MOBILE DECISIONS OF TRANSPORTATION OF DANGEROUS GOODS

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This paper presents several ideas of effective transport systems technologies, technological solutions in systems for identification objects on the road for dangerous goods transport. In the article the coherence of new technologies and new possibilities for location and control of cargo and vehicles with systems of positioning system, location system standards are theoretically shown. A remote identification system for freight transport allows new possibilities of differential GPS (GNSS) techniques and applications for dangerous goods safe transportation.

Keywords: *transportation, dangerous goods, location, vehicle, mobile decisions*

1. Introduction

Dangerous goods for transport on land include substances and articles that have explosive, flammable, toxic, infectious or corrosive properties, and containers that hold dangerous goods. All classes of dangerous goods are described in Table A of the Rule, which is based on classifications in the United Nations recommendations on the transport of dangerous goods – Model regulations.

Carrying goods by road or rail involves the risk of traffic accidents. If the goods carried are dangerous, there is also the risk of an incident, such as spillage of the goods, leading to hazards such as fire, explosion, chemical burn or environmental damage.

Most goods are not considered sufficiently dangerous to require special precautions during carriage. Some goods, however, have properties which mean they are potentially dangerous if carried.

The topicality of the problems analysed in the article makes as follows: there are still no safe enough requirements for dangerous goods transportation, when they are necessary, because transportation of dangerous goods is one of the most difficult and asks of the highest safety carriage technologies. There are no worked up requirements for dangerous goods transportation in Lithuania, which would allow supplying with necessary information about dangerous goods carriage with expedition.

2. Database of Responsibilities

Dangerous goods are liquid or solid substances and articles containing them, that have been tested and assessed against internationally-agreed criteria – a process called classification – and found to be potentially dangerous (hazardous) when carried. Dangerous goods are assigned to different classes depending on their predominant hazard.

When comparing road and rail transport, the risk mainly depends on the hazardous characteristics of the product. The size of the containers is generally larger for rail transport than for road transport, and consequently the amount of product potentially released, giving rise to impact areas slightly or significantly larger for rail than for road transport. When comparing road and intermodal transport, route length plays the most significant role: the longer the distance, the safer the intermodal transport.

There are regulations to deal with the carriage of dangerous goods, the purpose of which is to protect everyone either directly involved (such as consignors or carriers), or who might become involved (such as members of the emergency services and public). Regulations place duties upon everyone involved in the carriage of dangerous goods, to ensure that they know what they have to do to minimise the risk of incidents and guarantee an effective response.

Everyone involved in transporting dangerous goods has to comply with the Rule. Responsibilities are allocated according to tasks, and you're responsible for all the tasks you do.

Consignors (manufacturers, importers or distributors) are responsible for as follows:

- packaging, labelling and marking dangerous goods;
- providing dangerous goods documents;
- providing emergency response information.

Loaders are responsible for as follows:

- checking packaging, labelling and marking for obvious defects;
- preparing a load plan or container or vehicle packing certificate;
- segregating incompatible dangerous goods;
- complying with special loading instructions on the dangerous goods documents;
- placarding the vehicle or freight container;

- securing the load in the vehicle or freight container;
- undergoing training appropriate for the nature, quantity and use of goods they handle.

Drivers or operators of road vehicles are responsible for as follows:

- placarding the vehicle;
- carrying dangerous goods documents in the holder on the driver's door;
- making the documents available to an enforcement officer or emergency services personnel;
- updating the schedule of quantities or load plan;
- load security;
- complying with parking restrictions;
- stopping at railway crossings;
- carrying emergency response information;
- undergoing training specific to the goods they carry;
- having a valid dangerous goods endorsement on their driver licence.

Drivers or operators of rail vehicles are responsible for as follows:

- carrying dangerous goods documents in the holder on the rail vehicle;
- making the documents available to an enforcement officer or emergency services personnel;
- undergoing training specific to the nature, quantity and use of the dangerous goods they transport.

Employers are responsible for as follows:

- ensuring their employees comply with the requirements of the Dangerous Goods Rule.

