



REGERINGSKANSLIET

Memorandum

27 September 2007

**Ministry of Enterprise, Energy and
Communications**

Division for Infrastructure

Magnus Axelsson

Telephone +46 8 4051233

Fax +46 8 4053030

E-mail magnus.axelsson@enterprise.ministry.se

Swedish ERTMS implementation plan



Table of contents

Summary	4
Background	5
Assumptions	5
<u>Financing of the Swedish ERTMS implementation plan</u>	5
The Swedish railway infrastructure planning process	5
Costs for the ERTMS implementation 2008 - 2013.....	7
Costs connected to the vehicle strategy	7
<u>Technical requirements for implementation of ERTMS</u>	9
Existing traffic control system	9
ERTMS – a European standard	9
Technical requirements	9
GSM-R.....	9
Functional level	10
<u>Implementation strategy</u>	10
Vehicle strategy	10
Infrastructure strategy	11
Swedish ERTMS implementation plan	12
<u>Potential constraints</u>	13

Summary

This plan has been drawn up in order to meet the requirements in TSI 2006/860/EC ("Control-command and signaling subsystem of the trans-European high speed rail system") and TSI 2006/679/EC ("Control-command and signaling subsystem of the trans-European conventional rail system") that prescribe that each member state of the European Union shall present an ERTMS implementation plan for the TEN routes.

The proposed financial framework made by the Swedish railway authority (Banverket) for implementation of ERTMS is 700 million SEK (Swedish kronor) for the period 2008 - 2015. The implementation of ERTMS entails that large parts of the vehicle fleet need to be equipped with ERTMS equipment at an early stage in the implementation process. The total number of vehicles concerned by ERTMS in Sweden is 800 - 1 200. In the ERTMS plan, subsidies for infrastructure and vehicle equipment from the European Union are expected to part finance the implementation of ERTMS.

In order to implement ERTMS on the Swedish railways, a development work is needed in order to fill in the gaps in the ERTMS specification. The ongoing work originates from a few registered proposals for changes of the specification e.g. braking curves and level crossing functions. The proposals are expected to be included in version 3.0 of the specification.

The Swedish strategy for implementation of ERTMS in the infrastructure can be summed up in the following order of priority:

- 1) New and/or essentially upgraded routes or lines
- 2) Routes or lines without signal plants, centralized traffic control and ATP systems
- 3) Routes or lines with major reinvestment needs for existing signal plants
- 4) Routes or lines included in the corridors pointed out by the European Union used by freight trains crossing borders
- 5) The remaining parts of the routes in TEN and after that other parts of the railway network

ERTMS is planned to be implemented on the Swedish part of Corridor B before 2020 and on the Swedish railway TEN routes by 2035.

Background

This plan has been drawn up in order to meet the requirements in TSI 2006/860/EC ("Control-command and signaling subsystem of the trans-European high speed rail system") and TSI 2006/679/EC ("Control-command and signaling subsystem of the trans-European conventional rail system") that prescribe that each member state of the European Union shall present an ERTMS implementation plan for the TEN routes.

On account of the development of the ERTMS-Regional (ERTMS-R) concept in Sweden, early plans for implementation of ERTMS-R on suitable routes are included in this plan.

This plan is based on a number of assumptions due to the structure of the Swedish infrastructure planning process and the fact that several Swedish ERTMS projects and activities are in their initial phases.

Assumptions

The following assumptions, that have to be met in order to carry out the ERTMS plan, have been made:

- That procurements of ERTMS equipment (on board system, infrastructure system and ERTMS ready interlocking system) can be carried out as planned and that the results regarding time schedules for development projects and costs for equipment meet our objectives.
- That the development of the STM module can be carried out as planned.
- That proper incentives are found to encourage railway companies to invest in vehicle equipment, such as subsidies from the European Union.
- That the industry are able to support the railway companies with retrofitting of vehicles according to plan.

If any major assumption are changed or not fulfilled, in particular those connected to decisions, costs and time schedules, the ERTMS plan may have to be revised.

Financing of the Swedish ERTMS implementation plan

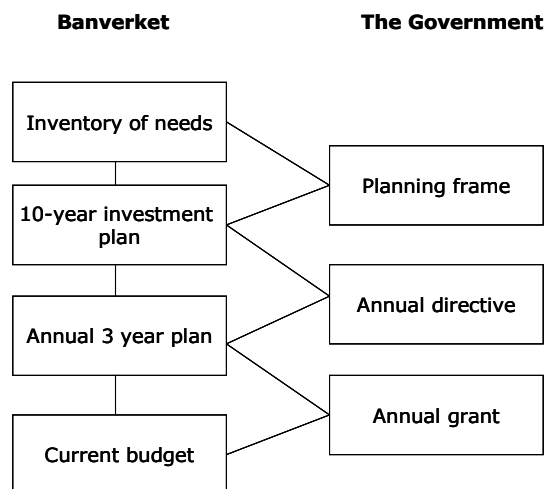
The Swedish railway infrastructure planning process

Based on visions of future traffic and infrastructure development, it is possible to make an inventory of financing needs. In order to materialize the suitable network and rail alignments, an infrastructure feasibility study is normally necessary. The purpose of such a

study is to clarify realistic, alternative solutions as well as their costs and benefits for the freight and passenger traffic development envisaged.

