SYSTEM GALILEO WILL HELP TO REVITALISE THE RAILWAYS

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Annotation: The article deals with the study, which is based on the expertise of the UIC work group GALILEO applications for rail. The power of using the satellite navigation technology in the railway system results from its combination with other technologies. The GALILEO technology provides an impressive potential for applications in the railway system.

Key-words: standards, integration, modularity, flexibility of the railway system

1. INTRODUCTION

The UIC specialists' work-group „GALILEO applications for rail" has produced two reports with regard to the application opportunities of the satellite navigation and precise timing.

The first report has established the roadmap for successfully implementing the new satellite navigation technology in the railway system. This report has identified and established a series of actions to promote the most impacting GALILEO applications.

The second report has analysed the principal factors and elements that should be considered when evaluating the economic use of the new technology within the applications to rail.

2. DESCRIPTION OF GALILEO

Galileo is the first satellite positioning and navigation system specially designed for civil purposes. Its profitable applications spread into many areas of all our lives – starting with safe and efficient transport.

The Directorate-General for Energy and Transport at the European Commission formulates and implements EU policy in two closely linked sectors. The 2001 White

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Paper European transport policy until 2010: time to choose, set out practical measures designed to bring about a considerable improvement in the duality and efficiency of transport in Europe by 2010. Galileo is a key instrument in achieving the main objectives of the White Paper.

The European Union, represented by the European Commission, is responsible for the political dimension of GALILEO and for setting objectives. The European Space Agency is responsible for the technical definition, development and the validation of GALILEO. The GALILEO Joint Undertaking will be responsible for the development of the GALILEO program and the selection of a commercial operator, who will make a significant contribution to the funding of the establishment of GALILEO from 2006 and will provide the GALILEO services from 2008.

Thanks to the compatibility and interoperability of GALILEO and GPS, users throughout the world will have easier access to signals emitted by navigation satellites and will benefit from much greater efficiency. GALILEO will also offer greater accuracy than GPS. The services offered by GALILEO will be covered by a guarantee of continuity which can even be laid down in a contract: this is a very important innovation when human life is involved, as with air or rail traffic control.

GALILEO will ensure Europe's strategic independence and enable European companies to be involved in a growing sector of industry whose annual market could be over EUR 200 billion in 2020 with 3 billion receivers in service.

The analysis of the performances of the satellite navigation systems and of their predictable evolution shows an increasing gradual satisfaction of the requirements of the railway applications.

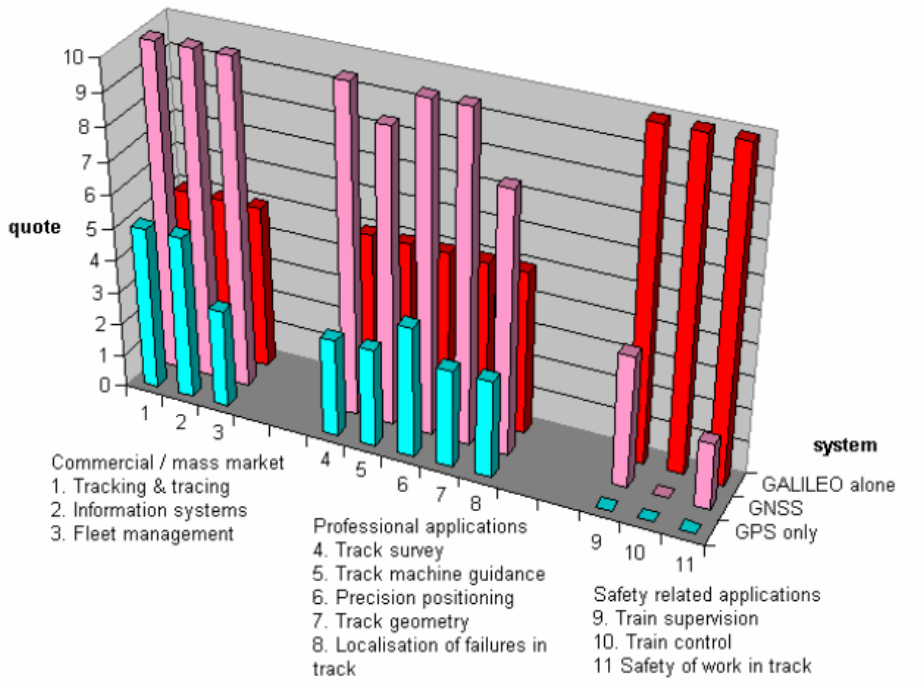

Figure 1 Satellite navigation systems and their predictable evolution

One of the most important strategic actions is the validation and certification of the GALILEO for rail. The validation and certification of GALILEO as a global system should enable its use as a constituent of rail intended applications and hence, the full reinforcement of existing standards and regulations applicable for the validation and certification of every railway intended application. This is the reason why the UIC specialists′ work-group advanced the third report.