Everyone involved is responsible for as follows:

- safely transporting dangerous goods and complying with the Dangerous Goods Rule;
- stopping the transport if the packaging is leaking;
- handing the dangerous goods documents to the next person responsible for transporting or handling the goods.

Anyone involved in transporting dangerous goods can ask of a package to be opened in order to see if it contains dangerous goods, or refuse to handle or transport the package.

Main dangerous goods transportation process participants are consigner, carrier, consignee, vehicle owner. A separate informational bloc is attributed to each of them.

Main element of the database structure is information about cargo. It includes data on dangerous goods type (name or identification number), amount.

Check block is important for experts and inspectors. Information entry, modification and removal blocks purpose is to adjust, enter and otherwise modify information.

Structure of database for individual participant of carriage is represented on Figure 1.

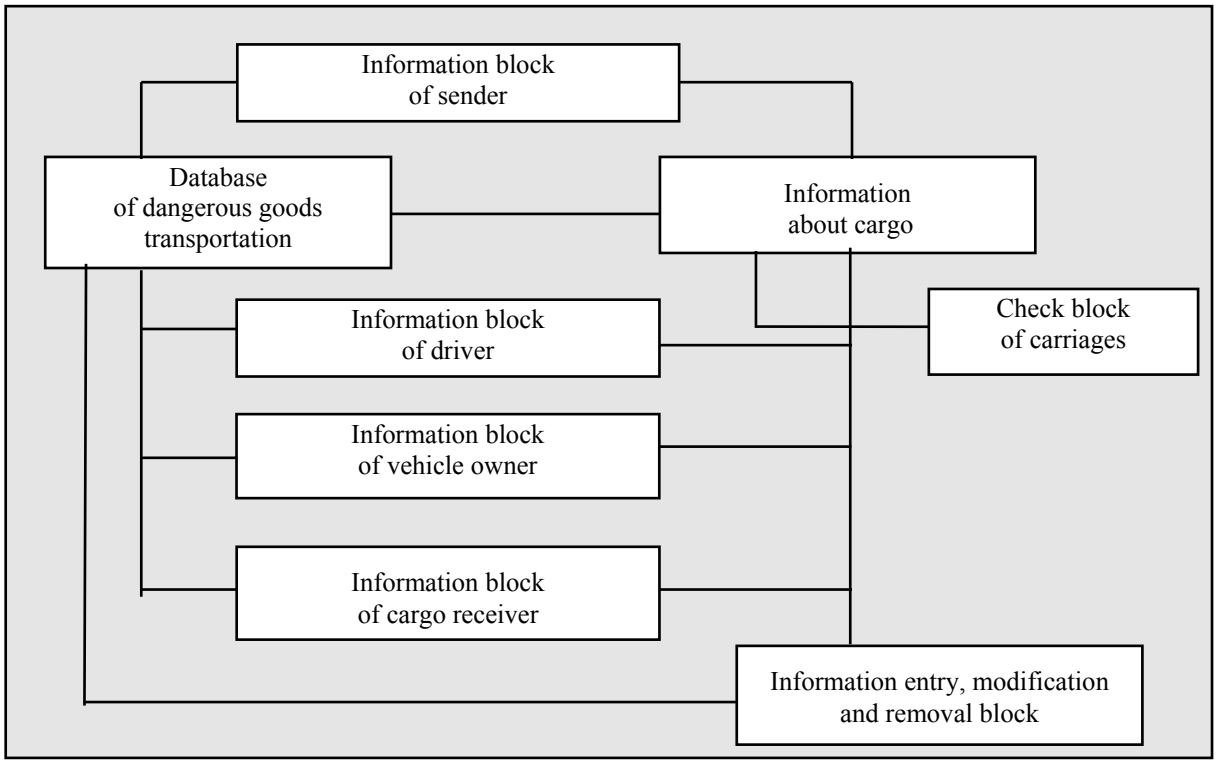

Figure 1. Structure of database for individual participant of carriage

3. Location System Standards

The emergence of road transport means is supported by telematics solutions, such as:

- Traffic monitoring equipment (sensors, detectors, steering equipment, video detectors), television supervision devices (supervising cameras);
- Systems of satellite navigation (GPS, GLONASS, EGNOS, GALILEO);
- Derivative systems used in navigation;
- Systems of radio communication;
- Geographical data base (GIS);
- Bases of road data;
- Electronic cards;
- Weather monitoring and measuring systems and other.

