



ERTMS® DEPLOYMENT IN DENMARK



ERTMS® deployment on the entire national Danish railway network

Banedanmark, the state-owned rail network infrastructure manager in Denmark, is upgrading of its mainline network in an ambitious and comprehensive ERTMS® programme. In a first-ever decision by a national infrastructure manager to modernise the signalling of its entire network (currently comprising more than 1.800 km of lines, the vision is to complete this modernisation by 2033. This involves removing the existing interlockings and signals and replacing them with ERTMS®, including cab signalling.



Is ERTMS® the answer to the signalling challenge in Denmark?

In response to significant challenges arising from a heterogeneous portfolio of ageing signalling systems, widespread capacity constraints and limited availability of skilled maintenance personnel, a strategic decision was made by the Danish Parliament in 2009 to deploy the European Train Control System (ETCS) Level 2 across Banedanmark's network, replacing the existing systems.

This decision entailed the comprehensive renewal and replacement of legacy signalling systems operating across the Danish railway network, some of which dated back to the 1910s, and most of which were expected to have exceeded the end of their service life by the mid-2020s. These systems had become increasingly difficult and costly to maintain due to obsolescence, limited availability of spare parts, and declining support for the national Automatic Train Control (ATC) system.

The modernisation programme was driven by an urgent need to address persistent signalling-related network issues, which accounted for approximately 50% of train delays. Consequently, Denmark elected to adopt a mature, interoperable, and globally recognised signalling solution capable of delivering long-term operational reliability and performance.

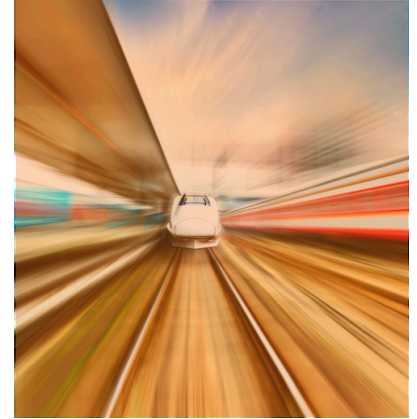
How can ERTMS® improve the existing system?

The decision will see a simplification of the national network, which is expected to lead to a reduction of life cycle costs, maintenance costs, reduction of staff numbers and provide the opportunity to simplify and update the national operating rules and optimise the national control organisation.

New interlockings are being introduced supported by the GSM-R technology thus allowing all old relay interlockings and the analogue radio systems to be replaced.

What are the benefits of implementing ERTMS® as a full network?

The introduction of ERTMS® will facilitate the connectivity between major cities in Denmark. Additionally, it will offer seamless travel within the EU. With ERTMS®, the Danish network will be able to reap the benefits of the inherent features of ERTMS®, like increased and homogenous safety levels, allow high speed train movements, increase network capacity, improve punctuality as well as offering the basis for better information to passengers on the performance of the network and the overall raising of the attractiveness of rail transport. Overall, benefits include the adoption of EU standards and fewer traffic management sites apart from, of course, economies of scale.



How is the implementation being executed?

In an extended and thorough process, Banedanmark reviewed all options in detail and compared ERTMS® solutions from different suppliers before reaching a decision with two consortia: one to implement the eastern zone (Zealand, Funen and Lolland-Falster) amounting to approximately 700 route-km, and another in the western zone (Jutland), amounting to approximately 1200 route-km. Both contracts included a condition of an early test deployment of the offered solutions, with both solutions demonstrating the same equipment, the same interfaces, and the same workflows, and ultimately a requirement of continuous engagement for 25 years of maintenance support.

A separate contract was placed in July 2012 for the upgrade of existing rolling stock (originally amounting to more than 700 vehicles) which will be led by an onboard retrofit design contract to ensure that First-in-Class designs are fit for purpose.