The inventory of the needs will serve as a basis for the Government's and parliament decision on the planning frame for investments. Based on the results of the infrastructure feasibility studies and the investment volume given by the planning frame, priorities are made and the Government decides on a 10-year investment plan. The above planning procedure is repeated about every third year in order to ensure a continuous review and in order to include new facts and needs to the inventory.

The 10-year investment plan gives Banverket a solid base for the budget process. The process includes annual budget requests to the Government with a description of what can be included in the plan and what has to be left out depending on the investment funding supplied. This process and the annual plans serve as an informative platform when the Swedish Parliament decides on the annual appropriation to Banverket. The annual Government grant thus decides the total final content for investments and the Banverket current budget.



The present 10-year investment plan is the framework for investments in the railway network covering the period 2004 - 2015. The plan is now due for revision, which includes elaborating an ERTMS (European Rail Traffic Management System) implementation plan.

The financial framework proposed by Banverket for ERTMS in the revised investment plan is 700 million SEK for the period 2008 - 2015. A decision by the Swedish Government regarding financing of the revised plan and the ERTMS plan, is expected in late 2007.

During the spring of 2007, the Government gave Banverket an assignment to carry out an initial study of objectives, strategies and economical implications i.e. to review the inventory of needs for the railway sector covering the period 2010 - 2019.

Consultation with railway companies, railway customers and local authorities regarding the study will give the Government a platform for developing a bill in order to set forth the direction for continuous planning and a financial framework for 2010 - 2019.

A bill to the Swedish parliament on the framework for financial resources for ERTMS implementation covering the period 2010 - 2019 will be decided on by the Government during the spring of 2008.

Costs for the ERTMS implementation 2008 - 2013

In the work with the revised investment plan made by Banverket, the costs for the implementation of ERTMS for the period 2008 - 2013 has been estimated to 700 million SEK. During the period 2008 - 2013, there is need for equipping approximately five hundred vehicles with ERTMS equipment. The cost is expected to be covered by the railway companies, however the total financing of the ERTMS equipment in vehicles is not determined.

In the proposed plan, subsidies for infrastructure and vehicle equipment from the European Union are expected to part finance the implementation projects.

Costs connected to the vehicle strategy

When ERTMS is implemented in Sweden, the railway companies and vehicle owners will – in the same way as today – be responsible for their vehicles including the ERTMS equipment and pay for this cost as well. However, Banverket takes on the complete system responsibility for ERTMS including procurement, development, verification, validation of the vehicle equipment.

For the vehicles using Öresundsförbindelsen, Banverket has applied for economical support from the European Union for prototype and installation costs in connection with upgrading for ERTMS of those vehicles. The support from the European Union can amount to maximum fifty per cent (50 %) of the prototype and installation costs.

A procurement of ERTMS vehicle equipment arranged by Banverket is in progress and fixed prices for the vehicle equipment are therefore still lacking. Banverket has set a target for maximum average costs for serial retrofitting of rolling stock to 1.1 million SEK per vehicle and a

prototype cost, i.e. the cost for the upgrading of the first vehicle of a certain type corresponds to 2.4 million SEK.

Today, there are about fifty different vehicle types operating in Sweden. For certain types of longer engine cars it will be necessary to double certain equipment. Within the scope of the present procurement of vehicle equipment, it is Banverket's ambition to receive tenders below the estimated price levels.

Banverket's most preliminary estimation of the number of vehicles which – according to the proposed ERTMS plan – needs to be equipped with ERTMS vehicle equipment before the year 2020 is accounted for below.

Route or region	Number of vehicles concerned	Period for retrofitting
ERTMS installations in the north of Sweden	115	2009 - 2012
Västerdalsbanan and low traffic lines	50	2009 - 2015
The Malmö region and Öresund	130	2009 - 2011
Malmö – Hässleholm	550	2012 - 2015
Other vehicles	355	2015 - 2020

The total number of vehicles concerned by ERTMS in the Swedish rolling stock is 800 - 1 200. In order to avoid that an unreasonable number of vehicles have to be retrofitted in connection with implementation of ERTMS on short sections, the implementation planning of ERTMS in the infrastructure shall take the number of vehicles running on these sections into consideration.