The GPS is well-known as a global navigation satellite system. The analogous systems are the Russian GLONASS and GALILEO system prepared by the European Commission and European Space Agency. GPS is the foundation of the present navigation systems. Actually, the GPS is the only one fully applicable global satellite position determination system in the world.

GALILEO is Europe's own global navigation satellite system, providing a highly accurate, guaranteed global positioning service under civilian control. It is inter-operable with GPS and GLONASS, the two other global satellite navigation systems. A user is able to take a position with the same receiver from any of the satellites in any combination. With the help of the systems GALILEO, SBAS, EGNOS, THALES NAVIGATION, etc. objects position may be estimated with the needed precision. It is very important when we want to watch a truck which position is always changing on the digital map.

These systems are the instrumentality for managing land transport in Europe, whether they are transporting by road, rail or inland waterways. They increase both the capacity and the safety of land transport. Not only airlines but also companies, which operate transport services, need to know where their vehicles are at any times.

Satellite positioning systems are widely used in the world, which enables to indicate the presence of the object, having the positioning equipment, with the wanted precision. To estimate the geographical position fast and precisely is very important if we want to track the object which changes its position (for example a car, a ship or a plane) on the digital map, especially while transporting dangerous freight by any mean of the transport. One of the ways to indicate the geographical position of the object is by using global positioning systems (GPS).

The main factors limiting GIS expansion are dependent on maximal computer resource and that the system is not freely distributed if compared to other programs as it is of an expensive product.

The project of GALILEO system will be very useful. Informational technologies DHLNET are mostly used for distribution and tracking of air transport freight which is hardly adapted for land transport.

As well as improving safety, world satellite navigation and positioning systems are an invaluable aid in managing transport operations. Managers will be able to know exactly when a consignment has been held up and its exact location. This will also improve customer services as clients can be notified of delays and the reason for them, and when necessary breakdown crews can be sent out immediately.

4. Major Decisions of Object Positioning

In solving the problems associated with vehicles and transportation of dangerous goods, one should always know an exact location of transport facility and the goods transported as well as the places of freight loading, unloading and transfer. The information of the past runs on particular routes should also be studied. This could allow us to effectively control all transport facilities as well as avoiding fire explosions of dangerous goods or other accidents. The information of any deviation from the route and other related data should be recorded.

During goods transportation a carrier (a company) should get the following data relating to:

- the location of the vehicle and whether the goods are being loaded or unloaded;
- the process of crossing the state border by the vehicle;
- the time of the vehicle's arrival at the terminal;
- observance of work and leisure time by the carrier;
- time of re-fuelling.

Vehicle control and freight monitoring are performed at the control room. A database (DB) is generated on the basis of the obtained information, which can be used for:

- collecting and storing the information on the route;
- coding transport facilities (e.g. loaded, not loaded);
- grouping the vehicles in order to divide the obtained information (messages);

– measuring time for determining the period of MCT activity after shutting down the engine;
– showing 100 previous positions of the vehicle on the map or providing textual information about it;
– providing some additional information about the state and location of the trailer;
– providing the information about the state of the refrigerator (e.g. its temperature, the temperature of re-circulating air and gases).

To identify goods at a distance from the containers or packages, method Cell-ID can be used. The coordinates should be able to read automatically. A view of object location based Cell-ID decision support system is presented on Figure 2.

