

## The use of the RFID in rail freight transport in the world as one of the new technologies of identification and communication

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*Article discusses the possibility of using technological advances of today in rail freight transport, with an emphasis on automatic identification systems and communications. Due to the need of finding an element that is sufficiently resistant to the rigors of the railways and flexible enough to replace the current system of rail freight was selected application the RFID technology. Purpose of selecting the technology was particularly the ability to automatically identify trucks, simplified registration and co-operation with the management information system of railways, the visibility of shipments in real time, and many other features that ensure data integrity, lower error rates in the process of record of the consignments, eliminating time-consuming documentation, etc.*

**Key words:** raw materials, RFID technology, application, rail freight transport

### Introduction

The issue of RFID applications in rail freight transport is justified not only because of the current situation in which there are railways in Slovakia but also in terms of competitiveness compared with other type of freight. Barcodes has been providing, and in many countries still provide tracking of the railways fleet. No unreadable codes in the polluted environment, in rain, snow, fog, on the greasy surface or non-metallic objects, and of course the ability to scan bar codes in direct sunlight, forced to act, first, the American railroads. The implementation of the RFID was the solution to the challenges and also brings benefits in the form of long-range shooting.

### RFID – Radio Frequency Technology

RFID (Radio Frequency Identification) RFID is a technology providing automatic, contactless identification of objects using radio waves. RFID system is often compared to the barcode identification system, which does not provide benefits far radio frequency identification, but nevertheless true that the cost of producing the bar code is still the lowest. Insufficient address space, UPC (Universal Product Code) bar codes, the need for manual scanning, a problem with the readability of dirty or damaged code, etc., are just some of the negatives, which started the development of identification technologies, such as the RFID[1].

### RFID in rail freight transport

Considering the fact, that the Slovak Republic is not using RFID system at the moment, this chapter will be devoted principally to the world pioneer in the implementation of RFID, but also two other U.S. states have implemented technology, or are in the testing phase (tab. 1) [2].

To ensure that complete information was provided of RFID technology for railways, issue has been consulted with experts, representatives of railway companies and manufacturers providing RFID solutions for specific railroad in the world (G. Blocker, J. Danyluk, representatives Transcore American company, world leader in RFID technology intended for transportation, S. Baiker, project manager for RFID solutions to the Swiss railway company SBB Cargo in Basel, M. Staffen Product Manager-profit organization GS1 [3], etc.).





























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Tab. 1. An overview of countries that have applied RFID in rail freight transport.

Representative Installations		City	Country
<b>AFRICA</b>			
Botswana Railways		Mahalapye	Botswana
Mauritania Railway		Zouerate	Mauritania
TransNet Rail		Johannesburg	South Africa
<b>ASIA</b>			
Ministry of Railways		Beijing, Chengdu	China
Ministry of Railways		Hangzhou, Shanghai	China
Ministry of Railways		Shenyang, Tiancheng	China
Ministry of Railways		Tianjin, Xi'an	China
KCRC		Hong Kong	Hong Kong
MTR Corporation		Hong Kong	Hong Kong
Penny's Bay		Hong Kong	Hong Kong
Ministry of Railways		Bhubaneswar, Delhi	India
Ministry of Railways		Gandhinagar, Mumbai	India
Ministry of Railways		Visakhapatnam	India
Shikoku Railway Company		Tokyo, Hiroshima, Nagasaki	Japan
Teito Rapid Transit Authority		Tokyo, Hiroshima, Nagasaki	Japan
Sin Bundang Line		Seoul, Incheon, Bussan	South Korea
<b>AUSTRALIA</b>			
Pacific National Rail		Sydney, Melbourne	Australia
Pacific National Rail		Adelaide, Brisbane, Perth	Australia
Queensland Railway		Brisbane	Australia
BHP Billiton		Port Hedland	Australia
Rail Corp		Sydney	Australia
<b>EUROPE</b>			
KLD		Vienna	Austria
Krems Chemie		Vienna	Austria
Vienna Transport		Vienna	Austria
Brussels Metro		Brussels	Belgium
Compagnie Nouvelle de Conteneurs		Paris	France
Norsider		Paris	France
SCAC Delmas Vieljeux		Paris	France

Source: adapted by [4]

## U.S.

Over fifty years ago the North American railway company began to look for an automatic identification system for railway vehicles. First attempt was a visual identification system, which did not work, because of colour-coded labels losing quality and functionality due to the pollution. Burlington Northern, the first railroad in North America, started testing radio technology based on the interest and successful implementations in shipping companies. [5]

In 1988 a study reported on a six-month test system achieved 99.99 % accuracy. Given the excellent results asked the Association of American Railroads - AAR (The Association of American Railroads) a development standard, automatic identification of assets for the railway industry in North America (railway wagons, locomotives, chassis, containers, etc.) with a team that will build on the existing concept ISO standards for the identification of containers. AAR, which require labeling of all cars and locomotives RFID tags, in 1989, chose the contractor for the identification system by Amtech - Transcore [5].

