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ERTMS., ETCS

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CONDITIONING OF INITIATION ERTMS/ETCS

Progress of technological applied national devices of steering railway movement, he extorted study of uniform system ERTMS. Placed ETCS in individual countries are different requirement installations. Differences result also from different reasons of individual investment. One from common requirements is limitations of costs one needs obviously in whole cycle of life of system. Fact, that system ETCS comes under European unification and it is offered by competing with itself of trades mans it favours limiting of costs. Present report introduces problem of choice of influencing factors ERTMS onto choice of system.

UWARUNKOWANIA WDRAŻANIA ERTMS/ETCS

Postęp technologiczny stosowanych narodowych urządzeń sterowania ruchem kolejowym, wymusił opracowanie jednolitego systemu ERTMS. Stawiane są różne wymagania instalacjom ETCS w poszczególnych krajach. Różnice wynikają także z różnych uzasadnień poszczególnych inwestycji. Jednym ze wspólnych wymagań jest oczywiście potrzeba ograniczenia kosztów w całym cyklu życia systemu. Fakt, że system ETCS podlega europejskiej unifikacji i jest oferowany przez konkurujących ze sobą dostawców sprzyja ograniczaniu kosztów. Niniejszy referat przedstawia problematykę wyboru czynników wpływających na wybór systemu ERTMS.

Due to different nature and extent of the existing train control systems, as well as due to different operational, geographical and economical conditions, there are also considerable differences regarding the need of ETCS in the various countries and therefore for the way of justifying this investment.

One common interest is of course the need for reducing the costs of the train control and train protection system over the whole life cycle. ETCS significantly contributes to this thanks to the Europe wide standardisation and the creation of true competition amongst several suppliers for the procurement.

The following table shows qualitatively the importance attributed by the various countries to several other relevant factors.

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Country	interoperability	cab signalling	safety	renewal of signalling	renewal of rolling stock
Austria	10	6	5	6	6
Belgium	8	10	8	7	4
Bulgaria	8	5	10	6	4
Czech Republic	8	2	10	4	2
Denmark	8	2	4	2	2
France	6	8	2	4	4
Netherlands	8	10	7	7	6
Luxembourg	10	2	8	4	6
Germany	6	8	2	2	4
Poland	10	8	10	9	6
Romania	8	6	8	8	6
Slovakia	8	6	8	4	2
Slovenia	10	8	10	8	8
Serbia	8	8	8	8	8
Sweden	4	8	2	5	6
Switzerland	10	10	3	7	6
Hungary	8	2	7	8	4
Italy	9	9	7	6	6
Legend	high 10, low 0				

Interoperability: The importance assigned to this aspect depends on how intensively the corresponding network is involved in international rail corridors and to what extent the corresponding operators run international trains entering into the neighbouring networks. Also Interoperability is probably more urgent for smaller networks, as bigger network benefit from national Interoperability based on their existing systems introduced over much longer lines and more nodes.

Need of *ETCS cab signalling* for high speed lines and/or heavily loaded conventional lines. Basically this requirement depends on two aspects: Firstly the existence of projects for new construction or modernisation of lines, where high speed and/or high train density is required. And secondly – if an existing cab signalling system is already in use - the willingness of the corresponding country to adopt ETCS in place of the old national systems. Pioneers in this regards are especially those countries, where new high speed lines are in construction, on which not only the train control but also the energy supply and/or the gauge is different from the existing network.

Increase of safety by preventing collisions and derailments caused by over-speed. The need of ETCS for improving the safety of train operation depends on one hand on the operational conditions and the track configuration in the various countries and on the other hand on the performance of the train control and protection systems already existing. The practical experience and theoretical studies made in various countries (see the example of Switzerland) shows that the risk of passing signals at danger and causing so accidents is varying to a large extent depending on the characteristics of the various line sections. Simple warning or warning/stop systems do not provide enough safety at all locations. Also the older speed supervision systems with discrete speed levels have certain limitations e.g. in station areas at lower speed. Optimal safety performance is delivered by continuous speed supervision systems or by cab signalling systems, whereby the latter have to be installed all along the lines.

