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Security modules and CPU in intelligent passenger information system

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ABSTRACT
This article presents selected components of the prototype of the Integrated System of Supporting Information Management in Passenger Traffic (the polish acronym of the system is ZSIKRP Demonstrator+). The system is equipped with significantly expanded range of offered functionality, which corresponds to the current demands of the market. Additionally, it has features distinguishing it from other products available on the market. Prototypes of the system are built in two versions: for electric (EMU - type) and diesel (PCS - type) vehicles. They will be installed in demonstration scale in real conditions in Mazovia Railways and Regional Transport. ZSIKRP system also focuses on ensuring the safety of travelers in both types of vehicles. It is done by installation of the fire alarm module in vehicles. Thanks to this it will be possible to transfer information about possible emergency situation to Supervision Center. The system also improves passenger comfort by wireless modules for Internet and Intranet access using "leaky cable" technology.

Keywords: safety in passenger railway traffic, CPU, wireless access to Internet and Intranet module, fire alarm module

1. Introduction

Poland, in terms of safety in rail transport, takes the last place in Europe. The overall level of safety in rail traffic (defined as accidents indicator) is worse only in Romania, while heavy accident indicator in Poland is the worst in Europe [1]. Data from the European Railway Agency shows that one in five fatalities in the European Union (EU) railway transport occur in Poland, where the Polish population is only one-thirteenth of the EU population.

Sources of rail events such as train collision, derailment of trains or fires are mainly due to failures in technical infrastructure, inefficiency procedures or events following from human factor. In all cases both the railway company and the infrastructure manager are responsible [2].

Noted above facts justified to work on a system which helps to reduce the negative effects of railway events.

At the same time actions to improve the comfort of passengers and operators were taken. PKP Polish Railway Lines from December 2013 introduced voice and visual passenger information at railway stations, stations and rail stops. Employees of UTK (Office for Railway Transport) conducted inspections in January 2014 years and detected malfunctions in Dynamic Passenger Information System. There were detected over 200 deficiencies.

Regional Transport tends to equip with the electronic directional boards the largest possible number of trains. Modern rail buses and electric trains are equipped with voice announcement systems directly at the factory but older vehicles are not. To improve comfort of the greatest number of passengers, the management of Regional Transport has decided to allocate greater means than usual for the modernization of the rolling stock. Funds will be spent mainly on the installation of modern passenger information systems in approx. 800 electrical trains [3].

There are very few trains equipped with an integrated system. Currently implemented modern types of rail vehicles have

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automatic counting rating systems (lubuskie province), equipment allowing free use of Wi-Fi internet (zachodniopomorskie province) passenger information systems as a speaker and light direction boards, monitoring, internet access (podkarpackie province) installed onboard. Low emissions exhaust characterized by railcars implemented in the Pomeranian province and the Lublin region. However, there is a solution that would completely meet the needs of carriers and manufacturers, and will modernize the rolling stock.

The integrated system in the proposed form integrates security modules that allow better management of the crisis, such as e.g. fire in the vehicle. In the case of crisis situation integrated modules, e.g. fire alarm (that has ability to detect toxic gases) and passenger information modules will allow automatic notification of the passengers using voice announcements and visual prompts. Additionally, the Supervision Center will be notified about the situation along with information about the nature of the danger . Integration of above modules with the central unit module, installed on the vehicle, with the fire alarm module will be done using the CAN bus (Fig. 3).

Introduction for future use of the integrated system implemented under the Project ZSIKRP ([6], [7]) will be of great importance for the comfort and safety of traveling and will raise the technical level and reduce maintenance costs of rail vehicles.

2. The concept of Central Unit module in ZSIKRP system

Central unit module manages the other modules on the vehicle, allows, inter alia, broadcast current passenger information, GPS location on a digital map, GSM data transmission, counting passenger flows, monitoring timetable by the driver, login driver to the system, collision detection and threats, fire detection, vehicle diagnostics, monitoring fuel consumption.