Transcore installed its equipment to 25 countries in the number of about 8.4 million tags and 28,500 readers in the rail and intermodal transport, which are placed at strategic locations such as cars, parking space trains, gates, site maintenance and so on. Transport companies have the ability to track serial numbers of coaches, their owners, type of wagon, number of axles and other physical characteristics, whose source is the inventory database AAR, or other tag information stored in a cargo of departure or destination, resulting from our database railways[6].

Passive RFID tags are placed on both sides of the coach and reading devices in the vicinity of the railway line (Fig. 1). The system communicates in a high frequency of 902 to 922 MHz and can read tags within about two meters, at speeds of up to a maximum isotropic force 128 km/h reader – 1 W.

According to information received from John Danyluk (manager Transcore), the item tracking GPS technology (in cooperation with RFID) occurs rarely. Satellite communication is used only for monitoring of locomotives and rail cars with high level costs. [4, 7, 8].



*Source: adapted by [8].*

*Fig. 1. RFID reading device near the rails in the U.S. [8].*

### **South Africa**

Although Africa automatic identification system in some car fleets introduced a few years ago, but the incorrect choice resulted in problems with the power source tag, crossing sensing and interference caused by congestion of the railway environment. The solution was changing technologies. By using passive UHF tags transmitting in the frequency range 915 MHz reached shooting distance 1.5 to 3 meters without unwanted interference and crossed near the capture tag scanning device. Provider of rail freight company Spoornet (now Transnet Rail), which represents a network of railways more than 23 000 km, has equipped its fleet by means of automatic identification. In 2007, passive RFID tags identified approximately 80,000 wagons. [2, 8]

### **Australia**

Eleven networks of automatic identification equipment to the Australian Rail consist of wheel detectors, used for the classification of locomotives and wagons, and Transcore RFID system to uniquely identify them. The process formation of trains processed data from wheel sensors that carry information about the type of coach and advise the fleet. Following association with RFID identifiers. These data are collected in formation of trains file that is created for each train set and sent to Pacific National's Train Management System (TMS) in Parramatta. The control system based on a set formation of trains verifies the data along the rail terminal, where the railway train stood.[7]

### **China**

RFID in China in addition to rail transport also met with support in several sectors including urban transport, national defense, in pursuit of dangerous goods, new possibilities of applications have emerged in the mining industry (coal), the processing of tobacco, production of electricity and its distribution, management food safety, etc.

Income of Chinese railways is more than \$ 40 million (28 million) annually on goods and passenger transport, which clearly gives the modernization of the area.

Automatic train identification system includes 17,000 RFID readers and passive tags 565 000 to enable automatic data acquisition, monitoring trains in real time for the administration of property, provide traffic information and information for travelers, as well as data relevant to the operation and maintenance. Using

RFID and other advanced technologies, system identifies the train number, status, position, speed and determination, which is a key role in monitoring and evaluating critical situations.

China's Railway systems are currently working on improving security in cooperation with Tagmaster, who is one of the leading manufacturers of RFID technology. Security system installed on the dashboard will alert the locomotive cab for speeding and specification of work on the track. In the second half of 2011 should be equipped with heavy-duty RFID tags (tags designed for tough conditions), and readers, together with specially developed components forming instrument RFID security system, the entire fleet of Chinese railways. [2, 5, 8]

### Europe

According to Greg, Blocker and vice-president for international Transcore area, the reasons why European countries do not reach the level of application of RFID in rail freight transport to the extent such as U.S., China, Australia or South Africa may be more. Frequency of exchanging the wagons between the countries has been limited, due to the lack of regulatory standards and development of RFID in the railroad industry and the size of the railway network from freight rail's point of view. With the emergence of standards ISO18000 6C has been a step forward, but not nearly in such a scale as in the U.S., China, South Africa and Australia. [8]

### Sweden

Swedish railways are currently testing RFID technology for wagons of freight trains with the ultimate goal - to develop a standard for identifying cars and thus contribute to the traceability of goods throughout Europe. 60 to 70% of railway carriages Iron Ore Line is coming from other European countries.

