PERIODICA POLYTECHNICA SER. TRANSP. ENG. VOL. 28, NO. 1–2, PP. 17–22 (2000)

THE CONDITIONS OF THE APPLICATION OF ETCS IN HUNGARY

Géza TARNAI*, Balázs SÁGHI* and László MOSÓCZI**

*Department of Transport Automation
Budapest University of Technology and Economics
H–1521 Budapest, Hungary
Tel: +36 1 463 1013
e-mail: {tarnai|saghi}@kaut.kka.bme.hu
**Hungarian State Railways
H–1062 Budapest, Andrássy út 73-75, Hungary
Tel.: +36 1 432 3390
e-mail: MosocziL@mavrt.hu.

Received: October 5, 2000

Abstract

The realization of the interoperability between the partners of an intermodal transportation chain as well as inside a single transportation mode heavily influences the quality of the whole transportation process. The railway can only be a competitive partner of the intermodal transportation chain, if the railway network is equipped by homogeneous infrastructure through several countries. Train Control Systems play here an important role. The main goal of this paper is to introduce the efforts for a unified European Train Control System (ETCS) and to present the results achieved up to now.

Keywords: train control, railway signalling, ETCS.

1. ETCS in Europe

1.1. Goals of the Introduction of ETCS

For the sake of stopping the loosing ground of the railways, the European Union (EU) adopted as a first step the aim of improving the competitiveness of railways in the member states. It was decided that the main economic and political centres should be interconnected with a passenger transport system offering fast travel, the ratio of combined cargo transport should be increased, the railway technical standards should be unified (facilitating interoperability) and at the border crossing stations the administration and staying time should be reduced to a minimum.

Over the years, a number of different Automatic Train Control (ATC) systems have been introduced in different countries at different times. These systems are incompatible with each other. Only a few are used in more than one country, and in cases where the same basic system has been adopted in different countries, there have been differences in detailed development which has resulted in incompatible versions. The large number of different national systems in use is a major obstacle for cross-border traffic in Europe.

According to the principles outlined above, in the early nineties, on recommendation by the EU, the development of the unified European Train Control System constituting a part of the unified European Railway Traffic Management System (ERTMS) was started.

There are several factors that force the introduction of ETCS. The needs can be classified as economic, business and technical aspects.

Economic aspects

The tendency of liberalization in the transport world means that in future the railways are going to be more competitive. The system of the future, therefore, is intended not only to improve operating efficiency, as will be detailed below, but also to seize every opportunity to reduce acquisition and maintenance costs. The adoption of a uniform system at European level will result in cost reductions, as system development and maintenance can be carried out in a uniform manner. Furthermore, the fact that all the railways will be using the same system means that the system components can be produced in larger quantities.

Business needs

All railways have the same business need: to be able to provide market-oriented, reliable, safe and cost-effective train transportation for both passengers and freight. One of the prerequisites for this is to have an appropriate system for automatic train control (ATC) and protection (ATP). The business aims of the railways can be listed as follows:

- enhance the safety of the train traffic by equipping lines with ATC/ATP,
- increase the carrying capacity of the line by taking the headway and speed to the limits physically possible, while keeping the existing safety level.

The current technical solutions for intentional traffic do not meet the railways' long-term reliability and efficiency requirements because the train can pass the borders only with the changing of the traction units due to the different ATC systems.

Technological needs

Increased use of microprocessors in conjunction with electronic data processing has led to the major changes in the systems, which control and protect train traffic. More and more significant parts of the system such as points or signals will be computer controlled. Such computers may be equipped on the ground or on the board of the vehicles and will be connected by means of data transmission system. The increasing complexity of the train control systems means that the cost of developing

new ones is continuously increasing. Smaller railways and manufacturers are less and less able to cover such costs. Joint work on the development of an ETCS system for the future will produce synergic effects for the railways and industry as a result of a sensible division of responsibility.

