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INTEGRATION and COMPARISON of MOBILE RADIOCOMMUNICATION SOLUTIONS: EUTELTRACS, INMARSAT -C, -D+ AND GSM FOR HAZARDOUS GOODS MONITORING OVER THE EAST-WEST TRANSPORT CORRIDORS.

Abstract:
Results of parallel application EUTELTRACS, INMARSAT-C, D+, GSM mobile terminals for hazardous goods monitoring are discussed. Number of alternative technical solutions and monitoring possibilities are checked. Common data base solution on Microsoft SQL- Server and parallel visualisation of monitored trajectories with digital map are created.
Project of Experimental Open Monitoring Centre with the above standards is presented..
Virtual Private Network technology is employed for monitoring system protection.
Work was done in frame of PBZ 029-06 Contract of State Committee for Scientific Research.

1. Introduction

Poland is a country characterised by extremely intense transit traffic between the Western Europe and Russia, as well as other countries of the Independent States Community. We observe rapidly increase of transit of chemicals and needs for new solutions of Fleet Management and Emergency Management

We also observe increasing number of interventions by rescue forces, as well as losses connected with road accidents.

Internal transport is also intense; over 6 thousand tank-trucks for transporting liquid hazardous goods are registered, and, apart form mass transport in tank-trucks, hazardous goods are also largely transported in other containers. Annual transport in case of just one type of hazardous goods, namely oil products, is estimated at about 5 million tons.

In this situation, activities aimed at reducing the risk of disaster become an urgent necessity.

Considering additionally the current state of telecommunications infrastructure (practical lack of a land mobile communications system), the use of satellite radio communications in cases of special danger becomes a basic technical solution, which can actually be applied, if allowed by legal and organisational arrangements.

2. Works performed so far

Monitoring of especially dangerous goods production and storage has been conducted in Polish industrial enterprises for several years. Industrial practice develops and implements computer systems for monitoring of production and storage processes, including systems for automatic servicing of alarms and blockings, so called "safety guard systems". For several years, PIAP has also dealt with issues connected with monitoring of especially dangerous goods transport. In this field, in 1993-1994, the pilot GENIE (Global Environmental Network Industrial Emergencies) project was performed in co-operation with international partners: IEB (International Environmental Bureau), EUROTRAFFIC, INMARSAT, De Te Mobil and DEC, as well as Polish partners: BSS TP SA and the biggest producers of hazardous goods, namely MZRiP "PETROCHEMIA" - Płock, Zakłady Azotowe (Nitrogen Works) - Tarnów and Zakłady Chemiczne (Chemical Works) - Bydgoszcz, which also have specialised trucking fleets for hazardous goods transport, as well as industrial rescue stations [1,2].

During the tests, a number of alternative technical solutions and monitoring possibilities were checked, including local monitoring stations and a flexible change of sending data to several addresses.

3. Project of Monitoring System [4] for hazardous goods transport

In order to reduce the threat connected with hazardous goods production and transport, it is necessary to create a Monitoring System based on satellite and radio communications.

The basic task of the Monitoring System will be to collect data and create a data base containing information about consignments, routes of transported goods and their state, as well as threats, irregularities and damages, and to automatically inform public services, in accordance with their competencies.

In order to afford possibilities for a full review of the situation connected with hazardous goods transport on Polish roads, the Monitoring System should be capable of collecting data from different sources, verify, protect and aggregate, as well as archive them and provide access for users.

Ensuring appropriate technical parameters (e.g., completeness, accuracy, etc.) requires constant control and verification of the quality of collected data. It will also be necessary to protect data in a proper way, both against their falsification, damage or loss, and against access of unauthorised persons.

The general structure of build in PIAP Monitoring System is shown on Fig.1. According to general conception this Monitoring System integrate and accepts different technical solutions for mobile communications the most frequently used in Europe. In project is widely used Virtual Private Network concept with PPTP protocol for protection see Fig. 2 and HTTP protocol for Internet access.

