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interoperability, telematic, applications for railway transport

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THE TECHNICAL SPECIFICATION FOR INTEROPERABILITY RELATING TO THE SUBSYSTEM TELEMATIC APPLICATIONS FOR FREIGHT OF THE TRANS-EUROPEAN CONVENTIONAL RAIL – CURRENT STATUS

The paper deals with brief information about the law regulations due to applying covenants of the 2001/16/EC Directive, executing documents in the field of telematics including Technical Specifications for Interoperability (TSI), and their influence and consequences for managers and operators of the railway infrastructure. The paper describes the current stage of work for the TSU TAF CR Specification (Telematic Applications) with important information such as Basic Parameters and Process Descriptions for telematics included. Also consequences of necessity to adapt systems and applications to the TSI TAF CR standard for the companies of the Polish State Railways Group are described.

SPECYFIKACJE TECHNICZNE DLA INTEROPERACYJNOŚCI PODSYSTEMU APLIKACJI TELEMATYCZNYCH DLA PRZEWOZÓW TRANSEUROPEJSKIEJ SIECI KOLEI KONWENCJONALNYCH – OBECNE STADIUM PRAC

W referacie przedstawione zostały w sposób syntetyczny informacje dotyczące uwarunkowań prawnych związanych z wdrożeniem w życie postanowień Dyrektywy 2001/16/EC, dokumentów wykonawczych w postaci Technicznych Specyfikacji dla Interoperacyjności (TSI) z zakresu telematyki oraz ich wpływ i konsekwencje dla operatorów i zarządców infrastruktury kolejowej.

Referat opisuje aktualny stan prac nad Specyfikacją TSI TAF CR (Aplikacji Telematycznych) oraz kluczowe informacje zawarte w tym dokumencie tj. parametry bazowe (Basic Parameters – BP), opis modelu procesu przewozowego (Process Descriptions) w ujęciu telematyki. W podsumowaniu omówione są konsekwencje dla spółek grupy PKP wynikające z konieczności dostosowania systemów i aplikacji do wymagań TSI TAF CR.

1. INTRODUCTION

The railway transport policy of EU is going to reach one European Railway System. The owners of the interoperable railway infrastructure will allow the compatible passengers and cargo carriers for exploiting the tracks using the interoperable rolling stock.

That made the European Commission to publish many directives and regulations including those about technical specifications and solutions. Applying them in Poland is

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preceded by the current analysis made by the Committee for Interoperability. The most important enactments are Directives 96/48/EC and 2001/16/EC, and Regulations 2001/260/EC, 2002/730/EC, 2002/731/EC, 2002/732/EC, 2002/733/EC, 2002/734/EC and 2002/735/EC that make complement of the Directive 96/48/EC.

Technical documentation supplementing the Directive 2001/48/ECis prepared by European Association for Railway Interoperability (AEIF) and will be published as a decision of European Commission. According to this Directive the Technical Specifications for Interoperability of the trans-European conventional railway system (TSI CR) are going to be prepared for the following subsystems: infrastructure, energy, control, rolling stock, telematics and traffic. These are the first priority TSI.

In October of 2001the works get started. Since the beginning the PKP SA representatives had been working with some of the AEIF groups preparing the TSI CR specifications. In April of 2002 the PKP SA representatives were working under all of the specifications for trans-European conventional railway system. In May of 2002 the Committee for Interoperability was established to coordinate the works of the Polish representatives.

2. TECHNICAL SPECIFICATION FOR INTEROPERABILITY: TELEMATIC APPLICATION FOR FREIGHT

This document is intended for the AEIF for the purposes of developing TSIs within the framework of Directive 2001/16/EC, referred to in the following as "the Directive". It must be used in conjunction with the Directive, the mandates for developing the TSIs provided for in Article 6(1) of the Directive, the guidelines for drafting TSIs (document 01/16-DV05) and the principles governing the relationships between TSIs, standards and other directives (document 96/48-DV37).

2.1. CURRENT STATUS OF WORK

All off TSI workgroups started to work on October 2001. The first kick-off meeting of TSI TAF team was in 11st October 2001 in Brussels.

Basic information about TSI TAF team show below:

- number of meetings - 18, (next meeting will be of Dec. 2003),
- number of members – 44 from 30 different Railway Companies (like Railway Undertaking, Infrastructure Manager, Producer, Transport Organisations,...) from 12 countries,
- status of TSI TAF document – finished – document TSI TAF sent to the EC on 2003 July 31.