Opportunity of installing *new signalling- and especially interlocking- installations.* Conditions for installing ETCS in a cost effective way are especially favourable if the

complete signalling installations including the interlockings have to be rebuilt or built newly. In this case ETCS level 2 without line-side signals and at a later stage ETCS level 3 should allow significant cost reductions compared with the tradition line-side signalling. A high priority for the fitment with ETCS should therefore be given on lines or nodes which are newly built or rebuilt. Opportunity of *putting into service new traction vehicles* or of *overhauling vehicles in the middle of their lifetime*. On rolling stock-side the installation costs for ETCS can be significantly reduced, if the units are purchased right from the beginning with the ETCS equipment or if on existing vehicles ETCS is retrofitted in context of a mid-life general overhaul. High priority for the fitment with ETCS on rolling-stock side should therefore be given to newly ordered vehicles or vehicles being overhauled at midlife time.

Below introduced choose conditioning of initiation ERTMS/ETCS for some European countries are.

Belgium

Interoperability: In passenger service, Belgium with the European capital Brussels is a turning table for high speed corridors towards France (Paris), England (London) , Germany (Aachen, Cologne) and the Netherlands (Rotterdam, Amsterdam). In addition, Belgium is ending point of an important conventional rail corridor from north (port of Antwerp) to south (border to Luxembourg).

Cab signalling: For the high speed lines cab signalling is required. Until now the traditional systems TVM 430 and TBL2 have been installed. Application fields for ETCS are the new lines in construction between Antwerp and the Dutch border as well as between Liège and the German border (Aachen).

Safety: Although better than nothing, the Crocodile and the TBL1 systems are not able to enforce trains to stop in every case in front of danger points and therefore are not sufficient for preventing accidents especially in zones with very dense traffic. A latest proof of this was an accident at Pecrot in 2001 with 8 persons killed. ETCS is urgently needed in the whole conventional network for enabling a continuous speed monitoring at least on safety critical line sections.

Need for renewal: Crocodile is a very primitive system from a functional and technological point of view. But also the TBL1 system is more than 20 years old and no further developments are envisaged.

France

Interoperability: Since the beginning of the implementation of the spectacular High-speed train network, French TGV trains have been ran also to neighbour countries. So the TGV Sud-Est has prolongation's to Switzerland and the TGV Nord is part of the high speed corridors towards England and Belgium - Holland as well as towards Germany. With the High-speed line East additional High speed connections are in construction towards Luxembourg, Germany and Switzerland. In a longer future new high speed links will be realised with Switzerland, Italy and Spain. For freight service, France is involved in several corridors linking all it's neighbour networks including the link to England via the Channel tunnel.

Cab signalling: As shown above, France will extend it's high speed network in the coming years. There is a need for increasing train density parts of the high speed network as well as on conventional lines and nodes.

Safety: There as never been a safety problem in relation with train control on the high speed lines. In the conventional network the combination of crocodile and KVB proves to be effective for preventing train accidents.

Need for renewal: On the high speed network the track-side signalling installation is far from needing to be renewed. It is more on the rolling stock side, where the oldest part of the fleet is reaching the mid-lifetime where in general a major overhaul is performed.

In the conventional network the signalling installations are ageing and a huge need for renewal is foreseeable especially in the field of the interlockings and the outside signalling equipment. As far as train control is concerned, especially the crocodile is definitely of poor functionality. Part of the conventional network in France consist of low density lines. Here low cost solutions are required for further rationalising the train operation on infrastructure-side.

Germany

Interoperability: As a consequence of its central position in Europe and the important geographical size, Germany is involved in several main European rail corridors. Specially on the corridors transiting Germany, the German portion of line length is relatively high, which makes it not easy to justify the instalment of ETCS in short term on track-side just because of the interoperability requirement. On the other hand it is a fact that on many of these corridors the neighbouring countries will sooner or later install ETCS, which means that German international trains running into these countries will need in any case an ETCS Eurocab equipment. As long as its lines are not converted to ETCS, STMS for PZB and LZB must be available to those operators wishing to enter into the German network with ETCS equipped rolling stock.