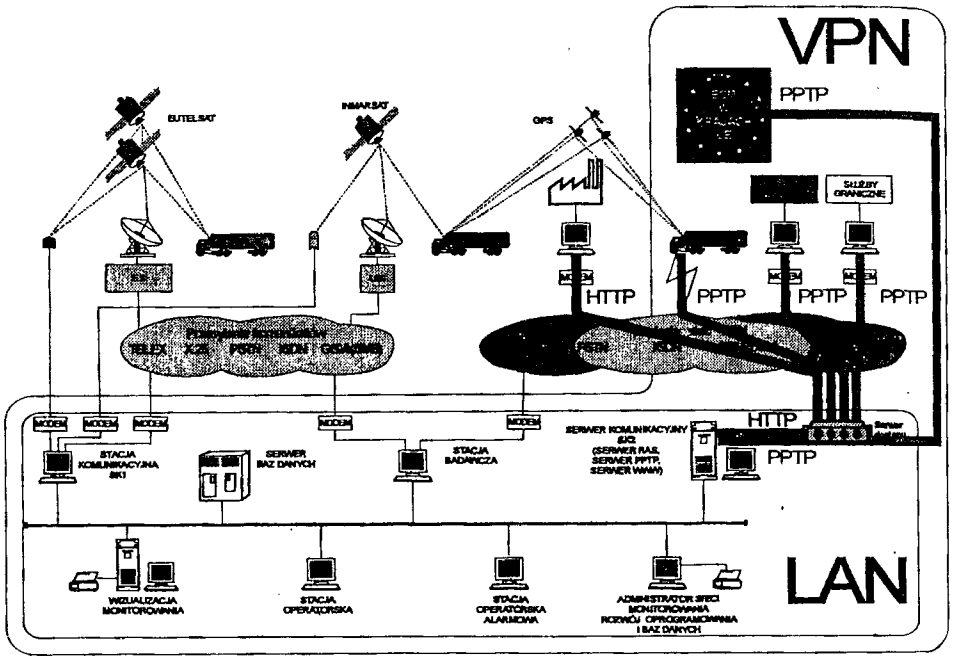


Fig. 1.The structure of Open Monitoring System.

There should be a possibility to supply the Monitoring Centre data base also from other sources, e.g., from data bases created in other centres, with which data could be exchanged in accordance with special principles. Here, we mean, e.g., data bases containing information about roads, vehicles, hazardous goods, road assistance, etc.

The System is designed for different users. Customers of monitoring systems will also include owners of transport fleets and forwarders. A possibility to communicate with a driver in any place at any time may be particularly important, especially for carriers providing services for the Central and Eastern Europe, where telecommunications infrastructure is poor and unreliable.

We observe now rapid growth of interest in possibilities of transport monitoring with the use of GSM, radio and satellite communications. Many companies got involved in development and manufacturing of appropriate equipment and software. Currently, many manufacturers offer their products in Europe.

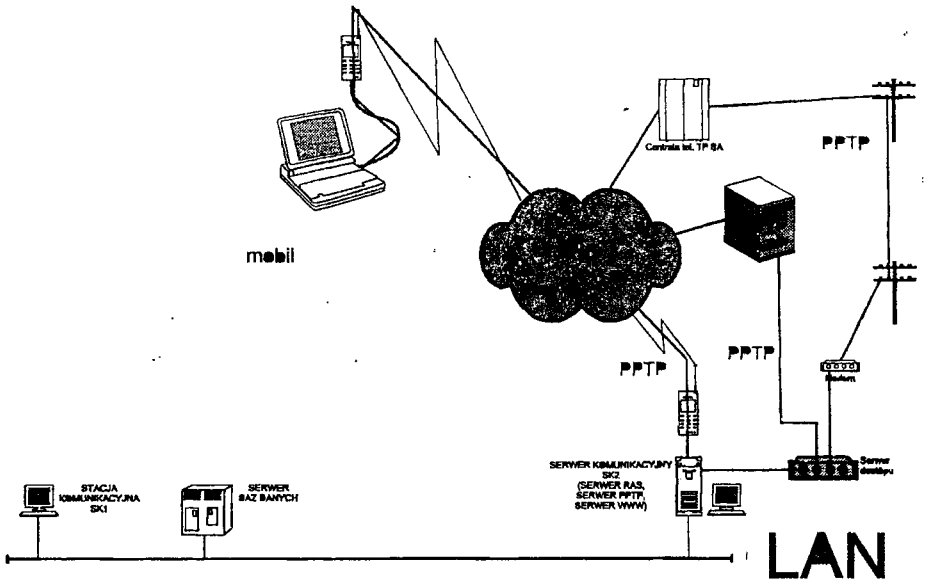


Fig.2 Communication of mobile terminal to Monitoring Centre via VPN and PPTP protocol.

