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CAR MONITORING INFORMATION SYSTEMS

Summary: The objective of this contribution is to characterize alternatives of information systems used for managing, processing and evaluation of information related to company vehicles. Especially we focus on logging, transferring and processing of on-road vehicle movement information in inland and international transportation. This segment of company information system has to monitor the car movement – actively or passively – according to demand of the company and after the processing it has to evaluate and give the complex monitoring of a situation of all the company vehicles to the controller.

INFORMATYCZNY SYSTEM MONITOROWANIA RUCHU SAMOCHODÓW

Steszczenie: Celem niniejszej pracy jest scharakteryzowanie alternatyw systemów informatycznych używanych do zarządzania, przetwarzania i oceny informacji związanych z pojazdami firmowymi. Zwracamy szczególnie uwagę na rejestrowanie, przekazywanie i przetwarzanie informacji o ruchu pojazdu na drodze w transporcie krajowym i międzynarodowym. Ten segment systemu informatycznego firmy ma monitorować ruch samochodów – czynnie lub biernie – według potrzeb firmy i po przetworzeniu ma ocenić i zapewnić kompleksowe monitorowanie sytuacji wszystkich pojazdów firmowych dla kontrolera.

1. INTRODUCTION

Recently, an information system has been more and more discussed expression in various life spheres, whether in science or governmental or private sector. Also the question of their utilization for administration and data-manipulation of the car-fleet of companies which more or less uses their vehicles for passenger, goods transport or another type of service comes to foreground. In all cases, it is necessary – even by law (tax bureau) or for internal company requirement – to monitor the status and utilization of all vehicles – their running, repairing, servicing, etc.

The objective of this contribution is to analyse various data recording and transfer of vehicle movement from the view of their economical and technological effectiveness in the area of Slovak republic. All of analyzed possibilities work on equal principles: a mobile device which is capable of recording data of vehicle position and status and thereby able to communicate with the outside world, and the fixed part which provides the capability of administration, saving and analyzing the obtained data and communication with the mobile devices located in vehicles. This part may be broken down

into two layers – system containing the application logic and data archiving system (database server). Simply it can be said that almost in all cases this is considered as three-layer architecture, as shown in Fig.1.

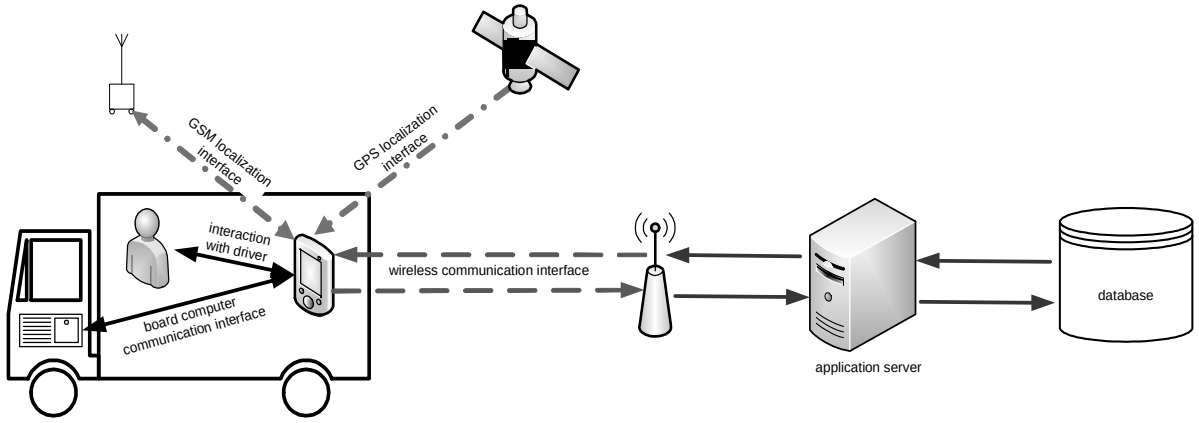

Fig. 1. System architecture
Rys. 1. Architektura systemu

For evaluation of suitability of separate alternatives it is necessary to respect specific needs of companies – some of them need vehicle movement information, obtained after its return to the car park; some of them need to be informed about status, location and motion of the vehicle in real-time; in some cases it is necessary to communicate with the device in the car in duplex mode and actively deliver data into computer in the vehicle, to inform the driver or to assign him various requirements.

2. ANALYSIS OF LOCALIZATION POSSIBILITIES

The main part of the entire system is vehicle localization. At present, there are in principle two most used technologies, which provide localization of vehicle – terrestrial and satellite.