2.2. TSI TAF – INTRODUCTION – TECHNICAL AND GEOGRAPHICAL SCOPE

This TSI relates to the Telematic Applications subsystem for freight services which is one of the subsystems of the operational areas listed in Annex II(1b) to Directive 2001/16/EC.

The commercial operation of trains, wagons and intermodal units throughout the Trans-European rail network requires, in particular, excellent compatibility between the characteristics of the infrastructure and those of the rolling stock, as well as efficient

interchange of information and communication systems of the different infrastructure managers, operators and other service providers. Performance levels, safety, quality of service and cost depend upon such compatibility and interchange as does, in particular, the interoperability of the Trans-European conventional rail system.

The technical specifications for interoperability also have an impact on the conditions of use of rail transport by users. In this respect the term users is understood to mean not only infrastructure managers or railway undertakings but also all other service providers such as wagon companies, intermodal operators and even customers.

Last but not least, the benefit of interoperability of the conventional rail system was taken into account to bring about the conditions for greater interoperability between modes of transport, in particular between conventional rail transport and combined rail transport.

The purpose of this TSI is to ensure also that the various transport production factors are 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.

All this means the building or upgrading of the Trans-European Conventional Rail System for conventional rail transport and intermodal transport. The need for such an upgrade of the rail part of the transport system can also be seen by considering the critical points (interfaces between the various partners involved) in freight transport on road compared with the critical points of freight transport on rail for one simplified scenario as shown below.

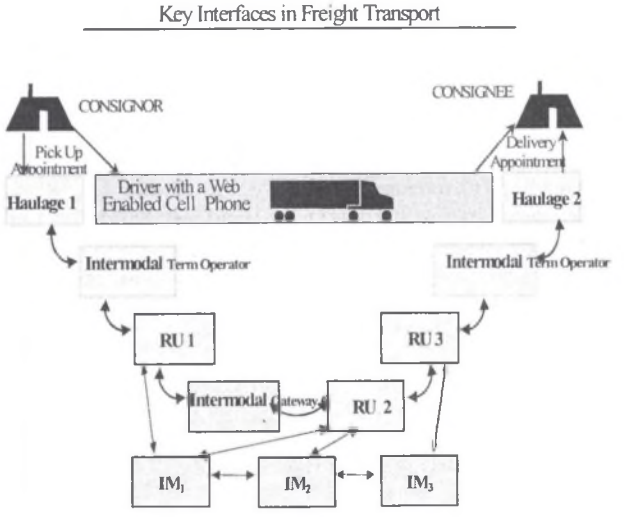

Fig.1. Critical points in Freight Transport

To manage shipments under these conditions by means of information exchange on the basis of the Directives 2001/14/EC and 2001/16/EC is the final goal of this TSI.

This short explanation of the scope of the conventional rail TSI Telematic Applications for Freight also shows the difference to the Conventional Rail TSI Traffic Management and

Operation. The second TSI covers the procedures and related equipment enabling a coherent operation of the different structural subsystems including, in particular, train driving, traffic planning and management, which is the original business of an RU according the definition.

However the TSI Telematic Applications covers not only, but mainly, the applications for freight services and the management of connections with other modes of transport which means that it concentrates on the transport services of an RU in addition to the pure operation of trains.

The geographical scope of TSI TAF is the Trans-European Network as described in Annex I to the Directive 2001/16/EC but this TSI may also be applied to the complete freight transport rail network of the member States of the EU, with the restriction that the requirements of this TSI may not be applied to freight transport arriving from or going to a third country.

2.3. PROCESS DESCRIPTION – BUSINESS MODEL

The most important role for the organisation of the transport is the role of the "Lead RU" (LRU). He has the contract with the customer and is the single point of contact for him. He organises and manages the transport line with the customer commitment (responsible for the Transit time against the commitment to the customer). If more than one Railway Undertakings are involved in the transport chain of a shipment, the LRU is also responsible for the co-ordination of the various Railway Undertakings. The LRU can be a forwarder, a RU involved in the transport or even an entity without involvement.

The communication between LRU and RU's is based on wagon number. Trains normally carry wagons from various LRU's.

The RU's have to provide (through contracts with IM's) the required train path for the LRU and to operate the train within their journey section. For the train path, they may use already booked paths (in planning mode) or they have to request an ad hoc train path from the Infrastructure manager(s) (IM's) relevant for the journey section for which the RU operates the train. The following Fig.2 (point B, D and E as Handover Points between IMs and C and E as Interchange Points between RUs) - shows as an example:

- RU1 has to request a train path A-B from IM1 and B-C from IM2,
- RU2 has to request a train path C-D from IM2 and D-E from IM3,
- RU3 has to request a train path E-F from IM4.