4. Some results of investigation of monitoring in main east-west corridors

In PIAP in frame of PBZ 029-06 Experimental Monitoring Centre was created for investigation and testing different solutions.

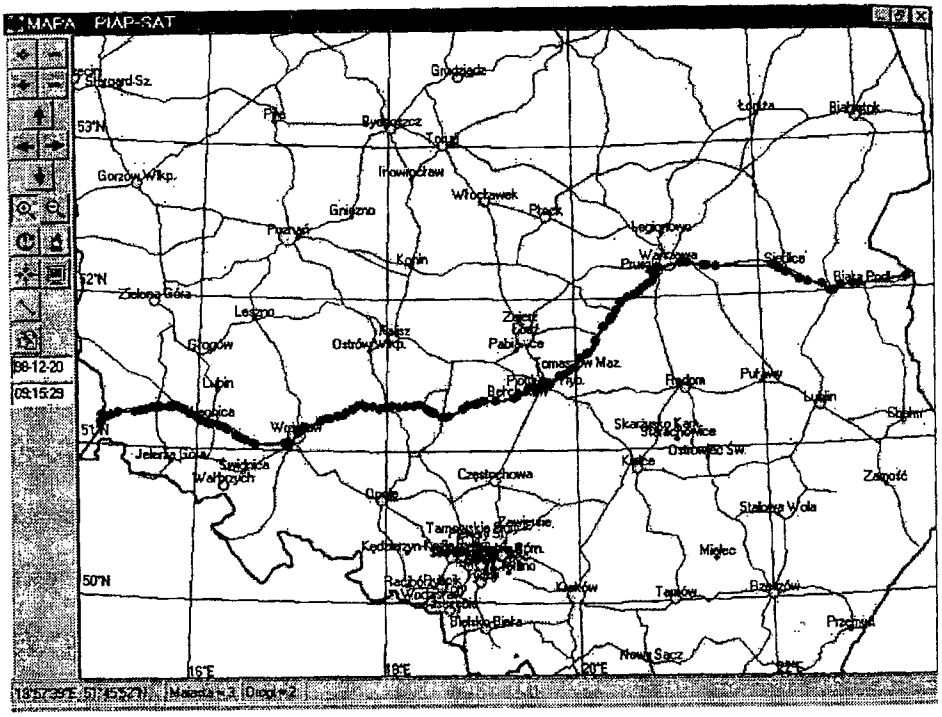
Sample results obtained with parallel application of different technical solutions EUTELTRACS, GSM/SMS, INMARSAT-C/GPS, INMARSAT-D+/GPS will be shown below.

Fig. 3 shows how significant variations of time of transmission of messages from track to Monitoring Centre we can observe along the east-west corridor Terespol -Zgorzelec. Time of transmission changes are from 50sec.to 20min. Mean transmission time we observe3:12min. EUTELRTACS was the most reliable solution-99% transmissions reach destination.

From Fig 4 we can see even bigger irregularities cost by lack of coverage of GSM (transmission time from 22sec to 20min. Transmission losses 9,17%.

Fig. 5 shows how complicated is messaging protocol for INMARSAT - C/GPS System what cost the longest transmission time even 27min and over 10% lost transmissions.

In application new INMARSAT-D+/GPS standard we find it very good and reliable work in channel from Monitoring Centre to Mobile terminal and unfortunately significant less reliable in opposite channel (from track to Monitoring Centre over 10% lost transmissions).



