

TELEMATIC SECURITY SYSTEM FOR CASH TRANSPORT VEHICLE

**Tomasz Kamiński, Mikołaj Kruszewski
Michał Niezgoda, Joanna Gacparska-Stolek**

*Motor Transport Institute, Transport Telematics and Management Center
Jagiellonska Street 80, 03-301 Warsaw, Poland
tel.: +48 22 8113231, fax: +48 22 8113231
e-mail: tomasz.kaminski@its.waw.pl, mikolaj.kruszewski@its.waw.pl,
michal.niezgoda@its.waw.pl, joanna.gacparska@its.waw.pl*

Rafał Grzeszczyk

*Automex Sp. z o.o.
Marynarki Polskiej Street 55d, 80-557 Gdańsk, Poland
tel.: +48 58 5220620, fax: +48 58 5220621
e-mail: rafalg@automex.pl*

Abstract

Paper describes security system mounted in the cash transport vehicle that was developed in "Pancermet" project. Consortium consists in addition to the Motor Transport Institute, another nine entities which represent science, vehicle producers and military. The system fulfils the new legal requirements in this area, and consists of the inside/outside video monitoring module and selective door locking mechanism. Every device was designed in accordance with safety and security principles. The video monitoring module includes four video cameras, audio-video recorder and smoke detector. Selective door lock module cooperates with on-board CAN network that allows selective doors locking with usage of the dedicated touch panel installed on the vehicle's dashboard. The module continually monitors the CAN network which allows also to gain information about opening and closing of every door and status of the lock. Information at touch panel screen, is continuously refreshed, allowing keeping control over all doors, for driver and transporting manager. Article describes also general description about communication with door locks in CAN network and problems encountered during modules development and their solutions. In article there were presented used devices which allows preparing the system for cash transport vehicle.

Keywords: *transport, road transport, simulation, combustion engines, air pollution, environmental protection*

1. Introduction

In Poland the transport of cash values is regulated by regulation of Minister of Interior Affairs and Administration. From 7th September regarding claims, that should be subject the exchange of money stored and transported by employers and other organizational units. According to this disposition the financial values above so called 1 computational unit (one computational unit reconciles 120 multiplicity of average reward in former quarter) is transported by cash transport vehicle (§ 6.1) except the situation, when there is no capability to approach with the vehicle to the bank place, where the financial value are collected or supply (§ 6.2). Cash-in-transit vehicles are the car vehicles assign for transport cash values, signed depending on construction and technical security as type : A, B and C (§ 1 pkt. 15).

The technical claims for cash transport vehicles are described in enclosures for disposition:

- Number 3 – technical claims for cash transport vehicle type A,
- Number 4 – technical claims for cash transport vehicle type B,
- Number 5 – technical claims for cash transport vehicle type C.

According to disposition to transport the financial value:

- below 8 computational units can be used the cash transport vehicle type C (§ 7.2 and § 7.3),
- between 8 to 24 computational units should be used the cash transport vehicle type A or B,
- over 24 computational units should be used the cash transport vehicle type A (§ 7.1).

The transport of financial values should be protected at least by:

- one member of escort – by transporting the financial value over 1 to 8 computational units, with reservation § 7 point 2,
- two members of escort – by transporting the financial value over 8 to 24 computational units,
- three members of escort – by transporting the financial value between 24-50 computational units,
- four members of escort – by transporting the financial value over 50 computational units.

The next part of the article describes effects of realization of the research-development project, within confines which was processed the telematic security system for the vehicle used in cash transportation.

2. General claims for installation to secure the cash transport vehicle and its equipment

The electric and electronic device installed in vehicle should grant claims of directive of council no 72/245/EEC from 20th June 1972, regarding approximation of States Members regulations concern to suppressing disturbance evoked by engines with ignition in motor vehicle (Dz. Urz. UE, Polish special edition, chapter 13, t. 1, str. 226) or the Instruction Book no 10 of European Economic Commission of United Nation Organization (UNECE) - Homogenous regulations concerning the homologation of vehicles in range of electromagnetic compatibility.

Additional electric installation of the vehicle (after building) should grant claims of norm PN-S 76021. Central lock should grant following claims:

- the system of central blocking should include all external doors of the vehicle,
- the system should signal all unclosed and unblocked door,
- system should be controlled by broadcasting pilot or equivalent device, which allows to interlock all doors of the vehicle and unblock only one door of the vehicle,
- system should be able to interlock and unblock individual doors from vehicle panel.

Immobilizer should grant the claims of Directive of Council no 74/61/EEC from 17th December 1973 regarding approximation of legislation of the State Members in range of security devices of motor vehicles against illegal use or the instruction book no 116 UNECE - Homogeneous technical claims protecting motor vehicles against illegal use.

