THE CURRENT TRENDS IN NAVIGATION

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Abstract: *In this article, I briefly present the perspectives of realizing multimodal intelligent transport in Europe. The main criteria that the European directives in the field of transport have in mind are: ecological and energy efficient transport, traffic decongestion, safety and security of the transport of people and goods, as well as a good interoperability management of the different modes of transport (road, rail, maritime and air). The advantages and positive effects are presented when implementing telematics systems and Intelligent Transport Systems, interconnected for all types of transport, supported by data hubs, based on data standards in a standardized exchange format through standardized interfaces, and some electronic channels for transmitting information.*

Keywords: *navigation; telematics; Intelligent Transport Systems; DGPS; sustainability*

1. Introduction

It is obvious that conventional approaches such as the development of new infrastructures cannot have the desired results in the time frame imposed by the scale of the existing challenges. Innovative solutions are clearly required if rapid progress is to be made, commensurate with the urgency of the problems facing the transport sector. It is imperative that intelligent transport systems play their role and enable tangible results to be achieved.

Innovations in the context of ensuring mobility in Europe in a sustainable, efficient and competitive way generate major challenges, to which we must respond effectively so that its transport system can fully fulfill its mission to satisfy the need for mobility of the European economy and society.

2. Intelligent transport systems

"Intelligent transport systems" (ITS) imply the application of information and communication technologies (ICT) in the field of transport. Such applications are developed for various modes of transport, as well as to favor their interaction (including intermodal platforms) (Fig. 1).

ITS can offer clear advantages in terms of efficiency, sustainability, safety and security of transport and can at the same time contribute to the achievement of the EU's internal market and competitiveness objectives. [1]

In Europe, activities have been carried out in this field since the 80s. In general, these activities have focused on specific areas such as green and energy-efficient transport, road traffic decongestion, traffic management, road safety, security of commercial transport operations or urban mobility, but they have often been put in practice in an uncoordinated and fragmented manner.

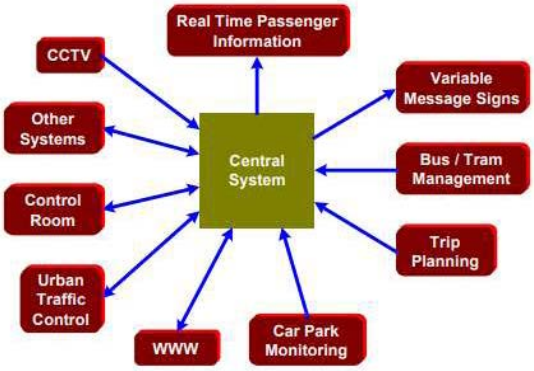

Fig. 1. Architecture of an ITS.

Despite these developments, it is necessary that certain aspects be approached from a European perspective, in order to avoid the emergence of a mosaic of STI applications and services. These aspects include geographical continuity, interoperability of services and systems, and standardization. They should facilitate the development of pan-European applications, guarantee the provision of accurate and reliable data in real time and adequately cover all transport modes.

- In the field of *air transport*, SESAR (Single European Sky ATM (Air Traffic Management) Research) will constitute the framework for the implementation of a new generation system for air traffic management (Fig. 2).

