Possibilities of using RFID technology in railway transport services [#]

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Abstract: Paper deals with the possibility of practical application of RFID technology into operation of rail freight in relation to the important international projects that may impact on successful implementation of electronic data exchange in international freight transport.

1. Introduction

In rail freight transport is in every process of the transport chain necessary to identify every transportation element: train - wagon - consignment. And this trio of information gives us complex information on any part of the transport chain. However, a lot of these information is currently available in some cases only after manually entering by the operator, that´s why information´s quality is questionable.

Implementation of various international IT projects to practice new and more complex information systems and technologies in the field of rail freight should systematically eliminate these deficiencies and thus strategic insight not only increase the quality of information in transport, but also increase overall competitiveness in the field of rail freight.

2. Radio Frequency Identification (RFID)

There are several technologies automatic data collecting and one of them is RFID technology. Compared with barcode technology the RFID technology offers a higher scanning speed and easier application in the automated systems. RFID components and systems most commonly divided:

1. According to the frequency band in which individual RFID components and systems work on:

• low frequency RFID systems operating in the 30   kHz to 500 kHz. They have mainly short-latency and low operating costs,

• high frequency RFID systems operating in the 850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz. They   offer a greater impact than low frequency RFID.

2. According to the type of the identification element to:

• active RFID systems are composed from active RFID elements,

• passive RFID systems are made up of passive RFID elements that do not have built-in power source and receive energy for its activities from the magnetic field of the reader.

3. According to their applications:

• EAS (Electronic Article Surveillance) systems: at present they are probably the most using application of RFID in practice with her encounter almost every day. It is the system that is primarily used to protect traders and shops against theft. Readers are stationary and are located at the exit of the store. When is good purchased, the RFID tag is degraded or deactivated.

• PDC (Portable Data Capture) systems: It is a system for monitoring the movement of goods and people. The specific feature is the using of mobile RFID readers.

• Network systems: These are similar to the previous RFID group in terms of use. However use EAS systems as well as stationary sensors, which scan the identification information from the RFID tags in the movement of goods or people nearby sensor and sent it to the central system.

• Systems for determining position: use RFID to identify the exact position of the object, or the vehicle identification while passing a checkpoint (e.g. toll systems).

3. Possibilities of application RFID technology in rail transport

For implementing RFID technologies are important standards that are directly related to implementation of this technology. Specifically, the Directive 861/2006/ES titled Technical Specification for Interoperability Subsystem rolling stock; range: freight wagons and standard ISO18000-6 (WAG TSI).

The base requirements for each subsystem are safety, reliability and ability to perform its function, health and environmental protection, technical compatibility, vehicle capability to transmit information between ground and vehicle.

If the wagon is equipped with an RFID tag so applies specification:

• two passive tags are located on the sides of the wagon indicated in Figure 1 such a way that reader can read the identification number of the wagon, and the data A1 and A2 are the maximum and minimum heights of centers of the tags above rail. (The minimum height is 500 mm, maximum height is 1100 mm.)

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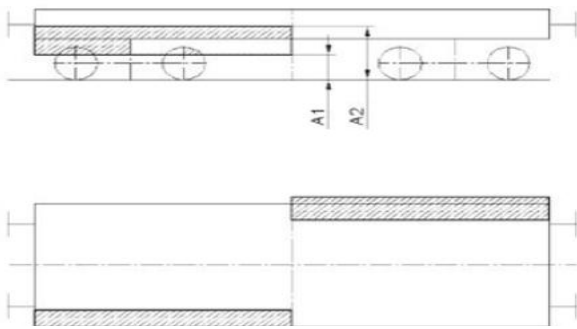** Corresponding Author: Jaroslav.Masek@fpedas.uniza.sk*

Figure 1. Location of the RFID tags on freight wagon (Source: Commission Decision 2006/861/EC)

• if the reader is available at the track, can decode labels at speeds up to 30 km/h and transfer information to a ground system for transmitting data, limitations are shown in Figure 2, where the reader position is defined by a cone,
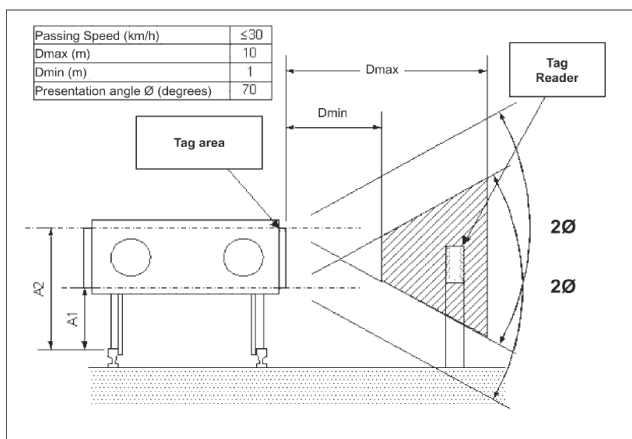

Figure 2. Location of the reader of passive RFID on freight wagon (Source: Commission Decision 2006/861/EC)

• interaction between the reader and the tag, protocols, orders, schemes collision investigation correspond to ISO18000-6 type A,

• readers are located on the entry and exit points where it can change order wagons of the train.

4. Practical application of RFID technology in the conditions of rail freight

The assumptions for the successful fulfilment of the requirements of the use of RFID technology:

• practical use of the electronic consignment list in the international and national transport of goods (the practical use of project ORFEUS),

• practical use of all information systems to support traffic management,

• markings all the wagons by RFID tags, according to the provisions of the TSI TAF in the conventional rail wagons and wagons qualifying for international transport

• the availability and deployment of RFID readers at all necessary places.