The vehicle should be equipped with the unit of car alarm system, granting the claims of Directive 74/61/EEC from 17th December 1973 regarding approximation of legislation of the State Members in range of security devices of motor vehicles against illegal use (Dz. Urz. UE Poland, special edition, chapter 13, volume 2, page 49) or the instruction book no 116 UNECE and the instruction book no 97 of European Economic Commission of Organization of United Nations – Homogeneous regulations regarding homologation of alarm systems and the vehicles in range their alarm systems (Dz. Urz. UE L from 2008 No 351, page 1)

The alarm system should allow at least use of:

- „panic“ function, switched on and off with one click of broadcasting pilot and additional switch inside passenger section,
- service mode,
- signalling the alarm with all indicator lights,
- outside monitored system of satellite localization and danger alarm system.

The alarm system should be equipped with:

- reserve power supply,
- additional alarm siren,
- sensors of protection of passenger section,
- blockade of engine.

The system of alarm transmission should transfer information at least about:

- localization of the vehicle,
- speed of the vehicle
- opening and closure of the door of passenger and cargo section of the vehicle,
- state of alarming, of the alarm system in the vehicle,
- inclusion and exclusion of the engine.

3. Device for intelligent blocking and unblocking the doors

Realization of claim concerning system of blocking and unblocking the door could be solved on two manners. First solution relies on severance of individual servo-motors from the route of CAN and steering directly the servo-mechanisms by use a switch. In this purpose should be employed additional cluster of wires connecting all locks with panel.

Besides, interference in existing electric endowment of vehicle is indispensable.

The second method relies on utilization of route for steering CAN to control individual executive elements like doors locks. The CAN network renders accessible information of current state of security of the vehicle. In comparison to former solution, the interference to electric network is in this case minimal.

Thus that majority of vehicles available on the market, that can be used as a cash transport vehicle, mentions information between individual steering devices using the CAN network, and taking into account the other advantages of this solution, they were accepted as a target in described project.

In the car Vito II, which was purchased in the confines of the project, door control is carried out with 3 drivers:

- driver of the driver's door, performing the following functions within the driver's door: locking, unlocking, checking the status of open/closed, steering the windows and serve the control buttons mounted on the door,
- driver of the passenger's door, performing the following functions within the passenger's door: locking, unlocking, checking the status of open/closed, steering the windows and serve the control buttons mounted on the door,
- driver of the rear and side doors, performing the following functions within the side and rear doors: blocking, unblocking, checking the status of the open/closed.

The drivers are connected with route CAN type B (CAN B) called „body CAN“ or „interior CAN“. The route is connecting the modules of the vehicle for controlling the elements of the vehicle, which do not affect his mobility. These are for example: drivers of the door locks, dashboard, lights, seats adjustment and others. The drivers of the engine, ABS, ESP, airbags are connected by fast CAN network type C (CAN C). Individual drivers CAN B are connected to the bus at collection points spread over different locations in the vehicle. For this purpose is used the commonly female connector (Fig. 1), allowing connection of several connectors removed from subsequent CAN modules or other collection point.

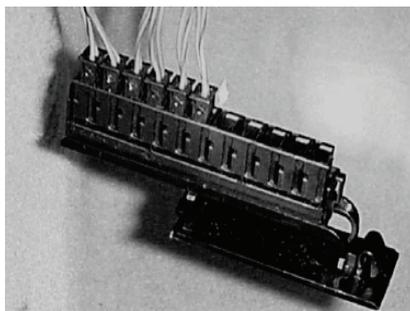


Fig. 1 Connector of the CAN route

Schematic diagram of the developed system is presented on Fig. 2. The system of central control door lock (UCSBOD) consists of, inter alia, two independent CAN channels, powerful microcontroller and clear user interface. The door drivers were unconnected with CAN B network in the collection points and combine with additional wiring connections completed with dedicated connectors with first channel (CAN 1) of UCSBOD module. The second channel (CAN 2) was connected with the B network of the vehicle. All data packets received from the route of vehicle CAN B are filtered before they are sent to the doors drivers and vice versa, which allows to sent to the driver only these packets, which meet the requirements in accordance with agreed strategy of security of cash transport vehicle. The filtering program rejects any disagreement with the strategy of security and attempts to lock or unlock the door.

For example, to use the button to open all door, which is located in the centre console of vehicle? The data are not filtered in case of trying to unlock or lock the door performed by UCSBOD interface and are sent directly to designated drivers door.