At this time, 3 existing satellite navigation technologies are discussed. It is (now fully operational) American system GPS, Russian GLONASS system and in the future – European GALILEO system.

The GPS system provides very exact time-reference almost anywhere on the earth or earth-orbit. The advantages are absence of operating costs by user-view due to free receiving of GPS signal and low prices of receiver-purchasing [1].

The GLONASS system at present consists of 18 satellites so it is fully operational for the Russian territory, whole earth has to be covered in 2010. Zero-operational-costs by user-view make this system also potentially suitable, but until this signal will not be worldwide, this is not an actual solution. Bad accessibility to receivers of this type of signal generates another disadvantage.

GALILEO navigation system, constructed under strong support of public finance of European Union, in contrast to both previous, is exclusively assigned to civil and commercial usage. Full configuration is scheduled for 2012. In contrast to GPS it will provide higher exactness and better coverage of areas far-away from equator (for example Scandinavia). Besides public free and encrypted exact signal it will provide priority service “Safety of Life” and emergency localization service. [2]

Presently it is possible to use only one alternative, provided by American navigation system GPS. But in the future it will be possible to use and receive simultaneously signal of all three technologies, whereas they will be reciprocally compatible. For this reason it is advisable to think about purchasing a receiver, which will be easily adaptable to receiving all signal-types at the same time.

The problem of technologies based on terrestrial localization is considered by suppliers of mobile technologies and providers of mobile networks already for several years. At present, mobile network-

operators offer localization on the principle of E-OTD (Enhanced Observed Time Difference method), where cell phone evaluates delay of receiving signals from the Base Transceiver Stations (BTS) in the range, thereafter data are sent to the centre, which computes location of cell phone. Exactness of this method is in the open area about 60 meters and in the urban areas about 200 meters.

Such type of position-information is not only relatively inaccurate but also quite expensive, whereas in case of vehicle-tracking the optimal localization-step can be about 1 minute. In addition, this type of service is not provided by all of mobile network operators which provide voice and data services. Then for all model examples listed below this type of localization is unacceptable.

3. ANALYSIS OF DATA TRANSFER EQUIPMENT BETWEEN VEHICLES AND ORGANISATION

Presently, for the wireless data-transfer it is possible to use the technologies which are described in the following sections:

3.1. Data-transfer via infrared technology

The advantages of IrDA (infrared radiation) data-transfer system include low prices of sensors and low absorption by passing a metallic glass, with which many modern vehicles are equipped. Disadvantage of this solution could be the need of direct visibility between devices and limited working radius (about 1 – 3 meters).

3.2. Data-transfer via bluetooth technology

The Bluetooth technology does not need direct visibility between devices. Signal strength provides communication possibility to 10 meters, but if there are barriers, accessibility decreases transfer of data through terrestrial mobile networks

As the mobile networks area-coverage is at this time at high-level, it is also possible to use this technology for remote wireless information transfer. Packet-switched technology GPRS based on GSM-standards is progressively replaced by faster third generation technology UMTS. The price for small data-volume is not enormous and also in the case of short sending data-interval the total amount is not so high. This solution is interesting for company vehicles, used inland, if it is needed to have on demand instant vehicle motion-information or to perform direct interaction with a device in the car or to give the driver necessary instructions. Disadvantages are incompatible settings of different mobile networks, which causes a potential malfunction after crossing country's boundary and changing the network (to roaming) – therewith the next disadvantage is related – the price for transferred data in case of roaming-using is incomparably – as many as ten times – higher against standard rates. But in unavoidable cases the information value of vehicle location, nevertheless, exceeds the financial value paid for data transfer.

3.3. Transfer of data through satellite communication systems

Satellite communication systems like INMARSAT or IRIDIUM have almost unlimited signal accessibility under the same communication conditions all over the world (they cover about 98% of the population). When crossing the frontier neither the configuration, nor the price for the services usage change. However, these are inaccessible in indoor and underground areas (closed park-houses, underground garages, tunnels, etc.). The next disadvantage is the price for transferred information.

Besides obtaining information about vehicle location in real time, this type of service makes the interaction with computer or vehicle driver possible.