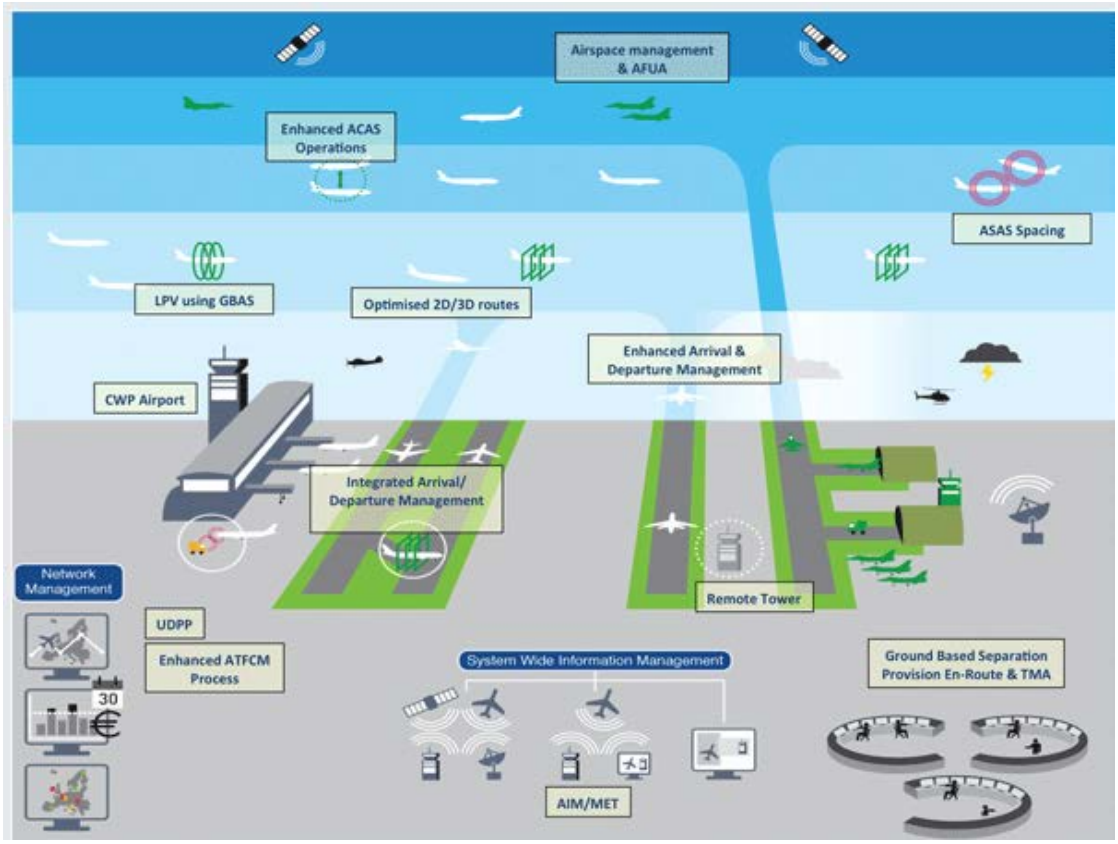

Fig. 2. Diagram of an ATM System.

Digital Aeronautical Information Management (D-AIM) aims to establish a general environment for information exchange by adopting a standards- and service-oriented

architecture. This allows static and dynamic aeronautical information to be merged and distributed through data hubs, based on data standards in a standardized exchange format through standardized interfaces. [3]

D-AIM shares ground-to-ground information, as well as ground-to-air information sharing, by integrating AIM communication and datalink as a common basis for interoperable technology studies. D-AIM meets the future requirements of Air Traffic Management (ATM) with up-to-date aeronautical information, progressing with automation and data integration into a new service delivery platform (Fig. 3).

Fig. 3. Air traffic command and control center.

- River information services (RIS) are available on inland waterways to manage the use of waterways and freight transport (Fig. 4).

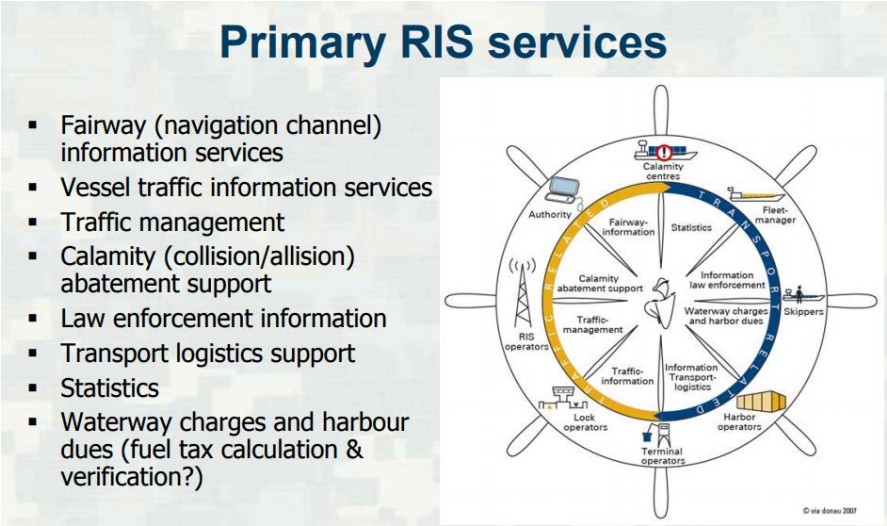

Fig. 4. RIS service components.