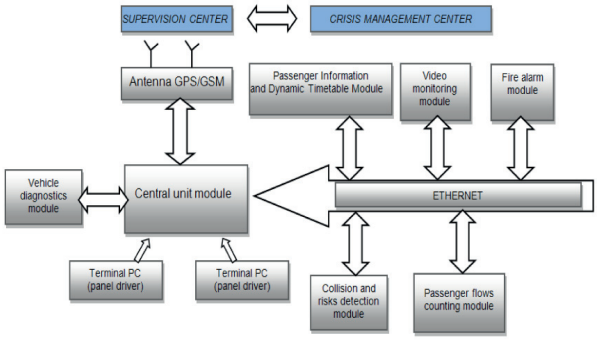

Fig.1. Integration of modules in an integrated system [own study]

Communications between subsystems is carried out using a wired Ethernet network. To communication between the central unit in the vehicle and the Supervision Center [8], [9], [10], [11] GSM network is used - Fig. 1. The Central Unit Module includes:

- the main control computer contains: GPS location module, a module of the road, GSM communication module,
- a computer with a DVD drive and a USB interface to control advertising subsystem,
- the power supply and battery backup,
- the I / O - input and output logic and digital interfaces, interfaces to communicate with the subsystems (Ethernet, CAN, USB, RS232, RS485, VoIP),
- stationary collision and threats detection module.

The following is a visualization model of the central unit module (Fig.2).

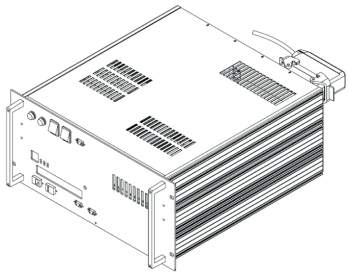

Fig. 2. Central unit module (The application number of the utility design: W.123475 of 14/10/2014, title: „The design of the Central unit module to support information management about passenger rail" [own study]

Central Unit module is based on device enabling data transmission in-band UMTS / HSDPA, GSM / GPRS. Sophisticated system interfaces, such as RS232, RS485, USB, CAN, Ethernet 10/100 MB / s allow integrating with: collision and threats detection modules and fire alarm module, as well as other modules, such as the optimization fuel consumption.

Central unit module [13] manages the rest of the system, including transmitting current passenger information, GPS location on a digital map, GSM data transmission, counting passenger flows, the preview of timetables by the driver, login in the system by driver. Communication between the individual modules is realized using a wired Ethernet network. Central unit module includes a computer with a DVD drive and a USB interface to the controller of advertising system and power supply and battery backup. Additionally, the module has an input and output interfaces, and digital logic and interfaces for communicating with other modules.

3. The concept of fire alarm module

Fire alarm module should enable the automatic monitoring of the passenger compartment of the vehicle and activate in the event of smoke or flame. The appearance of any parameter of the occurrence of hazards alarm activation have to provide information to service of train, notify passengers, etc. Also will be running the procedures related to the safety of passengers.

The system consist of controller of fire alarm, smoke detectors and heat detectors and hubs in the release of the cartridge. The system is physically connected to the Central unit module via the CAN network. Physically terminal of the fire alarm module is connected to the Central unit module via the converter Modbus

/ TCP. Data from the CAN bus are transmitted via Ethernet. In design the module in vehicles should take note of the PN-EN 45545 [4], [5] including fire protection issues in rail vehicles in terms of the General Conditions and fire protection systems.