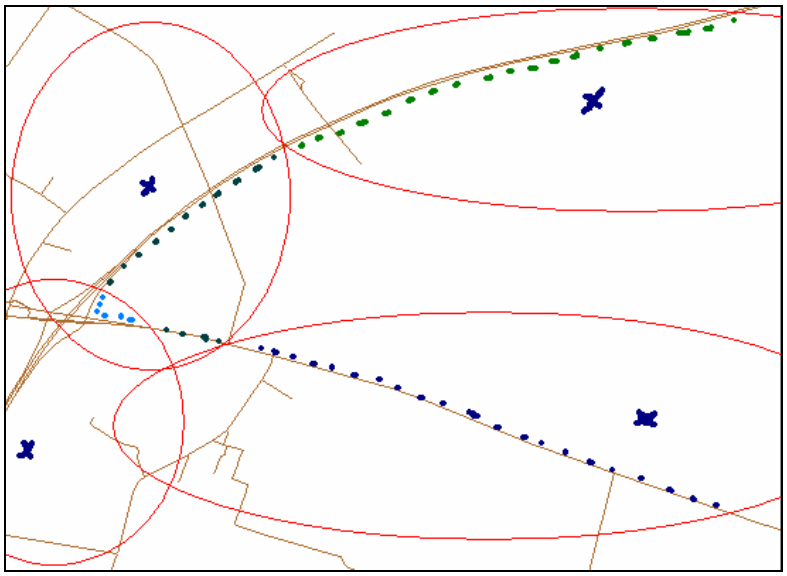

Figure 2. Presentment of objects location by handling of CELL-ID protocol

5. A Remote Identification System for Dangerous Goods Transport

The main units of the remote identification system of vehicles and goods embrace: TIP portal, TVIMP portal, content control system (SMS, GPRS), mobile phone, the unit for stating the geographical position of vehicles and goods.

TIP portal is a subsystem aimed at providing the data on vehicles. The users of the portal can obtain the required information there and use the additional portal modules and subsystems. TVIMP portal (i.e. a mobile portal for common information about transport) is a subsystem performing the function of providing open information about transport for the users of the portal.

TVIMP is designed for all users of this portal to perform the following functions:

- A mobile component allows the users to browse through a portal with a cell phone or other devices, using a WWW or WAP browser.
- Static information component collects and automatically updates static data (e.g. documents, links, etc.).
- Dynamic information component provides the dynamic information stored in the portal, i. e. news, messages/announcements from transport companies, services, etc.
- Open statistical data component provides generalized public statistical data about flows of transport, general use of roads, etc.

TIP is designed for the registered users to perform the following functions:

- Statistical component provides statistical data on vehicle and freight traffic.
- Visualization/location component deals with enquiries, providing textual and visual information from the location server (LAS) component about the location of objects.
- User data register and its control component register the portal users, allowing them to input/present the data on the monitored company's vehicles, transported goods, etc.
- Component for communication with external systems provides the interface for the portal communication with other systems.
- LBS (location-based services) implements and provides various services associated with user location.

Given such flexibility, services can be provided to a wide range of users, including large logistics companies as well as individual carriers. Both types of portals have an access to highly developed mobile phone lines.

A schematic view of object location based GSM decision support system is presented on Figure 3.

