic Application for Freight)

- Optimalisation of energy consumption – vehicles movement control.

The Present – using GPS positioning for applications not connected with safety of rail traffic operation, i.e. trains and wagons monitoring, fleet management, ...

The Future – using the information about position (from GNSS) for realization of functions connected with safety of rail transport operation.

Crucial projects:

1. LOCOLOC / LOCOPROL – is intended to use data only from a couple of satellites to define the train position, positioning with using 3 couples of satellites is considered enough. These satellites guarantee the accuracy of the positioning within 200m, speed measurement is based only on GNSS system,
2. INTEGRAIL – basing on EGNOS and GNSS-1 in order to run vehicles positioning in ERTMS system,
   ECORAIL – using GNSS for the purpose of defining the vehicle position, integration of GPS and odometer indication in order to work out the cryteria for level crossing signalling and sending through the radio the signal of warning,
4. GADEROS – use of GNSS transmitter for realization interoperability and cooperation with on-board system ETCS, use of GNSS application for needs of Signal box or train-regulating signal box,

Polish accents:

5. TRANSLOG LOGCHAIN – SAFETY (cooperating countries: Poland, Germany, Ukraine) – build and development of the system based on GPS technology, destined to monitor freight flow and guaranteeing safety on transcontinental transport corridors, mainly in the transport of dangerous and out-of-gauge load, but also standard materials,
   Project phases:
   Phase 1 – Monitoring of trains and freight wagons in order to get to know the actual state of moving shipment; external data bases provide constant information about transport; reaction for unexpected events is possible thanks to the combination of these both complete sets of information,
   Phase 2 – Adaptation of the satellite communication system IMMARSAT D+ to the integration with GPS system,
   Phase 3 – Adaptation of the cooperation of the satellite communication system GLOBLSTAR with GSM and GPS system; preparation of the monitoring places (points)
   Phase 4 – Reliability study of communication connection and monitoring sensors; design of stand-by modes monitoring systems,
   Phase 5 – Demonstration and testing on a train chosen line with the use of information collected by satellite communication

6. SZPS – IT applications of the operation system of the vehicle units basing on GPS and GPRS technology

Essential system functions:

- Tracking in real time of vehicle units movement and rolling stock on a digital map
- Identyfing all the system users
- Data base of the line section
- Reports and statistics (time tables, running times, working times, real used routes, standstill planning, etc.)
- Access and traffic control,
- Direct two-side audio communication with the vehicles,
- Data transmission to and from the vehicle (text announcements, vehicle data, control and command, etc.)

System elements:

- Train transceiver – communication terminal on the vehicle with module VHF, GSM (GSM-R in the future) and GPS transmitter
- Monitoring centre equipped with IT system – managing and communicating software, data bases,
- Communicating infrastructure – separated APN of GSM system and Internet.

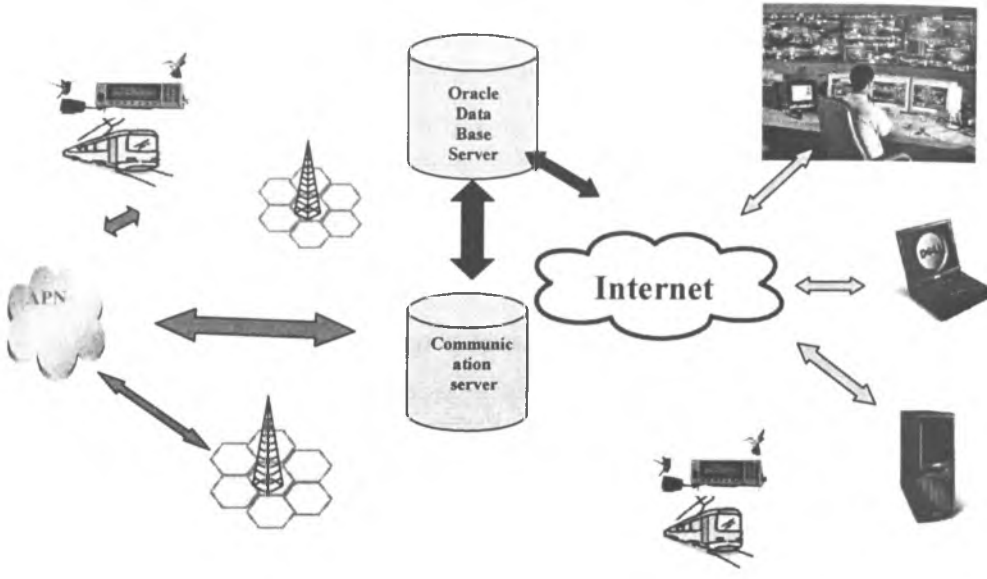

Fig. 2 System structure

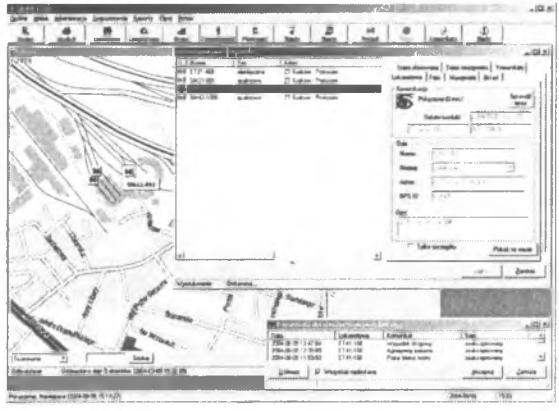

Fig.3. Example picture – locomitiv location on digital map

4. CONCLUSIONS

The TSI for Telematic Applications Subsystem defines the required information, which has to be exchanged between the different partners involved in a transport chain, and permits a standard mandatory data exchange process to be installed.
Application of standard telematic techniques, describe in TSI TAF, – spatial information, supplemented with GNSS applications makes possible obtaining functionality of traffic control system with the demanded level of safety, not worse than currently used in interlocking systems.

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