The trackside projects deploy new digital interlockings and ETCS Level 2 line by line, decommissioning the legacy systems simultaneously with the commissioning of ETCS Level 2. This means that Banedanmark's network progressively moves to ERTMS®-only, which requires close coordination between the trackside and onboard projects.

The ERTMS® programme was initially structured around upgrading the core network ahead of the secondary routes. Over time, it became apparent that this sequencing could not be sustained, largely due to regulatory requirements and the significant technical difficulties involved in aligning wayside installation with vehicle retrofitment. In response to these constraints, Banedanmark revised the approach in 2017, shifting to a migration model driven by rolling stock retrofitment. Under this model, decisions on where to deploy ETCS trackside systems were determined by which trains had already been retrofitted. This fundamentally altered the rollout sequence, bringing branch lines to the forefront, as they typically involved a limited number of vehicle variants requiring ETCS installation.

The expected costs of the total migration, for the trackside and onboard projects have, is 24,6bn DKK (€3.3bn). Additionally, Banedanmark administered a fund of 57m DKK (€7.7m) until 2025 to compensate freight haulage operators retrofitting locomotives operating in Denmark with ERTMS® equipment.[ii]

What is the current status?

The first route to enter in operation with the new signalling system was Frederikshavn - Lindholm in October 2018, followed by other 11 routes[iii]:

-  Roskilde - Køge in December 2019
-  Struer - Thisted in April 2020
-  Langå - Struer - Holstebro in March de 2021
-  Køge - Næstved in August 2021
-  Mogenstrup - Nykøbing F. Vest in December 2021
-  Vejle - Holstebro and Herning - Skanderborg in August 2022
-  Vigerslev - Ringsted in April 2023
-  Esbjerg - Holstebro - Skjern - Herning in June 2023
-  Aarhus - Aalborg Airport in October 2024
-  Lunderskov - Esbjerg and Bramming - Tønder in April 2025
-  Fredericia - Aarhus in March 2026



Image: Banedanmark Presentation at the ERA ERTMS Conference 2026.

Commissioning for the rest of the lines is expected no later than 2033:

-  Roskilde – Kalundborg: works have finished; the decision on commissioning date is pending.
-  Odense – Svendborg and Ringsted – Mogenstrup in the 2nd half of 2026
-  København / Vigerslev – Peberholm: Ny Storstrømsbro: and Fredericia – Middelfart – Padborg – Tinglev – Sønderborg in the 1st half of 2027
-  Ny Kong Frederik IX bro and Nykøbing F. Vest – Femernforbindelsen in the 2nd half of 2027
-  Korsør – Middelfart and Gammel Kong Frederik IX bro in 2028
-  Femern Tunnel; Ny Bane Vestfyn; and Ringsted – Korsør in 2029
-  Roskilde – Ringsted in 2030
-  København – Østerport in 2031
-  København/Vigerslev – Roskilde and Østerport - Helsingør in 2033

The programme is now progressing well. Over 1,100 route km have been commissioned with ETCS. The remaining 750 route km will be commissioned no later than 2033. Retrofitment of the white and yellow fleets is expected to finish in 2026.

The initial plan to retrofit 700 vehicles with ERTMS® has been revised because of retirement from the fleet. Banedanmark's retrofitment project has therefore totalled 321 vehicles, including the yellow fleet (maintenance vehicles). Newer vehicles are fitted with ETCS by the railway undertakings.

The pace of retrofitment was challenged several times throughout the programme, mainly due to approval procedures introduced following the Fourth Railway Package as well as the industrialization phase took longer than initially expected.

The expected benefits are a 50% reduction in signalling-related delays, higher train speeds and a reduction in travel times, capacity improvement and an increased, uniform safety level applied to the whole network with better traffic information.

[i] Source: Statistics Denmark (<https://www.dst.dk/en>)

[ii] Source: European Commission ([20240723final DK NIP ERTMS® \(D2801619\).docx](#))

[iii] Source: ([Ejernbanen | Banedanmark](#))