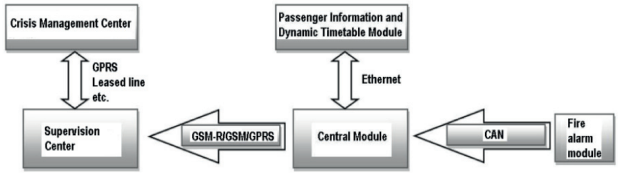

Fig.3. A block diagram of the Central unit module to connect the fire alarm module [own study]

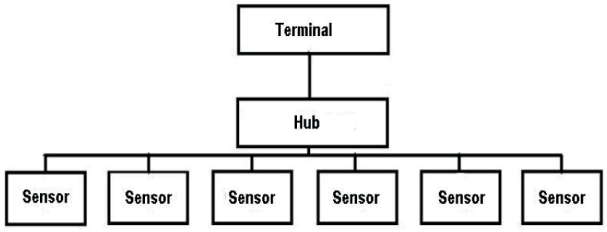

Fig. 4. The internal structure of the fire alarm system in the vehicle [own study]

The control panel installed in the cab generates audio and visual information about the activation of the detector, indicating that the detector reported threat by displaying its number.

The control unit in the basic mode works with smoke and heat sensors, distributed throughout the vehicle. The sensors should detect smoke in the initial stage of a fire originating from combustion eg. plastic, fabric, etc. The control unit is equipped with its own backup power source. The module must be able to send information to the module Supervision Center about fire alarms (ultimately the information can be send to existent dispatch systems – Supervision Support System (SWD), Fig. 5). Information can be sent in the form of a photo "screenshot" of the affected area, and may be generation of voice messages to inform passengers about the threat and how to proceed.

The module is used the differential heat sensor (Fig. 4) designed to detect the risk of fire in areas where the first stage of a fire can be expected to excessive or very rapid temperature rise, and where, because of the prevailing conditions, it is not possible to use smoke detectors.

In addition will be used processor, optical-temperature sensor to detect smoke and temperature rise associated with the formation of a fire in the early stages of its development. Built-in two detectors: smoke and heat, allow the use of detectors in rooms where in the case of fire, smoke may appear or occur rise in temperature or both factors simultaneously.

The detector of this type is useful for detecting all types of fires. In addition, the detectors are equipped with internal short-circuit isolators. The detectors guarantee provide an additional optical signaling by attaching the flag indicator.

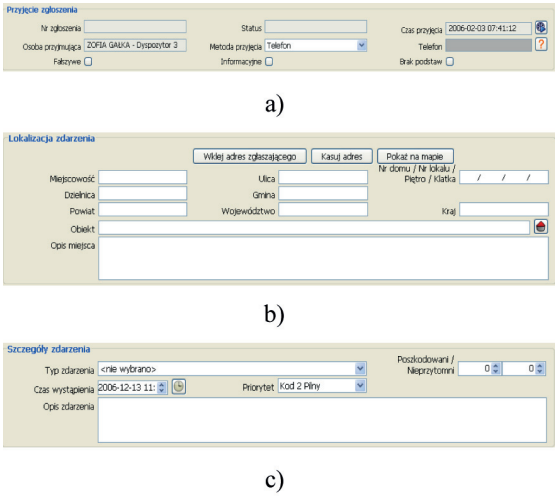

Fig. 5. The form of notification in the system SWD (existent dispatch systems - Supervision Support System) in informatic system Crisis Management Center a) Receive of the notification b) Location of event c) Event details [own study]

4. The concept of wireless access to the Internet and Intranet

Module to Internet and Intranet access is designed to be installed in rail vehicles and is used to transmit radio signals in LTE, UMTS and GSM. The module is implemented on the basis of the device operating in the band Wi-Fi 2.4 GHz and 5 GHz. The single vehicle includes one access device that provides Internet and Intranet over Wi-Fi. Instead many Wi-Fi antennas, leaky cable is used for optimum performance, providing radio coverage for a long vehicle space. The block diagram of the access to the Internet and intranet illustrated in Fig. 6.