For river navigation, the concept of Electronic Navigational Chart or ENC was imposed due to the need to provide navigators with the most accurate and up-to-date information regarding the characteristics of the navigable channel (navigation gauges ensured, trajectory configuration ideals that a ship must describe in order to navigate safely, through a certain sector, information related to the morphological elements of the river).

Permanently updated information is made available to navigators by an automatic data collection system from the ground using a set of sensors (DGPS positioning sensors, radar for capturing images, echo sounder for determining depths) and the graphical transposition of the results after their processing (Fig. 5).

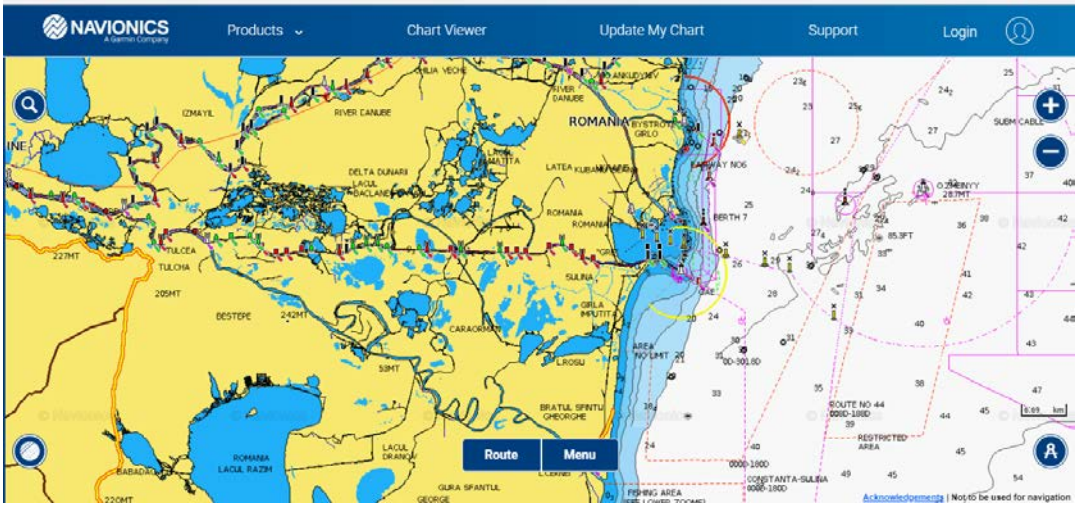

Fig. 5. Interactive digital map for navigation on the water.

- The maritime transport sector has introduced SafeSeaNet and the Vessel Traffic Management Information System (VTMIS) and is making progress towards the introduction of an automatic vessel identification system (AIS) and an identification and tracking system of long-range ships (LRIT) (Fig. 6). [5]