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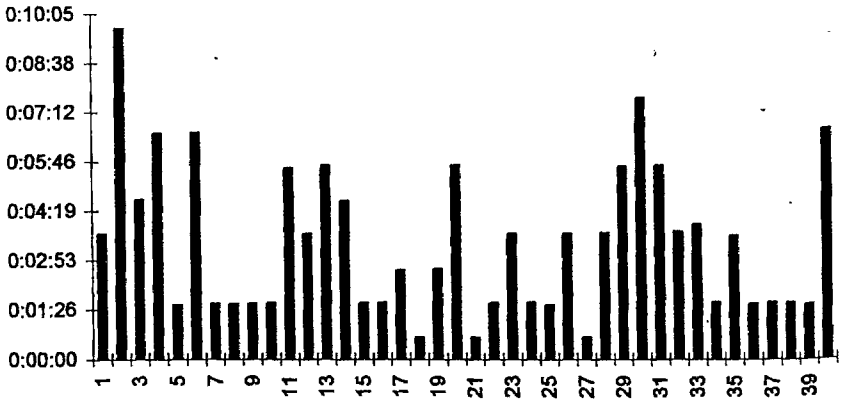


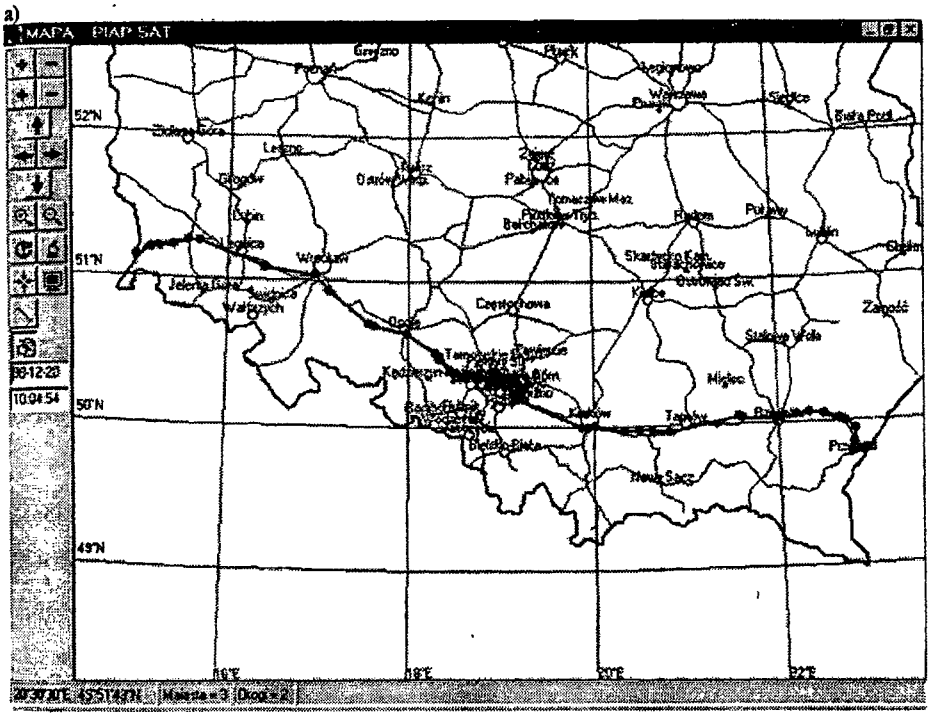
Fig.3 EUTELTRACS monitoring sample along the east-west corridor Terespol- Warszawa -Wrocław-Zgorzelec

:

a) visualisation of geographical positions

b) time of transmitission from track to Monitoring Centre

a)