The solution uses RFID Projects such as:

- postal wagons between Stockholm and Gothenburg, with the ability to capture passive tag with a success rate of up to 160 km/h, has so far identified nine mail wagons UHF Gen 2 Class 1 tags,
- more than 1000 Iron Ore Line wagons has been marked with an active RFID tag by Amtech Transcore company,
- in cooperation with SSAB (Swedish iron company), which is using an active system for steel plates carrying wagons,
- just reading and gathering tested the SCA carrying rolls of paper factories in Munksunde wagons bearing semi-active tags - 240 cars were marked with RFID components Tagmaster company.[9]

### Switzerland

Located in the forefront of research dealing with RFID technology in Europe. Evidenced by the number of pilot projects, such as [10]:

- EasyRide (2000) - Electronic tickets: pilot landed successfully, but implementation is planned until 2017,
- SBB-CFF-FFS (Schweizerische Bundesbahnen - the German name for Swiss Federal Railways), the pilot project applied passive RFID identification and control of wheel sets, because of problems with the identification itself and difficult maintenance conditions.
- A subsidiary of SBB Cargo, also conducted tests of HF and UHF passive tags about a year ago (2010), but because of problems with interference (water, snow) decided to HF system. According to S. Baiker, the result of the experiment is capability.
- Identification of up to 220 km/h.
- Swiss Federal Railways (SBB) and the Rhaetian Railway (RhB) - Swiss transport company, which owns the largest network of all the private railways in Switzerland, has tested automatic identification of locomotives, using GPS and GSM-R, and wagons in the form of durable active RFID tags and readers certified for railways. Communication takes place at speeds of 160 km/h. [11, 12].

### Czech Republic

Czech Dense company ArcelorMittal Ostrava, whose manufacturing activity is focused on raw iron and steel processing, is transporting most of its production by rail [13]. At the ArcelorMittal Ostrava's request, a fully automatic weighting system for weighting and identification of the track assemblies using

RFID technology has been developed in cooperation with Tamtron company, manufacturer of rolling scale systems (Fig. 2). [14].

Automated digital system ensures smooth running of the process of weighing cars and the consequent transfer of data into the information system without additional handling, manual recording, entering information and creating additional documentation. Information on the weight of the wagon, its type, serial number and set in its instantaneous speed of weighing is stored in the weight management system for further processing.

Very important information to complement the data were weighted to identify the car. For this reason, Barco Company has been selected, specializing in integrating RFID technology into enterprise information systems. With RFID technology system currently weighted wagon to assign a unique identification number and the data transferred to the weighing system. Installing the weighing system was conducted in December 2007.[14]



Source: adapted by [4].

Fig. 2. Two bridge weighing system for weighing 6-8 axle trailers.

### Germany

Hochbahn, the network operator of public transport in Hamburg, follows the movement of trains through RFID readers installed on sleepers and semi-passive tags mounted on the bottom of each wagon. When train is passing by the drive (Fig. 3), data are being collected and being sent to the dispatching system and inform the operator of the train that passed the reading device, at what time and what direction to move at a specific period of time. [15]

The German company DB Schenker uses RFID to monitor the heat-sensitive costs in carriages. Such goods (drugs f.e.), need to be maintained at a constant temperature. Active RFID tag with integrated temperature sensor provides important information about the status of the product. If the temperature falls or rises beyond this limit, the carrier is aware of this fact. [15]



Source: adapted by [15].

Fig. 3. The reader (TagMaster) installed on railway sleepers.

## Finland

According to recent information, the state railway operator VR Group, a subsidiary of VR Transpoint, implemented RFID EPC Gen2 tags generation of 10,000 railway wagons, locomotives and passenger cars. The aim is to increase the efficiency of processes in the fleet, improve the level of asset management, and improve compliance with orders and customer service. Tags are mounted on both sides of the vehicle (Fig.4), according to data encoded in a tag can determine its movement, namely or come or go to the depot. [8]



Source: adapted by [8].

Fig. 4. Employee Group VR when shooting hand-held tag reader.

## Conclusion

The application of RFID technology in terms of railway is one of the tools that improve the quality of transport services and the ability to apply to the transport market. Integration of RFID can provide many benefits for both carriers, but also for the customer.

Prospects for RFID deployment hinder us, except financial situation, the lack of a European standard for global deployment of all railways in Europe. The question is what impact will also have developed processes to train electronic bill and its implementation in terms of rail in terms of complexity of information systems, data integrity and information security.



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