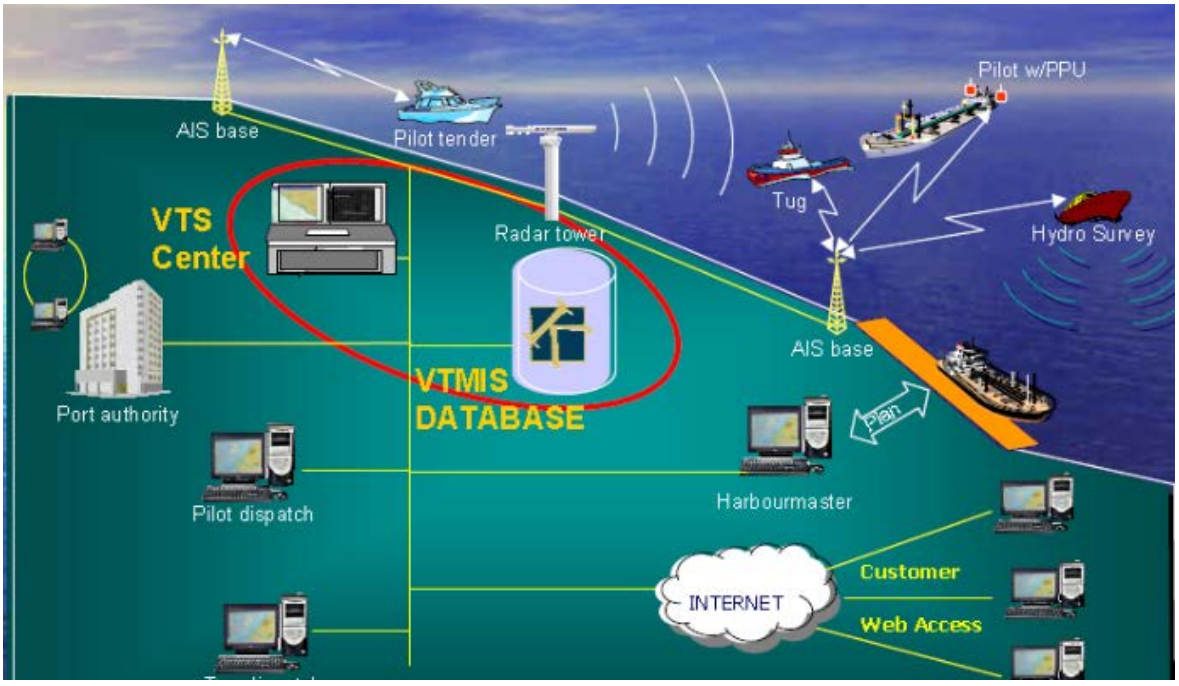

Fig. 6. Scheme of the maritime traffic monitoring system.

- The European Rail Traffic Management System (ERTMS), the European Train Control System (ETCS) and telematics applications for freight transport (TAF-TSI (Telematics Applications for Freight - Technical Specifications for Interoperability)) are gradually being introduced into the railway network (Fig. 7). [4]

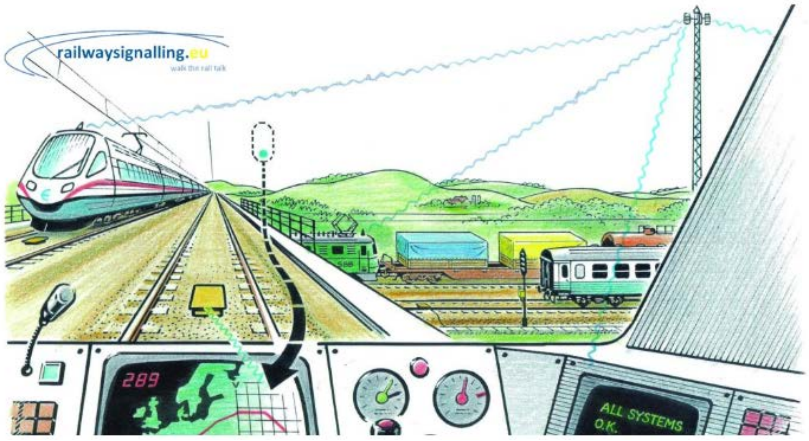

Fig. 7. ERTMS principle.

- Among the examples of applications in the field of intelligent road transport systems are traffic management and control systems in urban areas and on highways, electronic road toll systems and road navigation systems (Fig. 8). However, until now there is no coherent European framework of this type that allows road transport to be interconnected with other modes of transport. [2]

Fig. 8. The schematic concept of a road ITS.

"Green Transport Corridors" is an EU initiative to promote the concept of integrated freight transport, which consists of combining transport modes in order to offer greener alternatives for long-distance transport between logistics platforms. The use of advanced ITS technologies are essential to achieve this goal. [1]

ITS tools are an indispensable factor for the management of some logistics chains, especially in terms of managing the physical flow of goods with the help of an electronic information transmission channel (eFreight).

Real-time Traffic Information (RTTI) services, increasingly available in combination with satellite navigation systems, are now provided from both public and private sources, thus facilitating mobility (Fig. 9).

Fig. 9. Vehicles and infrastructure communicate in real time.

In the long term, cooperative systems (C-ITS) based on vehicle-to-vehicle (V2V), infrastructure-to-infrastructure (I2I) and vehicle-to-infrastructure (V2I) communication and information exchange, as well as, where appropriate, positioning in time and space through GNSS will show their true potential. [6]

Navigation, location and tracking systems can contribute to the remote monitoring of vehicles and goods in traffic.

3. The benefits of introducing a unique Intelligent Transport System in Europe

Common actions at European level can directly contribute to:

- addressing the complex aspects of ITS implementation, considering the large number of parties involved, as well as the need to ensure synchronization both geographically and between the partners involved
- supporting the market penetration of advanced mobility services for citizens, while promoting public transport alternatives to replace the use of the personal car
- ensuring the necessary conditions for generating savings for a more cost-effective, faster and less risky ITS implementation
- accelerating the current pace of ITS implementation in road transport and ensuring the continuity of services throughout the Community
- strengthening the leading role of the European ITS industry on international markets by encouraging the provision of innovative products and services for car manufacturers, transport operators, logistics providers and users.