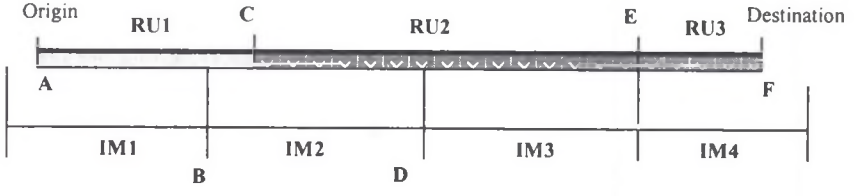

Fig.2. Example for train path request scenario

The communication during the train running between RU and IM is always based on train number, whereas the IM communicate with this RU, who has booked the train path on his infrastructure. This means for the example above:

- For the journey section A-B, IM1 communicates with RU1,
- For the journey section B-C, IM2 communicates with RU1,
- For the journey section C-D, IM2 communicates with RU2,
- For the journey section D-E, IM3 communicates with RU2,
- For the journey section E-F, IM4 communicates with RU3.

This example is the most complicated one. If the RU1 provides the complete journey A – F to LRU (Open Access by RU1), then each IM involved communicates directly with RU1 only. This "open access" by RU1 can be realised by booking the train path via "One Stop Shop" or sectional by each IM directly. The TSI takes account both cases.

For a customer the most important information is always the estimated time of arrival (ETA) for his shipment. From the information exchange between LRU and IM (in case of Open Access) ETA can be calculated. In the case of co-operation mode with various RUs, the ETA and also the estimated times of Interchange (ETIs) can be determined from the message exchange between RUs and IMs and provided to the LRU by the RU's.

2.3.1. BUSINESS MODELS

The RU contacts all involved IMs directly or via the OSS to organise the paths for the complete journey. In this case the RU has also to operate the train on the complete journey according to Article 13 of the Directive 2001/14/EC.

Path booking via OSS by the RU for Transport Journey from A to B.

One RU is booking via OSS the complete path assembly from A to B. The train must be operated by the RU for the complete journey, therefore no Interchange points exist.

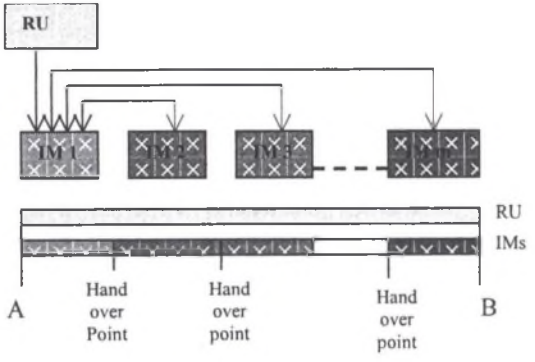

Fig.3. Map 1 RU Path booking via OSS

Direct path booking by the RU for Transport Journey from A to B.

One RU is booking directly from the various IMs the several paths from A to B - section by section - between two Handover points. The train must be operated by the RU for the complete journey, therefore no Interchange points exist.

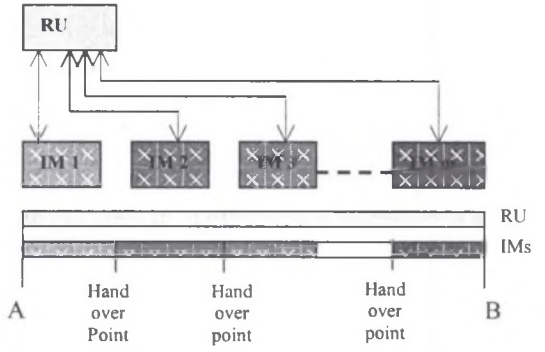

Fig.4. Map 2, RU, IM Path booking

Each RU involved in the Transport Journey from A to B contacts the local IMs directly or via OSS to request a path for the journey section on which it operates the train. Various RUs request from the various IMs or via OSS only the path(s) for a journey section between two Interchange points of the complete journey for the train from A to B. The RUs operate the train on its booked path. In this example RU1 is booking the paths from A to the Interchange Point C directly, whereas RU2 is booking the paths from the Interchange Point C to the nest Interchange Point D via OSS. In this example: RU 1 is the LRU to co-ordinate the involved RUs.