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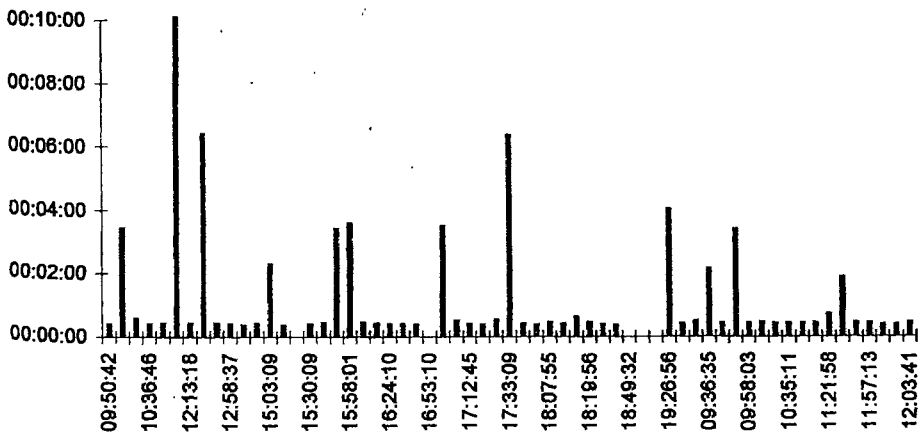
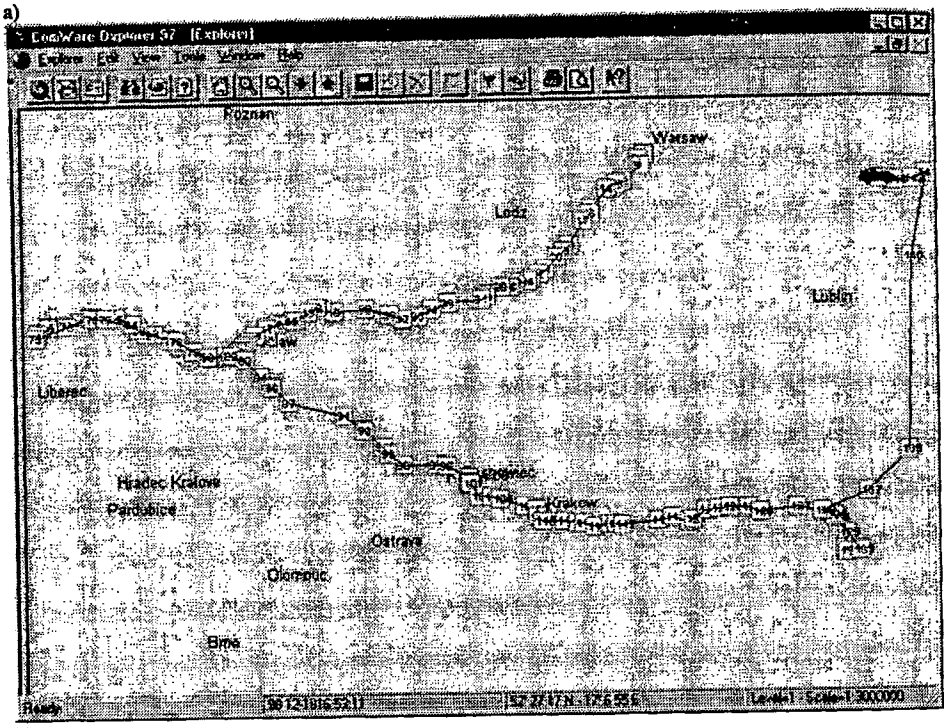


Fig.4 GSM/PIAP monitoring sample along west-east corridor Zgorzelec -Wrocław-Medyka

a) visualisation of geographical postions

b) time of transsmision from track to Monitoring Centre

a)



b)

Forward Messaging Protocol for the Inmarsat-C System

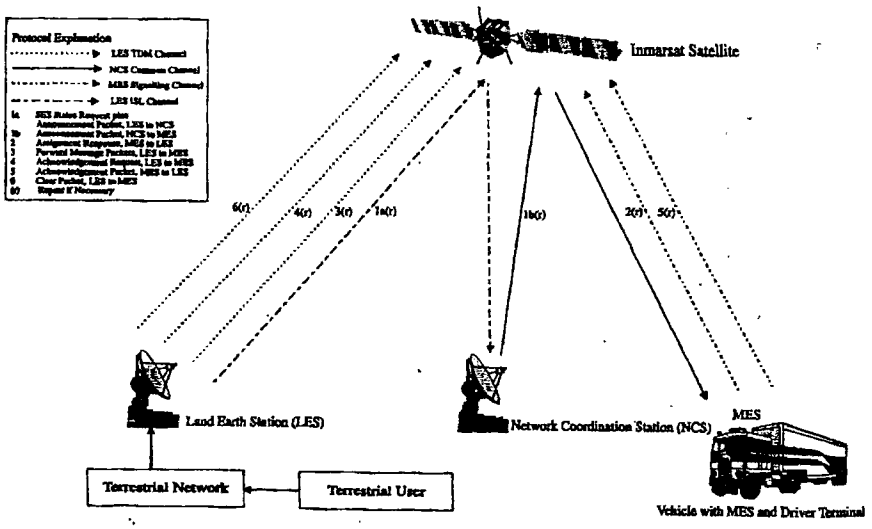


Fig.5 a) Visualisation of positions monitored by INMARSAT D+ mobile terminal

b) Used Forward messaging protocol for INMARSAT -C/GPS

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