1.2. Benefits of Installing ETCS

The benefits of installing ETCS on the European railway network can be summarized as follows:

- Faster and better international traffic, it will become possible to apply more reliable and more cost-effective equipment to rolling stock used for high-speed passenger traffic.
- Reduced headways on highly loaded parts of the network, additional level of functionality, available to all the railways, such as driving on electronic sight, will allow those parts of the network which present bottlenecks to be loaded to their physical limit.
- Reduction in costs of building and renovating lines and stations and of replacing outdated ATC systems.
- Reduction in a workload for the technical departments of the individual railways, as a result of the provision of uniform documents and aids for the construction and maintenance of the equipment, drawn up in accordance with the European standards.
- The establishment of a competition among the manufacturers.
- The precondition for the future harmonization in other areas of operation control.
- Increased availability, based on the evaluation of EU-wide failure statistics.

Obviously, the significance of these benefits can be different for each railway.

1.3. ETCS Application Levels

ETCS is defined to be a very flexible system offering easy configuration features to different application levels. Fall-back solutions and interoperability with existing national ATP systems in Europe are provided. The level to which a part of a line or the vehicles are equipped with ETCS equipment determines the level of performance of the system, i.e. the number and sophistication of the functions available on that line. On the other hand, each level of application also defines the amount of equipment to be installed. The application levels are defined as follows.

Level 1 provides Automatic Train Protection with supervision of line speed and braking to restrictive targets. It is proposed to be used in connection with fixed blocks, signals, and train detection functions outside the ETCS system (e.g. by track circuits or axle counters). Level 1 can be implemented with spot transmission

(balises, short loops) or with target information updating (infill) by medium length loops or radio.

The higher application levels provide Automatic Train Control (ATC) with conventional train detection and fixed block sections with or without lineside signals (Level 2), or with continuous train location, radio block, and possibility for moving block operation (Level 3).

2. Introduction of ETCS into the Hungarian Railway Network

2.1. ETCS-VB Project

In 1993 the Hungarian State Railways (MÁV) decided on starting the introduction on its network of a new, point-type (intermittent) train control system in relation to the elevated train speed. Having studied the market and the international development trends, tendencies, the management of the company decided not to implement an already existing train control system on the network but rather to install the ETCS Level 1. This was justified by the fact that owing to the intent of joining the EU, it is expedient to choose it, as this system is advantageous for achieving the interoperability of the main lines and because by the middle of the nineties the development of the system has advanced [4].

Accepting the proposal of the EU and the International Union of Railways (UIC), the Austrian Federal Railways (ÖBB) and the Hungarian State Railways (MÁV) agreed that with certain conditions they will install the ETCS system on the Budapest – Vienna line.

Following a preparatory period of nearly one and a half year, the ETCS-VB (European Train Control System Vienna – Budapest) Consortium has been established by ÖBB, MÁV, five industrial companies and the ARSENAL Research and Development Centre (Vienna). The Consortium has won the support of EU. Beside the Spanish, Italian, German and French projects, the ETCS-VB is the only project with the participation of an East-European country and the only one incorporating a border crossing.

The tasks to be solved in the ETCS-VB pilot implementation project are illustrated in *Fig. 1*. The project (large gray box) is a part of the overall ERTMS/ETCS project and surrounded by other ETCS specifications, definitions and test projects [2].

2.2. Aims of the Introduction of ETCS in Hungary

The setting up of the experimental section including the Hungarian – Austrian border crossing and the implementation of the test program was planned with the main aims as follows:

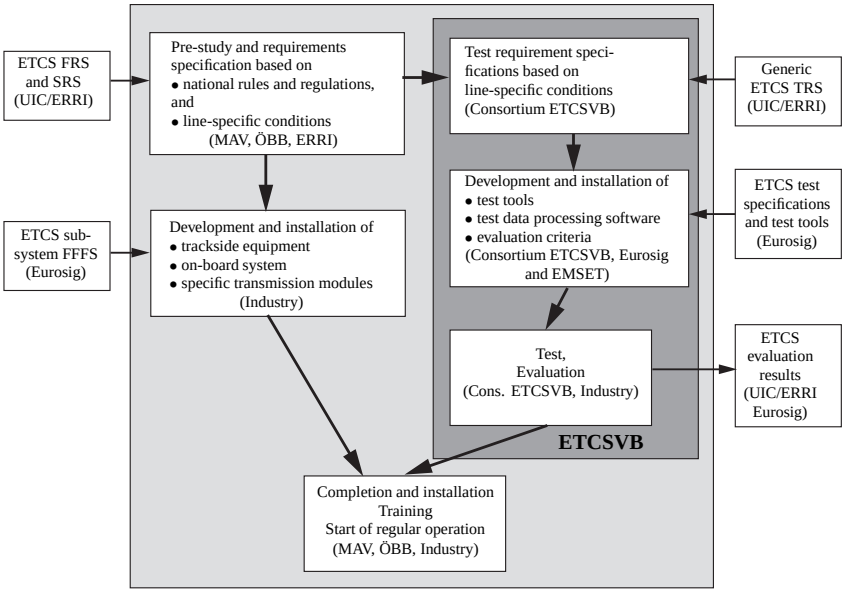

Fig. 1. ETCS pilot implementation project Vienna – Budapest (task overview) (ERRI: European Railway Research Institute, UIC: Union Internationale des Chemins de Fer, EUROSIG: Consortium of European Manufacturers, FRS: Functional Requirement Specification, SRS: System Requirement Specification)

- investigation of installation of the system on a real railway track section without interrupting the scheduled traffic,
- testing the possibility of interfacing to the existing safety equipment and the feasibility of fulfilling the prescribed functions,
- feasibility of compliance with the user requirements formulated by the railway companies, and
- checking the possibility of solving the technical questions of border crossing.

3. Evaluation of the ETCS VB Project

The pilot plant organized by the MÁV (on the Hungarian part) has proven that the specified system is viable and ready for operation [3].

In the course of the tests, the basic functions of the lineside signal transmitter elements were checked in regular operation and also in a simulated breakdown. It has been proven that the system is capable of triggering a safety reaction defined by the railways in case of a breakdown endangering the safe operation that leads finally to the stopping of the train.

The tests have clearly demonstrated that the guidelines formulated by the European Union are basically correct. The system corresponding to this can be fitted to the existing station and lineside safety equipment at the railway lines pertaining to the international basic network (such as the Budapest–Hegyeshalom line section).

Furthermore it has been proven that the system complies with the conditions of high-speed traffic, even more in some cases it can contribute to increasing the throughput capacity of the line, less traffic disturbing in the case of a possible failure of the lineside equipment.

For MÁV the participation in the first experimental project of ETCS was an advantage with particular attention to formulating the demands and expectations related to the ETCS system and to the further installation of the system along the entire Budapest–Hegyeshalom section.

For the better presentation of the lineside and on-board systems a simulation and training system introducing the functionality of ETCS has been developed at the TU Budapest, Department of Transport Automation. The system is capable of being applied for the primary training of the engine drivers and the persons responsible for the maintenance of the lineside equipment, and at the same time for providing information of sufficient quantity and level for the decision-makers [1].

The pilot plant – considering also the preparatory, design, implementation and evaluation stages – has shown the areas where new regulations should be worked out and new technology provisions should be introduced.

References

[1] ARANYOSY, Z. – MOSÓCZI, L. – RÁCZ, G. – TARNAI, G.: Training the Personnel Using Simulator and Training System. *World Congress on Railway Research Conference*. Florence, Italy, 1997. pp. 745–751.

[2] DOPPELBAUER, J. – RHEIN, D. – MOSÓCZI, L. – ZIERL, A.: The New European Train Control System (ETCS): Installation Problems on an Existing Line. *World Congress on Railway Research Conference*. Colorado Springs, USA, 1996, pp. 151–157.

[3] ETCSVB Project. Final Report for Publication. 29.02.2000. p. 106.

[4] GÁL, I. – MOSÓCZI, L.: Development of the Signalling System and Introduction of ERTMS/ETCS at Hungarian State Railways. *Railway Signalling and Telecommunication Technology Conference*. Tokyo, Japan, 1998, pp. 235–241.