Cab signalling: Germany has a growing high speed network where modern cab signalling is an absolute necessity. In the last decade, important developments have been made for increasing the system capacity by means of optimal design of several parts in the rail traffic management system (CIR-ELKE). Until now, the underlying cab signalling system has been the LZB which (like any other existing national system) has not been chosen to become the common European standard. Therefore, for future extensions track- or train-side ETCS should be used as soon as possible. ETCS level 2 will not immediately give a better performance than LZB; but it opens the way for future application of ETCS level 3 which will significantly reduce costs on the track-side.

Safety: Thanks to the relatively extended investments into the LZB and PZB train control systems there is no general safety problem in Germany which would justify immediate investments in any train control system. Of course, ETCS will provide in future at least the same safety level as the existing PZB and LZB systems.

Need for renewal: On the conventional main lines and nodes, generally the interlocking-installations are ageing and a huge need for replacement is foreseeable. ETCS level 2 will allow to renounce to lineside signals. With ETCS level 3, also the device for detection of track-occupancy can be left out. This solution could be introduced in the most easy way on regional lines with low traffic density. On lines with low traffic there is a potential for rationalisation by fully automating the infrastructure-side train operation.

Italy

Interoperability: The Italian peninsula is linked on the north to the neighbour countries France, Switzerland, Austria and Slovenia. There are international rail corridors to all these countries; new rail passages for passengers and freight through the Alps are planned or in construction at the Mt. Cenis, the Lötschberg, the St. Gotthard and the Brenner. Interoperability is required for linking these access lines together with the national Italian rail system.

Cab signalling: In the coming years, several new high speed lines with a total length of about 600 km will be put into service. A new, modern cab signalling system is required (the existing 50 Hz BACC system can not be used also for technical reasons on the new lines to be electrified with AC 25 kV, 50 Hz; the 83,3 Hz BACC system will be installed on the lines influenced by the new lines to be electrified with AC 25 kV, 50 Hz, i.e. the conventional lines near the high speed lines.

Safety: As explained above, there is an urgent need for improving safety on main and secondary lines, so that one man train driving can be introduced. The new RSDD/SCMT system uses Eurobalises for the data transmission but (not yet) with a European ETCS telegram. At least on the lines without BACC it should be possible to implement at a later stage also European telegrams possibly based on the new mode "Limited Supervision".

Luxembourg

Interoperability: Luxembourg city is starting/ending point of several conventional rail corridors towards France (Metz- Paris/Strasbourg), Belgium (Namur/ Liège- Brussels) and Germany (Trier- Koblenz). In future one branch of the TGV Est will connect Luxembourg city with Paris.

Safety: There is an urgent need for reducing the risk of train accidents by introducing a modern train control system with continuous speed supervision.

Netherlands

Interoperability: For *passenger services* Amsterdam is starting/ending point of the high-speed corridors towards Belgium- England and France (Antwerp- Brussels- London/Paris) and towards Germany (Duisburg- Düsseldorf- Cologne- Frankfurt). For *freight service* Rotterdam with its very important shipping port is starting/ending point of the north-south corridor leading via Germany and Switzerland to Italy. Given the relatively small geographical size of the Netherlands, the Dutch portion on the total length of these corridors is relatively small. Therefore it is of interest, to enable international trains run on these lines just with an ETCS Eurocab without any specific Dutch national ATP systems (especially ATB first generation) which are only in use in this country. A separation between international corridor lines and the national system will be facilitated by the fact that the traditional network is electrified with DC 1,5 kV, while the power system planned for new international lines is AC 25 kV, 50 Hz.

Cab signalling: At the time being, two new high speed lines are in construction, for which a modern cab signalling system is required. The Dutch rail system is one of the most intensively used in the world. For the coming years the National Transportation and Traffic Plan (NVVP) considers various scenarios whereby in every case a strong increase in railway transport is expected. For example, the increase in train-km by 2020 varies between a minimum of 60% and a maximum of 100%. Such an increase of railway traffic requires better use and more flexible network capacity and services in comparison with the present situation. Therefore, the modernisation of the rail traffic management system including ETCS with level 2 and in future possibly with level 3 is seen as an important mean for increasing the capacity and the quality of the train service.

Safety: As mentioned above, the existing national ATB first generation system does not prevent passing signals at danger and gives no supervision under 40 km/h especially in station areas.