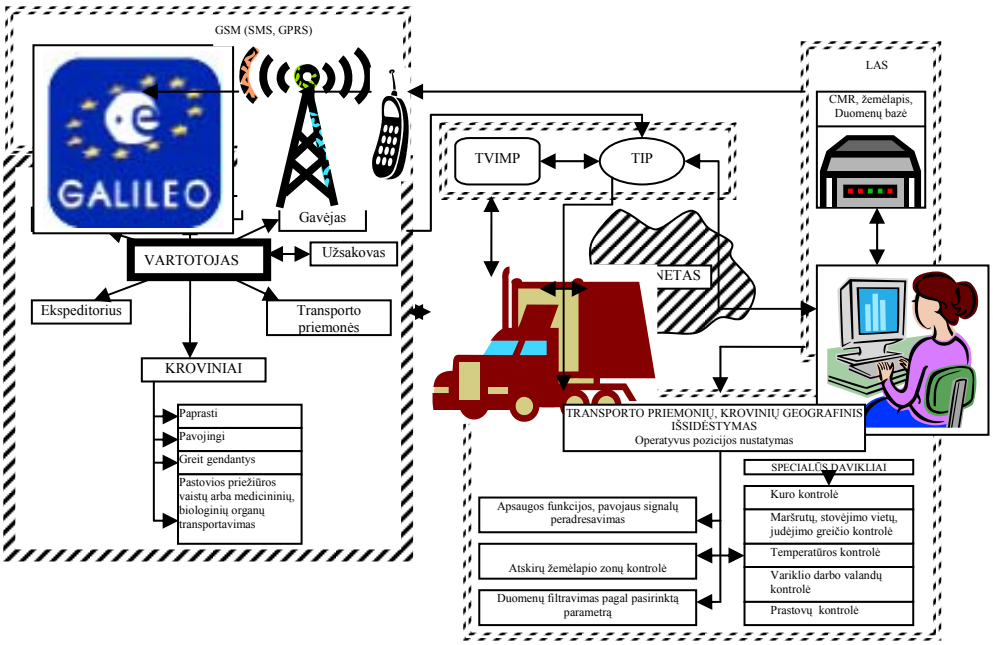

Figure 3. Diagram of function / interaction of portals TVIMP and TIP

Dangerous cargoes require special precautions. Applying the above-described system to transportation of dangerous goods, the main tasks are to ensure monitoring and control. Disposable sensors attached to packages can be used in this case, particularly, when transporting the most or highly dangerous goods (i. e. auto-reactive, radioactive materials, organic peroxides), as well as goods transported:

- by vehicles with the mass exceeding 3.5 tonnes;
- by vehicles carrying dangerous cargoes in fixed or removable tanks of the capacity exceeding 1 m^3;
- by a battery of similar transport facilities with the total capacity exceeding 1m^3;
- by containers, removable containers or DDK, with the capacity exceeding 3m^3 per vehicle;
- by vehicles, carrying 1st grade materials or products, irrespective of the largest mass of transport facility.

In transporting dangerous goods, the route of vehicles should be known and a system for moving objects control should be provided. The latter could ensure the safety of the transported dangerous goods.

This system would also be useful for carrying perishables because their transportation should be controlled.

A schema of purporting aggregation subject to selection service is presented on Figure 4.

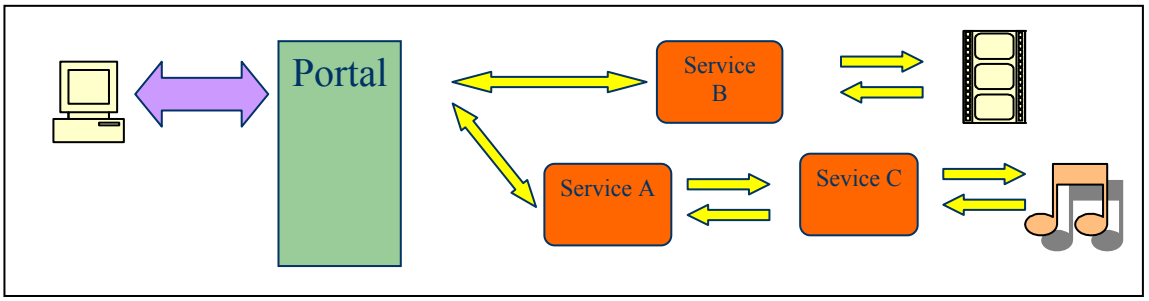

Figure 4. Schema of purporting aggregation subject to selection service

Conclusions

1. Tracking and location systems play an important role in transportation of dangerous freight because dangerous freights may cause serious danger for the environment and the society.
2. As well as improving safety, world satellite navigation and positioning systems are an invaluable aid in managing transport operations.
3. The portals TVIMP and TIP can provide their users with various kinds of information, including public, legal, statistical, geographical and other types of information, as well as some confidential data based on vehicle monitoring required for the effective company performance.
4. A system of remote identification of vehicles and freight allows the carrier to determine:
   - where the vehicle is located and if it is being loaded or unloaded;
   - how the vehicle is crossing the state border;
   - when the vehicle arrives at the place of destination (terminal).

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