With possible exceptions of the regional traffic in the west of Sweden, all vehicles are presupposed to be equipped with ERTMS vehicle equipment the year 2020.

When ERTMS vehicle equipment is available in Sweden, it will be regarded as standard equipment and required for all new vehicles.

During the period 2008 - 2020, a number of older vehicles will most likely be replaced. For the traffic crossing borders, subsidies from the European Union may be paid for the approximately 130 vehicles directly affected.

Technical requirements for implementation of ERTMS

Existing traffic control system

In the present situation, Sweden has a well-functioning Automatic Train Protection system (ATP), which was introduced in the beginning of the 1980's. Systems and components are expected to have reached the end of their technical and economic life before the year 2020. This is valid for both vehicle equipment and infrastructure systems.

The Swedish railway installations contain signal plants of varying age. In the present situation, supply of spare parts for several of the signal plant's subsystems is uncertain.

Banverket plans a structured phase out of a number of interlocking system models during the 2010's.

The implementation of ERTMS in Sweden implies that existing interlocking systems have to be upgraded or replaced since they are not prepared for ERTMS.

ERTMS – a European standard

The development of ERTMS has – with Swedish participation – been going on in Europe since the beginning of the 1990's and the specification has now reached version 2.3.0. ERTMS is often presented as a European standard system for control of the railway traffic, which is fundamentally correct.

The directive for high-speed trains and the Technical Specifications for Interoperability (TSI) connected to it were the first regulations decided on. On account of that, the primary development of ERTMS has so far been aiming at high-speed railways. This has resulted in gaps in the specification for the conventional railway network.

The system is still not a completed product for the conventional railway network which can be directly implemented in the different European railway networks without adaptations.

In order to implement ERTMS on Swedish railway, a development work is needed in order to fill in the gaps in the ERTMS specification. The ongoing work originates from a few registered proposals for changes of the specification e.g. functions for braking curves and level crossing. The proposals are expected to be included in version 3.0 of the specification.

Technical requirements

GSM-R

The implementation of GSM-R (Global System for Mobile communications-Railway) in Sweden has been carried out in

accordance with the GSM-R standard EIRENE (European Integrated Railway radio Enhanced Network). The parts of the Swedish railway network included in TEN (Trans European Network) are already equipped with GSM-R.

Functional level

The ambition is to implement ERTMS level 2 and only in exceptional cases, e.g. at larger stations and railway yards with extensive shunting movements, ERTMS level 1.

ERTMS level 3 (ERTMS-R – European Rail Traffic Management System-Regional) will be implemented on low traffic lines, which in the present situation are supervised by way of manual train announcement and used by passenger trains to such an extent that it justifies an implementation.

The starting point for the strategy is not to equip the infrastructure with two parallel systems principally because of the expense.

Implementation strategy

Vehicle strategy

The vehicle strategy forms the basis of the implementation of ERTMS in Sweden and implies that all vehicles using the sections that will be equipped with ERTMS needs to be equipped with a special on board equipment. This equipment, consisting of ETCS (European Train Control System), GSM-R and STM (Specific Transmission Module), allows use of lines with the existing ATP system as well as new ERTMS lines.

When ERTMS is implemented on junctions with interregional traffic, almost all vehicles intended for interregional freight and passenger traffic will have to be equipped with ERTMS equipment. Not until then, the upgrading of the infrastructure will commence.

The vehicle strategy has the advantage that when the vehicles concerned have been upgraded, also the infrastructure can be upgraded from a traffic optimization point of view and other criteria implying that the implementation is carried out where the greatest possible benefit can be utilized. With this strategy, new lines do not have to be dual equipped.

The disadvantage with the strategy is that there will be a gap in time between the time when the railway companies have to invest in new vehicle equipment and the time when the companies can benefit by the ERTMS implementation in the infrastructure. On account of this gap in time between costs and benefits, financial support from the European Union is expected.

Infrastructure strategy

The strategy for implementation of ERTMS in the infrastructure can be summed up as follows and in the following order of priority:

1) New and/or essentially upgraded routes or lines

ERTMS will be implemented according to valid requirements when a new railway is built or when existing railways are upgraded to a considerable extent. On special occasions, there may however be relevant to apply for exception to the requirements. In those cases, preliminary work, e.g. implementation of widely spread interlocking system technology, shall obviously be carried out even though ERTMS is not installed. A reason for applying for exception may be to be excused from implementing ERTMS in short line sections, which if ERTMS is implemented, in its turn causes that many vehicles have to be equipped with ERTMS at an earlier stage than justified.