To achieve these objectives, the EU can use several instruments: financial support, standardization initiatives, legislative and non-legislative measures.

ITS service providers are able to provide information to travelers through various channels before and during the trip, e.g. devices on board the vehicle, web services, message boards, special kiosks, mobile phones, etc., providing support for choosing the best way and the best route, but also information about the costs of the trip.

ITS helps provide a complete travel service: from travel planning and route guidance to ticket and parking reservation.

Most urban areas in Europe already use different types of ITS to support traffic control and management and public transport operations, but also for access control and regulatory enforcement (Fig. 10).

Fig. 10. ITS command centers.

There are many ITS applications designed to help traffic management and provide support for drivers of vehicles on motorways and other road categories, providing the following categories of data:

- Providing traffic information and guidance to drivers via message boards or on-board devices.
- Traffic speed control on congested highways to streamline the total flow of vehicles (avoiding the propagation of congestion).
- Automatic incident detection systems that automatically send messages to traffic control centers and provide immediate warnings to drivers.
- Intelligent Speed Adaptation (ISA) systems that ensure speed limits are maintained at all times – and even dynamically change these limits depending on road and weather conditions.

For both long-distance and urban freight transport, ITS applications can increase the efficiency of operations, encourage the use of different modes of transport and also improve transport safety by:

- Systems for scheduling and allocating vehicles, loads and drivers and automatically generating transport reports.
- Determining the optimal route for both normal and special transports, such as oversized vehicles or dangerous goods.
- Monitoring operations related to vehicle safety, with on-board recording of data and providing data in response to queries from ground equipment.
- Track and display routes for commercial vehicles, containers or cargo during transport, along with physical condition monitoring, e.g. for food and dangerous goods.
- Automatic generation and maintenance of commercial and other documents accompanying commercial vehicles and goods.
- Automatic detection of violations of traffic rules, e.g. high speed, disobeying traffic lights, along with details of the respective vehicles.
- Automatic tolling that allows vehicles to be tolled correctly without stopping at the payment desk. [1]

Telematics solutions are fleet monitoring systems that track various factors regarding the use of vehicles, such as tracking cars and routes traveled, fuel consumption or the behavior of drivers in traffic, aspects that decisively influence fleet management costs. Based on the reports provided by the telematics solutions, the car fleet managers can spot and correct any problems in time, taking measures to reduce costs and make the company's activity more efficient. [7]

At the same time, telematics solutions allow automatic processing of the main factors regarding fleet management (number of kilometers traveled, fuel consumption, number of consecutive hours the vehicle is driven, etc.) and setting the evolution of certain indicators, so that the dispatcher is alerted only when deviations are found.

The positive effects that can be observed when telematics systems are used can be:

- increasing the rate of use of vehicles by 15-20%, by reducing their wear and tear;
- significant reduction of fuel consumption and noxious emissions;
- reducing the average working time, respecting the work/rest schedule by drivers;
- monitoring and improving the behavior of drivers, following the constant evaluation of speed and potentially dangerous maneuvers in traffic;
- optimizing routes and changing routes depending on traffic, implicitly reducing delivery times and increasing customer satisfaction;
- avoiding fines and additional taxes;
- increasing revenues through the optimal use of the same resources (technical and human) and reducing operational costs;
- the complex reports provide a clear and synthetic picture regarding the performance of the car fleet and allow quick decisions to make the activity more efficient - a competitive advantage;
- trip and distance traveled reports show the degree of use and loading of the fleet;
- some telematics solutions have a function for calculating fuel consumption and automatic payment of road taxes in various countries - very helpful for international transport companies.

4. Conclusions

The technological evolution in the field of IT and communications facilitates direct communication between smart objects (internet of things). Thus, communication connections between vehicles (V2V), between vehicles and transport infrastructure (V2I) or between various types or elements of infrastructure (I2I) are possible today. All this leads to increased safety in the field of freight and passenger transport, of all types, to a less polluting transport and, why not, to autonomous vehicles without a driver, being equipped with all types of sensors and on-board controllers to make the mobility of people and goods safe, sustainable and fast.

5. References

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