3. THE THIRD REPORT „GALILEO APPLICATIONS FOR RAIL“

The third report analyses the factors and elements that may maximize the effects of using the satellite navigation technology when integrating it with other technologies such as radar, video, telecommunication, advanced sensors, servo-controlling, etc. The study develops the principles of “integration platforms” capable of inter-connecting modules and devices in scalable and flexible architectures.

The third report analyses the integrating factors and the typical high-level structure of integrating platforms at three levels:

1. at multi-functional device – incremental level,
2. at railway vehicle (locomotive, train-set, coach, wagon)
3. at area level (traffic control area, level crossing area)

Another aim of the study is to provide a representative selection of integrating technologies and of the technologies that have the potential to be combined with the satellite navigation to offer enhanced applications through integration.

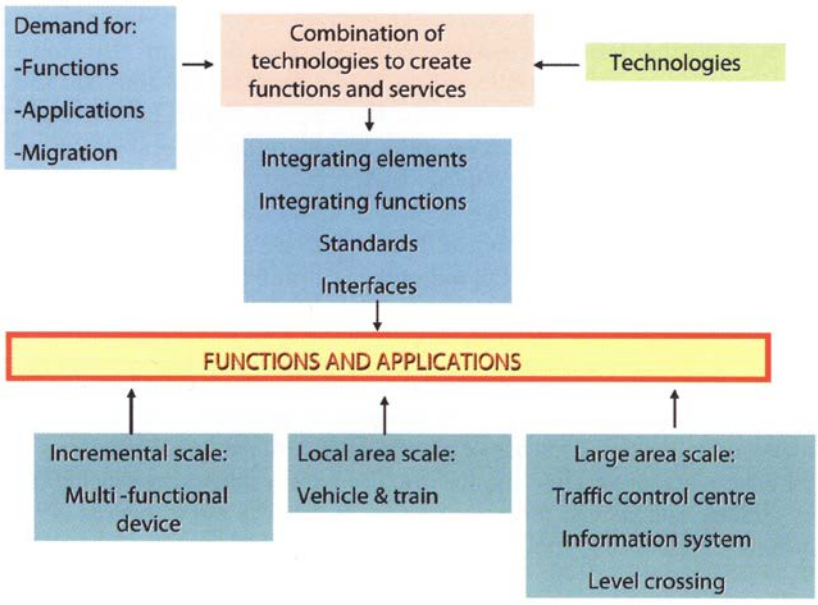

Figure 2 Illustration of the document′s logic structure

The figure 2 illustrates logic structure of the document “GALILEO applications for rail – Integration of technologies for maximalisation of effects“, which is the third report of the UIC specialists′ work-group.

The study opens the opportunity to benefit from common standards and common development frameworks, to secure interoperability, decrease costs and assure the migration on a large technology basis. Other integrations may involve specific “platforms” that are initially conceived for “classical” technology integration, such as the vital computer of the ERTMS/ETCS, the safety critical train ground telecommunication systems (GMS-R).

4. EDDY-CURRENT DEVICES FOR SENSING THE RAIL DISCONTINUITIES

The study deals also with the use of Eddy-current sensors which are exemplified on the basis of the German system DemoOrt. The basic idea consists of developing a platform with an onboard autonomous and vehicle autarkic technology which also integrates and uses available as well as innovative technologies with the main focus on satellite based positioning (GPS, GALILEO and EGNOS).

The system is designed to be highly available and will be deployed for applications bearing safety responsibility. In order to fulfill the requirements the fusion of diverse position information is necessary as shown in next figure.