The biggest problem is just the wagon labelling by RFID tags. The process must be performed on all conventional rail with the same standards and very importantly, at the same time. If these tags are not installed at the same time, it would be needed the additional marking of wagons on the infrastructure of another country. In this step, it is therefore necessary synergies and resolve international institutions to determine the sequence of labelling all wagons (eg. by revision of the wagon).

Tag will be encoded by information about wagon number or other information as appropriate the owner or operator. With this information, in conjunction with other information systems, would be a wagon or consignment in the wagon uniquely identified during the all transportation processes.

From wagon number according to the database can get basic technical and transport characteristics of the wagon (length over buffers, tare weight, braking weight, height and loading space, capacity, etc..). By using the electronic consignment list is possible the unique identification of the sender, consignee and payer, type of goods, the total weight and other. In the information systems for operational traffic management could be wagon characterized in terms of the processes that can be make with wagon (accepted for carriage, assigned to a specific train, removed from a train, determine the directional track, etc.).

So practical using of these systems can uniquely identify any transportation element: train - wagon - consignment.
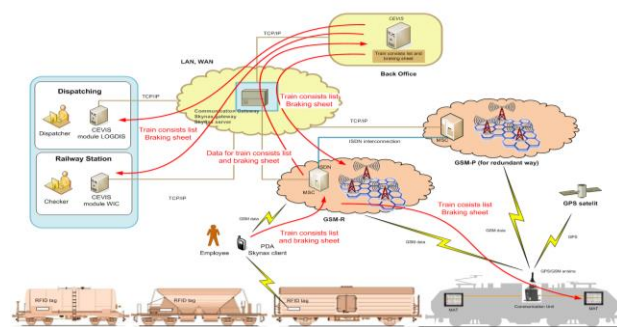

Figure 3. Up-to-data collection by RFID technology for preparing train consists list [4]

According deployment of the readers we can consider on two basic types - stationary readers and mobile readers. Mobile devices could be practically used mainly for pick-up goods trains where each intermediate station would make changes in the composition of the train and train documentation (couple and decouple the wagons). Already existing mobile devices for data collection, which uses cargo carriers, are pre-prepared for this possibility of data collection. It just has to be supplement by the reader of RFID tags module. Stationary readers should be installed at border crossing stations and in marshalling (or formatting) stations (separately before the reception tracks group, the hump and the departure tracks group).

5. Impact of RFID technology on technological processes in railway transport

The implementation of RFID technology into practice will result in a simplification of technological activities both in border crossing stations, marshalling yards, but also in individual small intermediate station and railway sidings. It also finds application in the administration of consignment and delivery wagon load.

One of the projects for research and support for RFID application in the railway sector was the project LOGI-GATE - RFID Reader Gate for Railway Rolling Stock, Road Vehicles and Storage Mechanisms. The project has been solved from March 2010 to January 2014, the head of research team was company OLTIS Group, Olomouc (CZ) and one of the partners was the University of Žilina. The basic objective of the project was to create an integrated system of collecting and processing information from wagons and logistic units on transport networks, or logistics

centres and warehouses, production and installation of a prototype system and test all components in the laboratory and in the fully operating conditions.

Another goal of the project is to develop software for the collection and processing of information retrieved from RFID tags. The project was completed successfully and reached certain goals. There was developed the special tag for railway wagons, reader (gate) and software for data processing. Connection between wagon (tags) and gates was testing up to speed the 200km/h very successfully.
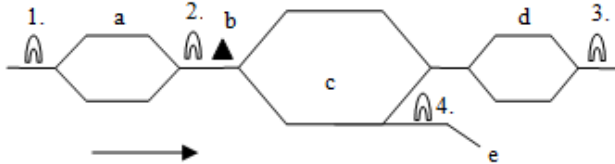
a - reception tracks, b – hump, c - sorting track, d - departure tracks, e - siding track, 1- 4 positions of RFID gates

Figure 4. Position of RFID gates in marshalling yard

The most significant time savings (cost saving) can be expected mainly in marshalling yards, where activities related to the control of the accompanying documents, activities for preparing shunting list and processes for preparing train consists list needs considerable amount of time demands. Preliminary shunting list would be automatically generated during the arrival of a train at the station just over stationary reading device placed in front of the reception tracks group.

Collected data (position gate 1 - Figure 4) should only be compared with the data in the electronic consignment list. In cooperation with hump system other stationary reader should identify overrun wagon and automatically manage the sorting of wagons (position of gate 2 - Figure 4). According to possibilities of the hump safety device could also use this information for control of filling in each sorting tracks of the session.

In relation with activities in the originating train could not make train consists list manually, but would be generated automatically through the latest stationary reader located in the departure group (position gate 3 - Figure 4) of tracks in all directions and then distributed to all the necessary information systems.

Figure 5. Inside of reader RFID gate [4]

All these automated activities would result in massive time

savings, personal cost saving and also reduce the possibility of making errors in collecting and transmitting data by the human factor.

Figure 6. Position of RFID gate on railway track [4]

6. Conclusion

Implementation of new technologies into practice is an irreversible process in all sectors, so railway transport cannot be an exception. Only for short introduced the possibility of using technology for automated data collection and processing, development and testing new RFID technology for railways and expected technology changes these ideas just confirmed. RFID technology is flexible, cost saving and brings benefits for carriers and their customers.

Functional interconnections are necessary and desirable for future accelerating and improving the quality (especially the quality of information) of the all rail freight services sector. Existing benefits of RFID technology in response to the international exchange of information therefore the competent national and international institutions need to consider these facts and quantify them at all levels and then introduced them into daily practice in rail freight services.

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