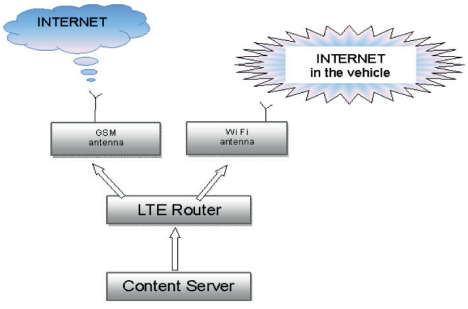

Fig.6. The block diagram of the access to the Internet and Intranet [own study]

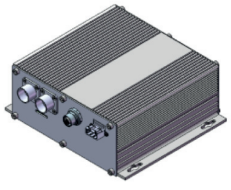

Fig. 7. Visualization of the chassis the Internet and Intranet access module (LTE Router) [own study]

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Installation and access to service Internet and Intranet (Fig. 7) is designed to increase the comfort of passengers. Time spent in travel, passengers will be able to use for work or entertainment. To achieve access to the Internet and Intranet technologies will be used technologies: Wi-Fi, 3G, LTE. Equipping train in internal wireless InterMedia (Intranet) network will provide all kinds of travelers, periodically updated content such as movies, music, magazines, etc.

Leaky cable technology ensures uniform signal coverage throughout the train without the need for additional antennas (Fig. 8). The parameters of the proposed solutions allow you to define it as radio All-IP network. This means possibility to use wireless services supported under this protocol, and thus fully customizable access to the transmission medium of all devices operating on the basis of standard Wi-Fi (laptops, cell phones), the ability to transmit video, the possibility of voice communication basing on VoIP technology.

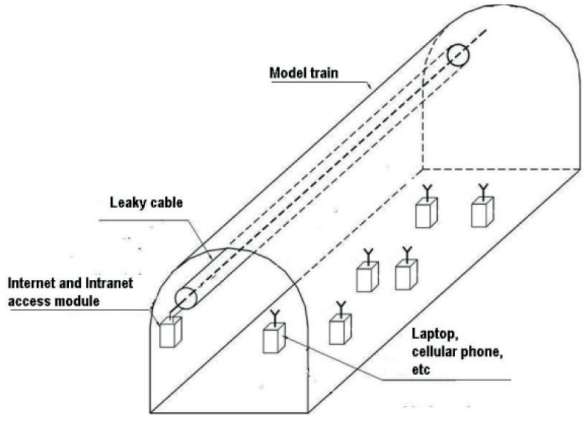

Fig.8. Train installation diagram [own study]

The module access to the Internet and Intranet for one vehicle includes one device allows access to WiFi-Internet – Intranet operating in LTE, one internal antenna in the form of a leaky cable on one band Wi-Fi and GSM antenna mounted on the roof of the vehicle.

5. Conclusion

Society in Poland is the information society, in which an important role plays access to information (Internet). Therefore of particular importance is carriers offer in which a prototype of the Integrated System ZSIPKRP (Mazovia Railways and Regional Transport) will be offered. Observed a temporary increase in passenger traffic during the month of October (for the last few years), is due back from the holidays and the start of the academic year.

Travel time can then be related to the time to study or additional work with free, easy access to the Internet. Therefore, it is reasonable to providing access to the Internet (Fig. 6), realized with the use of "leaky cable" technology. Additional access to the Intranet can familiarize the passenger with the passenger transport offer. It should be more competitive. In two prototype systems will be installed in a vehicle the content server.

Simultaneously exist a need for modernization of rolling stock taking into account the safety aspect travelers. Despite made modernization the part of the machine park, trains still don't fully meet the expectations of passengers in terms of ride comfort.

It should be noted that the EC Regulation No 1371/2007 covers issues obligation to care for the personal security of passengers and provide information to people with disabilities. It should be noted that the institution UTK-to-date take actions aimed at directly and indirectly to improve the safety and quality of services provided by the carrier transport services [12].

Acknowledgments

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The right of protection *for a utility design, under the application No. W.123475 date 14.10.2014 by Polish Patent Office was granted on the device* presented in Fig.2.

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