2) Routes or lines without signal plants, centralized traffic control and ATP systems

When a line without a technical safety system shall be equipped with such a system, ERTMS becomes cheaper than the conventional ATP system. Examples of such lines are Ådalsbanan, Haparandabanan's new and upgraded parts and Västerdalsbanan. For lines with passenger traffic supervised by way of manual train announcement, there are also requirements for increased traffic safety from Järnvägsstyrelsen (the Swedish Rail Agency). ERTMS-R is Banverket's solution of this requirement.

3) Routes or lines with major reinvestment needs for existing signal plants

In spite of the fact that a signal plant has a very long life, provided that sufficient resources for operation are provided, the plants have to be replaced when maintenance no longer is adapted to its purpose, e.g. on account of high maintenance costs, insufficient reliability in operation and uncertain spare part supply.

4) Routes or lines included in the corridors pointed out by the European Union used by freight trains crossing borders

ERTMS will be implemented on the Swedish part of corridor B, i.e. the section Öresundsbron – Hallsberg/Stockholm.

5) The remaining parts of the routes in TEN and after that other parts of the railway network

Swedish ERTMS implementation plan

During June 2007, Banverket has presented to the Government a proposal for a revised investment plan covering the period 2004- 2015 including documentation for aim and direction planning for further discussion and decision. The proposed revised investment plan includes a proposal for ERTMS strategy for Sweden.

Sweden participates in the planning of the implementation of ERTMS on the freight corridor B (Stockholm – Naples) pointed out by the European Union. The implementation plan for ERTMS on the Swedish part of corridor B is based on discussions within the scope of the corridor B work, where other parts of the corridor will be equipped with ERTMS prior to the year 2020.

2008 - 2015

During the period 2008 - 2015, the work with the projects included in Banverket's proposal for revised investment plan for the railway is planned to proceed. The projects in question are Citytunneln in Malmö, including Malmö passenger railway yard, Öresundsförbindelsen, Botniabanan, Ådalsbanan, Haparandabanan and Västerdalsbanan, which constitutes pilot line for ERTMS-R. Another five or six low traffic lines are planned to be equipped with ERTMS-R. Those lines will be specified in a decision later on. In connection with the commencement of the implementation of ERTMS on the section Malmö – Hässleholm along Södra stambanan, the implementation of ERTMS on Kontinentalbanan and Malmö freight railway yard is initiated. Malmö is an important junction for freight and passenger traffic and installation of ERTMS in the Malmö region is therefore governing for a very large part of the vehicle upgrading. The vehicles which have Malmö as destination have to be equipped with on board equipment able to manage both ERTMS and the existing ATP system. This is valid even though the main part of the vehicles services is performed on sections not yet equipped with ERTMS.

2016 - 2019

ERTMS will be implemented on sections where comprehensive upgrading projects or reinvestment needs in the signal plant justify an early implementation. Malmbanan is an example of the last-mentioned. In connection with Citybanan being built, adjacent parts of the railway transport system in Stockholm are proposed to be upgraded to ERTMS as well. The implementation of ERTMS is proposed to proceed during this period on the remaining part of Södra stambanan (Hässleholm – Hallsberg) and on Västra stambanan (Hallsberg – Järna – [Stockholm]). The proposal implies that the Swedish part of corridor B will be equipped with ERTMS in the year 2020.

2020 - 2025

ERTMS will be implemented on the parts of the railway network where the system entails a capacity contribution, on the parts of the network where entirely new railways are built and where implementation is justified by operation reasons. The lines and routes

coming into question during this period are principally Väst kustbanan, Norge/Vänernbanan (Göteborg – Kornsjö), Västra stambanan (Hallsberg – Göteborg), Södra stambanan (Mjölby – Katrineholm), Ostkustbanan and Arlandabanan.

2026 - 2030

ERTMS, The implementation is expected to proceed on the remaining lines in TEN. Finally, other lines in the railway network will be equipped.

The proposed ERTMS implementation plan implies that the major part of the Swedish railway network will be equipped with ERTMS round the year 2030. GSM-R has already been implemented on the entire TEN railway lines and on the low traffic lines where ERTMS-R is implemented, GSM-R will be installed as well.

Decisions about financing of this ERTMS implementation plan have not yet been made. The Swedish Government is planning to take a decision in late 2007 concerning the period 2004-2015 and a proposal for a framework on the financial resources for ERTMS implementation covering the period 2010 - 2019 will be decided on by the Government during the spring of 2008..

Potential constraints

The planned implementation of ERTMS on each respective line or route may be affected by the following factors:

- Available conditions (national budget, subsidies from the European Union and profitability within the railway business)
- The possibilities of carrying out the work without unacceptable disruptions
- The supplier and contract market's ability of corresponding to the railway sector's need for equipment as well as for competence and manning of the projects
- The development rate within the European Union in broad outline

ERTMS deployment plan

2026-2030 —

2020-2025 —

2016-2019 —

2008-2015 —



GSM-R

In operation —

Roll-out 2008-2015 —

