Ministry of Infrastructure
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Swedish National Implementation Plan concerning fulfilment of TSI-CCS (2016/919/EU) Chapter 7.4.4.

General context description Swedish railway

Sweden has around 14 100 km operational railway lines, whereof the majority is single track (around 9 100 km) and electrified (around 12 300 km). Around 9 800 km are equipped with ATC, Sweden's current Class B system. Currently, Sweden has around 780 interlocks, 35 000 ATC balise groups and 15 000 switches, and train detection is done with track circuits. The Swedish rail network is mainly governed by the Swedish Transport Administration. Sweden has one border crossing to Denmark via the Öresund Bridge, four to Norway and one to Finland. The railway undertaking is highly privatised for both passenger and freight traffic, with around 50 operators.

Open market conditions

Sweden has ensured open market conditions for its legacy Class B train protection system by developing a STM. The STM is now available on the open market.

Cost Benefit Analysis of ETCS implementation

The CBA can be found in **annex 1**.

Planning

The Swedish planning horizon for infrastructure investments is 12 years. The plan is updated every forth year. Consequently, the plan for ERTMS implementation is divided into several national transport plans.

- The current national infrastructure plan covers the period 2022–2033.
- For the period from 2034, planning will take place in the subsequent national infrastructure plan for 2026-2037.

The full planning, including dates for ETCS deployment, decommission of the Class B system and ETCS-only operation, can be found in **annex 2**.

Annex 1: CBA Swedish ETCS implementation

Background

The current signalling equipment in Sweden is old, heterogeneous and based on outdated relay technology. The majority of the equipment will have reached its economic life expectancy within the upcoming 10 years, and in approximately 20 years will have passed its technical life expectancy. Expertise on legacy systems will disappear, creating maintenance problems. Assuming that the ETCS framework in the national plan is maintained, it is expected to take about 50 years to complete ETCS implementation. More specifically, the current signalling equipment architecture of around 780 interlocks will be reinvested into an architecture of around 160 standardised, modern, computerised interlocks placed in clusters. This reinvestment will be an important step in taking Swedish railway into the modern digital era and lead to great benefits. Standardised, computerised interlocks with ETCS enables features such as increased surveillance and predictive maintenance, as well as the possibility of further expansion of new capacity and traffic planning in a more cost-effective way. Standardisation streamlines the demands for spare parts as well as skills supply for maintenance personnel. Furthermore, the minimisation and cluster position of interlocks simplifies and facilitates maintenance.

Scope of CBA

The CBA describes the implementation of the Class A (ERTMS) in accordance with the planned pace of implementation based on the Government’s decision on a new national infrastructure plan 2022–2033. Furthermore, the scope is limited to the current network; future lines are excluded.

Scenario

The scenario for the implementation of ETCS is in accordance with the Government’s decision on a national infrastructure plan 2022–2033. For the period 2033–2035, the same allocation has been adopted in accordance with the precautionary basis. The reasons for this scenario are as follows:

- Gradual phasing-in of ERTMS while ATC interlocks are phased out in the 2020s as orders placed are completed.

- ERTMS deployment is concentrated primarily in control areas that need new signalling to solve critical life cycle issues for interlocks, composite brake blocks and anchor points.
- The pace is adapted to allow for vehicle conversion and resource enhancement across the sector. Creating the conditions for ERTMS deployment (regulatory framework, production, resources, management and operation with two different systems).

Final phase 2036–2070:

- Aims to phase out ATC from the rail system as quickly as possible, based on allocated funds.
- Deployment continues to focus on lifecycle-critical control areas and completing the TEN-T core network and other core networks by 2070.

Time frames

Costs are quantified up until 2070, though the benefits are currently not quantifiable in the short or long term.

The scenario is based on the allocation in the national infrastructure plan for 2022–2033. However, the decision on the plan mandated the Swedish Transport Administration to report annually on the progress of ERTMS deployment, the cost savings that have been achieved and the measures that have the potential to reduce the costs of deployment over time. It was also stated that the direction may be adjusted on the basis of these reports. It is therefore possible that the time frame will be modified on the basis of such an adjustment.

Cost

Costs of signalling equipment

The cost of the total deployment is approximately SEK 50 billion, excluding indexation given the scenario's deployment pace. This cost estimate is based on an average cost per signal object. The cost for the period up to 2037 is approximately SEK 18 billion.

Market conditions

Given the length of the ETCS deployment, it is difficult to assess how market conditions may be affected over time. Thus, it is not possible at this stage to report on costs below.

Onboard costs

In the scenario, the majority of all vehicles will need to be equipped by 2030. This is based on the assumption that all vehicles need to be equipped before the core network is fully ETCS deployed. This cost does not take into account any additional costs, only installation costs for vehicle owners.