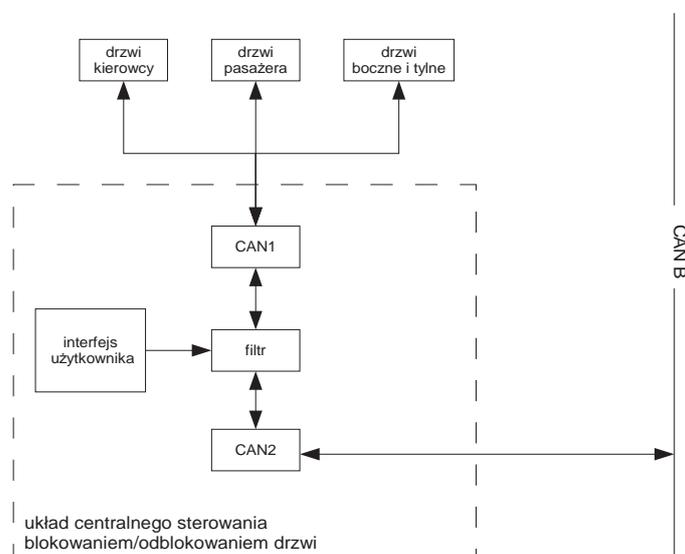


Fig. 2 Schematic diagram of system of selective door locking

4. Interface of the user

Computer interface locking and unlocking the door was made using the LCD touch screen with size of 118x90 mm (Fig. 3). The screen is installed in the immediate vicinity of the dashboard taking into account quick and intuitive access to functions



Fig. 3 Touch panel steering the cash transport vehicle

On the screen is presented information based on the data read from CAN B network. There are four states signalized in different ways:

- Unlocked, closed – on the screen appears doors in closed position and red button,
- Unlocked, opened – on the screen appears doors in open position and red button,
- Locked, closed – on the screen appears doors in closed position and green button,
- Lock/unlock – on the screen appears the blue button and red doors, in the last saved position.

If the doors closure process takes more then 3 seconds, there is activated an alarm in form of exclamation mark with a suitable description. Then the door status is changed into „unlocked“. Touching individual doors or buttons starts the procedure of blocking or unblocking, depending on the initial state. At the bottom of the screen there is an emergency button that closes all the doors. The exclamation mark on the left side of the screen appears in the time of detection unlocked door or failure.

5. Used hardware

The system controller is built based on modern and powerful microcontroller with an ARM Cortex-M3 processor (Texas Instruments Stellaris LM3S9B96). The microcontroller has Flash memory of 256 KB, and 96 KB of RAM, the maximum frequency of clocking in the core is 80 MHz. The device is equipped with ROM memory with a set of standard operating procedures for peripheral devices.

The microcontroller was chosen because of its efficiency and access to peripheral devices as:

Dual CAN interface, ADC converters to operate the touch panel and a number of GPIO outputs enabling the connection of the LCD screen.

Supporting the CAN network requires use of adequate systems fitted the SN65HVD230D route.

Thanks to the rapid microcontroller and large size of the RAM memory, all tasks of filtering and processing data received from the CAN route and interactions with the user were implemented.

To conserve the energy, the device switches into sleep mode after ten minutes after switching off the ignition and closing all vehicles' doors. Back to the activity state is made automatically after switching the ignition or the appearance of any data packet on the CAN B route. System needs less than 100ms to turn into activity mode.

6. Summary

In September 2010 has changed the law concerning requirements for cash transport vehicle. The new requirements envisaged the need of selective locking/unlocking vehicle doors. Control of the door locks this way was easy to realize in cases of traditional solutions, in which were not used the control devices using the CAN network. In case of its application, there is a problem associated with continuous diagnosis of the lock door driver, what was associated with the ability to their selective locking and unlocking. The device described in article is an original way to solve this problem.

Increasingly sophisticated control systems with the latest teleinformatic solutions used in vehicles, results with increasingly complex problematic with controlling their activity.

References

- [1] Council Directive No. 72/245/EWG of 20th June 1972 on the approximation of laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines used in motor vehicles.
- [2] Council Directive No. 74/61/ EWG of 17th December 1973 the laws of the member states relating to motor safety vehicle safety device to prevent unauthorized use.

- [3] Regulations No. 116 EKG ONZ uniform technical requirements for protection of motor vehicles against unauthorized use.
- [4] Regulations No. 10 Economic Commission of Europe United Nations – Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility.
- [5] Regulations No. 116 EKG ONZ and regulations no 97 Economic Commission of Europe United Nations – Uniform provisions concerning the approval of emergency vehicles and vehicles with regard to their alarm systems.
- [6] Regulation of the Minister of Internal Affairs and Administration of 7th September 2010 regarding the requirements for secure the cash values stored and transported by traders and other organizational units.