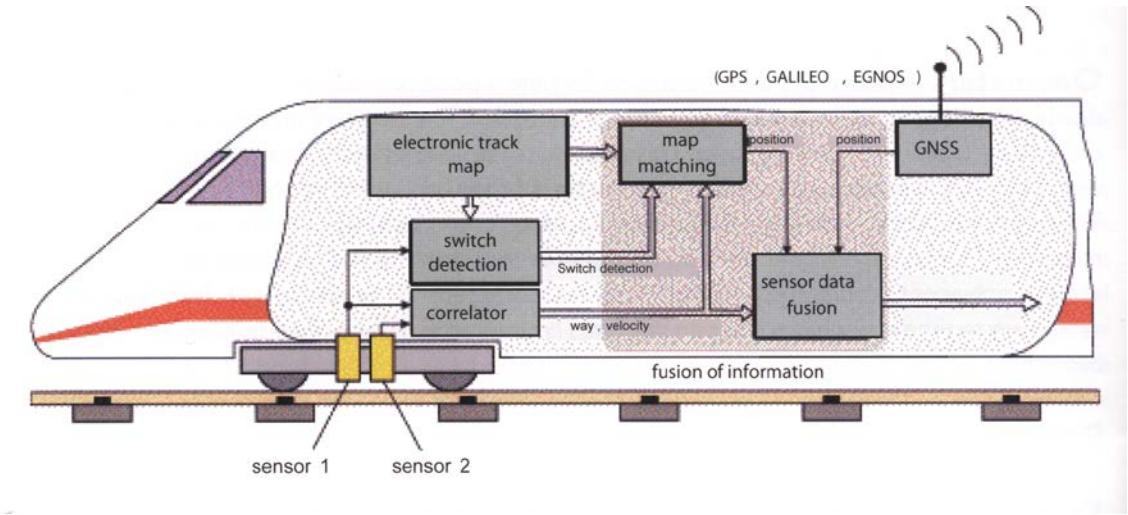

Figure 3 DemOrt locator principle

The main idea is to use different sensors with different principles of measurement. Three basically different sensors are used for one highly available and safe system. These are:

1. GNSS based receiver
2. Eddy current sensor
3. Map matching

5. EXAMPLES OF APPLICATIONS

Examples of application for railway transport are commercial, operation and data handling. We can separate applications:

1. Location of vehicles for commercial tracking and tracing – locates the vehicles and transmits position via GSM (or GSM-R) to central management point.
2. Location, diagnosis of vehicle status and operational conditions – adds information with regard to vehicle diagnosis and/or diagnosis and status of cargo.
3. Location, monitoring, remote control (temperature, doors…) – monitors the cargo and enables automation (remote control) of some vehicle features.
4. Location, information systems for freight and passengers – users the location and movement detection to feed information systems for passengers and freight.
5. Fleet management (optimisation of use, programming) – appends "intelligent" tools to the simple display of position and optimises the dispatching of vehicles in relation to the traction or transport demand.
6. Passenger information systems (schedule, connections, guidance) – adds timetable and guidance information to the raw train position and movement information.
7. Location of GSM-R mobile equipment/handover of cells and frequencies – locates the GSM-R terminal to instruct the GSM-R roaming to allocate the optimum cell for communication – reduces the access duration and solves problems of communication management.
8. Precise timing for synchronization of data transmission and record – precise time stamp makes information more robust and reliable.
9. Precise timing for synchronization of TC networks and equipment – precise time for synchronization of digital telecommunication equipment – makes the whole transmission chain cheaper, robust and increases the data throughput capacity.
10. Precise timing for increase of data security (precise time stamp) – precise data stamp protects a data frame against intrusion or falsification (currently used for high responsible banking transactions)

6. THE POSITIVE EFFECTS OF THE COMBINATIONS OF SATELLITE NAVIGATION AND OTHER TECHNOLOGIES

The positive effects of the combinations of satellite navigation and other technologies results from:

- The optimisation of the equipment – this optimisation shall be understood as:
  - the capacity of rationalization of equipment (use in application each time one functional equipment that integrates its information in multiple functions)

- the capacity of enhancing functionality and performance.

- Modularity and scalability of applications, when a “core” design can be the base of adding modules (hardware) and functions (“intelligence”, software) in the scope to “tailor” the application to the intended conditions of use.
- Migration of applications, to follow the natural path of the technological development in electronics, data processing, telecommunication and networking, when knowing that the railways are not the driving factor of technology development in this field.

The maximalisation of positive effects can be achieved when the applications' design follows the principles of “integration platforms”. An integration platform is a combination of integrating functions (such as computing, data processing, etc), integrating elements and standards (such as interfaces based on standards) and of other utilities. Utilities are capable of accommodating combination of modules to form complex functions and applications, providing scalability of functions and performance and disposing of its own external interfaces to realize information links with other platform and/or devices. An integration platform shall provide a “core” design that contains the integrating functions (data processing, data exchange, inter-connections, external communication via standard interfaces).

7. CONCLUSION

The conclusions of the study aim at establishing what are the most promising “integration platforms” for railway applications. The integration platforms are essential tools that should be employed to reach the full use of technologies with maximum efficiency. Even in the conditions of a large standardization framework, the railway applications could take serious advantage of versatile and generic industrial standards.

The applicable standards are briefly indicated in the description of technologies and of integrating elements. They are connectivity and interfacing standards common to the computer technology, networking standards, access point standards characteristic for networking technology, radio-communication standards applicable in the railway operation and railway interoperability specifications.

LITERATURE

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