Need for renewal: On track-side, the coded low frequency track circuits are becoming more and more a limiting factor for the use of modern traction systems as they are affected

e.g. by electromagnetic interference or by inadequate shunting. On rolling stock side, one third of the fleet still has an ATB equipment in discrete electronic design whose end of technical life cycle is approaching.

Pro Rail, the new Dutch rail infrastructure management company, will have to renew within a relatively short time the major part of its signalling installations including the interlockings and the track-side train control equipment.

Switzerland

Interoperability: Switzerland is located in-between the four major neighbour states Germany, France, Italy and Austria and there are international traffic flows on roads and railways with all of them. The most important international rail corridors are the St. Gotthard and the Lötschberg- Simplon lines which connect Basle in the north with the border stations Chiasso/Luino respectively Domodossola in the south. Especially for passenger service there are also international corridors from Basle, Berne, Lausanne and Geneva to France, as well as from Zurich to Austria and to Germany. Already now international high speed train sets are transiting to Switzerland from Germany (ICE trains), France (TGV trains) and Italy (Pendolino trains). Especially between Germany and Switzerland also more and more international freight locomotives are used. This use of international rolling stock will certainly be even more generalised, once the new transalpine lines at the Lötschberg (opening of new base tunnel in 2007) and the Gotthard (opening of the new base tunnel planned for 2012) will be put into service.

Cab signalling: Until now the maximal line speed has been 160 km/h. In context of the overall projects "Rail 2000" and "Alptransit" new lines for speed of 200 km/h and higher are in construction. Modern cab signalling based on ETCS is not only seen as necessity for high speed train operation but also as a "soft" mean for further increasing the network capacity. Actually a regular time table with 30 minutes intervals is operated on the main part of the Swiss rail system. Within the next decade, 15 minutes intervals will be necessary on several connections. Most recent studies of SBB show that in the future, capacity bottlenecks will not lay so much in the lines but in the hub nodes. ETCS level 2 or even level 3 will contribute to solve capacity problems in such main stations as Zurich, Basle, Olten or Berne.

Safety: Thanks to the instalment of ZUB ATP in parallel to the old Signum Warning and Stop system there is no urgent need for further improving safety by means of train control systems on normal lines. In the future, the challenge is to further increase traffic density without deteriorating the safety level.

Need for renewal: "Signum" is a "grandfather" system in a cumbersome obsolete technology. But also the track elements used for ZUB do not any more correspond to the state of the art technology. The cable-loops must be removed prior to major track maintenance work and reinstalled afterwards, which negatively affects the duration and the costs for this work. For the coming years, a huge need for re-investments in the field of interlockings is foreseeable.

Poland

Interoperability: Polish railway lines (~20 000 km of lines) from the point of view of importance are usually subdivided into three groups - main lines (~5 500 km of lines), first priority lines (~13 500 km including main lines), and secondary lines.

Those lines connect Poland with Germany, Czech Republic, Slovak Republic, Lithuania, and also with Russia, Ukrain and Bielorussia and via Baltic with Scandinavian countries.

Cab signalling: At the moment no trains in Poland run with speed higher than 160 km/h but PKP is upgrading railway line between Warsaw and Katowice to 200/250 km/h (speed will depend on traction power supply possibilities). Already now it is decided that to run with speeds higher than 160 km/h trains will have to be equipped with cab signalling. Appropriate national cab signalling doesn't exist so for sure those trains and the Warsaw-Katowice line will be equipped with ETCS.

Safety: The SHP and RADIOSTOP are simple systems able to protect trains only in some emergency situations. A new ATC system widely installed will certainly ensure higher safety. As a need for safety improvement is applicable at least to all main railway lines economical considerations will have to take into account so called "level 1 limited supervision" solution if it will be accepted as a European one.

Need for renewal: SHP is an AWS system ensuring spot transmission based limited functionality. It is also old from technical point of view. RADIOSTOP is integrated in the analogue 150 MHz voice radio, which will have to be replaced by GSM-R. Replacing both systems by ETCS witch is an ATC system ensuring continuous speed supervision is an ideal solution. 17 500 km of lines with SHP and 24 000 km of lines with RADIOSTOP mean long migration period counted in years. From technical point of view shorter migration period is better but unfortunately it needs more finances per year. As both systems are only used in Poland and are widely used together a single STM will be used during migration period. The STM is not yet available.

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