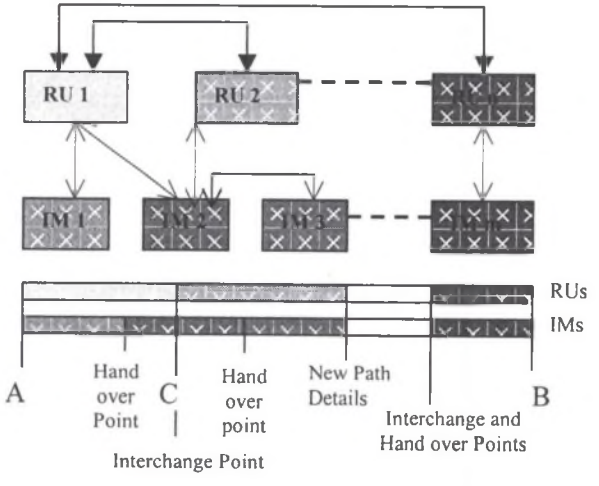

Fig.5. Map 3, RU, IM Path booking

2.4. 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,
- Path Request,
- Train Preparation,
- Train Running Forecast,
- Service Disruption Information,
- Train Location,
- Wagon / Intermodal unit ETI / ETA,
- Wagon Movement,
- Interchange Reporting,
- Data Exchange for Quality Improvement,
- Infrastructure Register,
- Rolling Stock Register,
- Various Reference Files,
- Electronic Transmission of Documents,
- Networking & Communication.

The detailed specifications are outlined below:

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. The relevant messages are:

- Train Running Forecast
- Train Running Advice

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. ESTIMATED COST SHARE PER BP BETWEEN THE 2001/14/EC AND THE 2001/16/EC

	Basic Parameter	Estimated cost share relative to Directive	
		2001/14/EC	2001/16/EC[2]
1	Path Request	75%	25%
2	Train Preparation	25%	75%
3	Train running Forecast	25%	75%
4	Service Disruption Information	50%	50%
5	Train Location	10%	90%
6	Shipment ETI / ETA	0	100%
7	Wagon movement	0	100%
8	Interchange Reporting	0	100%
9	Consignment Note data	0	100%
10	Data exchange for Quality Improvement	0	100%
11	Infrastructure Register	25%	75%
12	Rolling Stock Register	0	100%
13	Various Reference Files	10%	90%
14	Electronic Transmission of documents	0	100%
15	Networking & Communication	25%	75%

[2] This share includes, as cost related to Directive 2001/14/EC, the adaptation cost (for the countries who have already started to implement the Directive 2001/14/EC Requirements) and the cost for the requirements from the TSI.

4. CONSEQUENCES OF APPLYING THE TSI TAF CR REQUIREMENTS

The Telematics subsystem specification defines the databases and interfaces for the information exchange that is needed to provide the unified cargo and passenger services. Applying TSI CR TAF will cause necessity to adapt already existing and used by the PKP group informatics systems to the EU standards. Those systems will make available the unified cargo (first stage of implementation) and passenger (second stage of implementation) services. Monitoring the vehicles and freight also using the intermodal transportation is one of the most important aims of the Telematics subsystem. The TSI CR TA specification in opposite to the TSI CR CC (control) specification does not refer to the defined requirements that allow preparing detailed conception of implementation.

The TSI-Telematics does not need specific clarifications for the physical layer of the informatics network. It only defines base parameters, databases, and standardizes data exchange interfaces. Applying the TSI requirements will cause preparing by the PKP group the individual strategy of implementation. That is going to be complicated because any other specifications and particular resolutions are not included.

That is why there is a necessity to name needs for the physical layer of the existing informatics networks, and according to the TSI defined requirements for data exchange and cooperation between existing applications and other systems. That may cause changing existing databases structures, and preparing new software that affords the TSI requirements for data exchange interfaces. These TSI-Telematics requirements must be covered.

As far as the costs of upgrading the physical layer to the TSI requirements are described, the estimation costs of acquiring the TSI requirements for software and application layer will be possible after the implementation strategy for the PKP group companies is accepted. It is important to name ether the application layer and logical structure of the systems will be created from the beginning or will be modernized using already existing applications. That means that specific applications for the access to the databases classified by the TSI must be named by particular railway managements including PKP group.

This is a consequence of conditions applied by the European Commission that the aim of TSI is not to define the applications but databases and interfaces between those applications.

If the TSI requirements are not applied the attractiveness of the PKP group companies for the cargo and passenger services may go down.

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[2] TSI TAF CR Technical Specification for Interoperability relating to the subsystem Telematic Applications for Freight of the Trans-European Conventional Rail (1.1 version of July 31, 2003).

[3] Directive 2001/16/EC.

[4] Directive 2001/14/EC.

Reviewer: Ph. D. Andrzej Białoń