Operating and maintenance cost

In the scenario, the signalling system will be heterogeneous over a longer period of time, which should generate increased operating and maintenance costs compared to a faster deployment rate, though these are currently not quantifiable.

Total cost

Given the uncertainties related to the implementation interval, it is not possible to present a cost picture for ETCS deployment.

Benefits

Capacity

Capacity simulations show that there will be no significant differences between ERTMS and current ATC once the signalling equipment has been renovated for both scenarios. Since the same reinvestment in signalling equipment takes place in both scenarios, the same tuning measures for increased capacity can be made in both cases to an equivalent cost. Consequently, there is zero difference in capacity between the two scenarios.

Safety

There is a high level of safety in the current signalling system. Although ETRMS using GSM-R is a train control system with continuous monitoring, unlike ATC where the train control system provides spot monitoring when vehicles pass balises, differences in benefits are considered to be small and have not been quantified. Consequently, there is zero difference in safety between the signalling safety systems.

Reliability performance

The scenario has a slow deployment rate and thus the signalling system will be heterogeneous over a longer period of time. A heterogeneous signalling system with components that have passed their technical life expectancy is considered to result in poorer reliability performance compared to a faster deployment rate.

Other benefits

A number of other benefits are considered to result from ERTMS implementation. Due to inadequate models for measuring and valuing these effects, they have not been quantified. The most important of these benefits are:

- Standardisation: standardisation of components, administrative rules and technology leading to innovation and lower long-term cost are assumed to occur within ERTMS, also including maintenance, but not with ATC.
- Interoperability benefits: with ERTMS leasing of vehicles over borders will be possible, which would generate a better opportunity for fleet optimisation.
- The benefits of digitisation and monitorability create benefits that have not been quantified.

Socio-economic result

It should be noted that this is not a traditional CBA. Resulting from the current state and large reinvestment need of the signalling equipment in Sweden, there is no ‘do nothing option’, regardless of signalling system in place. Consequently, there is no NPV ratio.

Annex 2 – Implementation of TEN-T lines – according to core network lines in Sweden

National implementation plan ETCS 2022–2037 – Planned status by year 2027

Line/Node	Stretch * Operating location in brackets is not included in the stage
Malmbanan	Riksgränsen – (Holmfors)
Mittbanan	Sundsvall C – Nacksta – (Töva)
Västerdalsbanan	(Repbäcken) - Malung
Tjust- och Stångådalsbanan	(Linköping) – Bjärka-Säby – (Västervik) (Bjärka-Säby) – Rimforsa
Öresundsbron	(Kastrup) – Peberholm - Lernacken

National implementation plan ETCS 2022–2037 – Planned status by year 2030

Line/Node	Stretch * Operating location in brackets is not included in the stage
Skellefteåbanan	(Bastuträsk) – Skellefteå – Rönskärsverken
Norrbotniabanan	(Skellefteå) – (Umeå)
Umeå	(Brännland) – Umeå – Gimonäs – Holmsund
Ostkustbanan	(Gävle C – Örbyhus - Storvreta
Västkustbanan och Skånebanan	Furet – Halmstad – Ängelholm
Skånebanan	(Åstorp) – (Hyllstofta)
Södra stambanan	Lund – (Arlöv)
Malmöområdet	(Lernacken) – Malmö C – (Arlöv)

National implementation plan ETCS 2022–2037 – Planned status by year 2033

Line/Node	Stretch * Operating location in brackets is not included in the stage
Malmbanan	Holmfors – Boden – Luleå
Ostkustbanan	(Sundsvall) – (Söderhamn) samt (Storvreta) – Uppsala – Myrbacken
Ostkustbanan	(Storvreta) – Uppsala – Myrbacken
Ostlänken	(Gerstaberg) – Skavsta samt (Nyköping)
Sydostlänken	(Älmhult) – Olofström – Skärsemon
Västkustbanan	(Kållered) – (Furet)
Godsstråket genom Skåne	(Åstorp) – Kävlinge – (Arlöv) och (Lund)

Malmö området	(Lernacken) – Lockarp – Arlöv

National implementation plan ETCS 2022–2037 – Planned status by year 2037

Line/Node	Stretch * Operating location in brackets is not included in the stage
Norrbotniabanan	(Luleå) – Piteå – (Skellefteå)
Ostkustbanan	Söderhamn – Kringlan – (Gävle)
TEN –T godsstråk norr	(Söderhamn) – Kilafors – Fagersta – (Hallsberg)
Ostlänken	(Skavsta) – Norrköping – Linköping
Västkustbanan	(Ängelholm) – Helsingborg – Kävlinge
Rååbanan	(Helsingborg) – (Teckomatorp)
Skånebanan	(Åstorp) – (Helsingborg)
Blekinge kustbana	Sandbäck – Karlshamn

Figure 1 –Planned status by year 2037