3.4. Data transferring via technology of wireless fidelity

Technology of Wireless Fidelity is the standard-package for wireless local networks LAN (WLAN), at present based on specifications IEEE 802.11. It provides connection to the network in the Access-Point neighboring devices with wireless adapter (PC, notebook, PDA …). Frequencies Wi-Fi are not licensed, however only devices with broadcast performance until 100 mW are allowed, so they have limited accessibility. Typical Wi-Fi router could be reachable within 45 meters in the buildings and 90 meters outdoors. It appears from this that this technology does operate without usual operational costs but it is only able to inform about the vehicle movement after arrival to parking place or garage of the company.

The new system called WiMax defined in the standard IEEE 802.16 will operate based on similar principles as the supplement of this technology with operational range of 40 – 70 km in outdoor environment possibility-analysis in model examples

3.5. Daily press distribution

A company which is concerned with this type of business does not need to use navigation system, because their drivers have driven this route already several times. The question of vehicle localization is not necessary to be discussed. But foreground there is in a problem of localization-data transferring. This type of company does not need to have the overview of actual location of each vehicle but it is necessary to know which vehicles are on the way, which of them are in the parking place etc. For such a company it is enough that the car-movement data are collected at the moment of its arrival to the parking place, like in the past as in “Driving-book” manual was, and this fact can spare relatively considerable amounts of money. Of course, the transfer as such has to be equally secured that the information-distortion through drivers or third persons does not occur. The combination GNSS (GPS) – localization and Wi-Fi/WiMax – data transferring appears to be the most suitable system for this type of company.

3.6. Taxi service

For taxis it is already suitable to think not only about recording, eventually localization of exact route, but also about active navigation by software with loaded relevant map-details. The taxi-service with a big car park employs also its own dispatchers. After a demand they have to choose a vehicle, which is not busy and/or reserved and simultaneously is closest to the point of customer-pick-up point. All these conditions indicate that the online vehicle localization is necessarily required. The point of customer pick-up driver can be informed about in two ways – by making use of two way communication with a vehicle or by a transmitter. In the first case the possibility of satellite data transfer is clearly eliminated due to high cost and consequently, it is obvious that advantages of satellite communication will not be utilized in this case, as the taxi vehicles are not usually crossing country frontier. In this case, the optimal combination of technologies is: GNSS (GPS) for localization and GPRS/UMTS for data transferring.

3.7. Emergency systems

During operating service, the emergency vehicles have absolute priority on the road communications. Also in this case, as with the taxi-vehicles, it is suitable to use the navigation system. In addition to localization of the vehicle, used by the operator, it is in the interest of human lifesaving, to connect the navigation software (with the map details) with the mobile device (or to implement it) which performs the localization and data transfer. Hereby it is necessary to use the duplex transfer mode (in this case in the direction to vehicle) that the driver and crew of these vehicles have their shortest or fastest route already scheduled at the time of getting into the car. This solution clearly speeds up the arrival of emergency to the destination point and thereby increases the probability of people survival after serious accident or other events that need the action of emergency system. Next, after the arrival to the destination, in case of serious event, it is easy to report how the situation looks like, to the operator and to evaluate if the next emergency vehicle is necessary. The operator can see on the display where the car is located and he can manage and send the next emergency vehicle very easily and fast. Optimal combination seems to be the couple of technologies GNSS (GPS) and GPRS/UMTS. But as human life is concerned in this case, any failure of such a system is not allowable, and for that reason it is exceedingly needful that the backup system will be applied. Good selection for data transferring backup-system could be a satellite communication system, although very financially costly, also the combination of GNSS (GPS) and GPRS/UMTS/SAT will be used.

3.8. Mass public transportation

In the age when every saved minute by travelling counts, it is very important for the travelling public to know where the public transport vehicle, which a passenger would like to get in, is situated. He needs to know the delay of the vehicle if it occurs and to have the possibility to use another alternative or to use the time reserve for other meaningful activity. Information system has to localize the vehicle, calculate the probable time of arrival to every following bus stop and to send information to the centre. In this section, it is possible to segment the transferring method to urban and interurban. Within the frame of operational costs minimisation the wireless Access Points around the transportation lines in the whole town will be arranged, which provides for the data receiving between vehicles and the centre. The side effect of this solution can be the creation of many free hot-spots around the city, in the case of adequate secured transfer. For this model example the following combinations could be suitable:

- in the case of interurban or long-distance transportation the data transfer through GPRS/UMTS is the optimal solution;
- in the case of urban mass public transportation the data transfer can be solved via Wi-Fi hot-spots;

Localization by GNSS systems (GPS) is in both cases optimal. It is necessary to say that in the international mass public transportation this type of information system does not make sense.

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