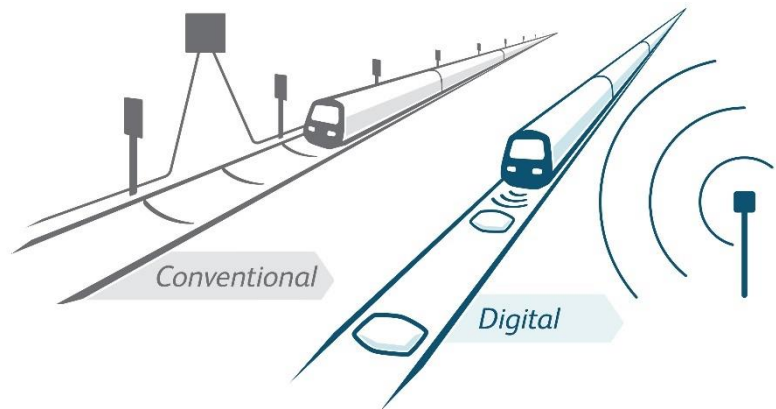




1. Executive Summary

This report is the response to a DfT request for a long-term plan to sustain signalling assets using modern technology.

The DfT request, in the form of a letter to the Network Rail Chief Executive Officer of 19 March 2018, is that the Digital Railway Programme develop a plan for digital train deployment from CP6 onwards that shows signalling renewals to be 'digital' or at the very least 'digital ready'. The request is rooted in an understanding that there is a significant backlog of renewals which cannot be addressed through conventional technology.



The Digital Railway Strategy announced jointly by the Secretary of State for Transport and Network Rail's CEO in 2018, sets out the delivery strategy for digital deployment across the network – identifying and prioritising schemes with the most compelling business cases. This strategy aligns with similar initiatives in Europe and in other countries, to use modern technology to improve cost effectiveness, capacity, performance, safety and sustainability.

The Digital Railway Programme has already identified areas of the network that would benefit most from the early deployment of digital train control. These short to medium term activities have been presented in the Control Period Strategic Business Plan for funding as part of CP6.

This report presents a Long-Term Deployment Plan (LTDP) that sets out the case and timeframes for evolving to digital train control, aligning train fitment and infrastructure renewals. For the purposes of this exercise, the focus has been on building a comprehensive baseline upon which enhancement opportunities can be planned at a later stage.

The LTDP has been developed in collaboration with industry partners including the Railway Industry Association, Rail Delivery Group (representing TOCs and FOCs), National Joint ROSCO Project (NJRP), Network Rail Routes, System Operator, Infrastructure Projects (IP) and Safety, Technical and Engineering (STE).

A principle led approach at the core of building a robust long-term plan

A set of principles and working assumptions have been developed that underpin the plan (see Appendix A). Of those, the following are key considerations:

1. A joint industry analysis conducted on infrastructure renewals work suggests the maximum volume of works deliverable for digital and conventional signalling schemes is 3,000 SEU (Signalling Equivalent Unit) per annum and 1,800 SEU p.a. respectively¹. This is based on number of teams and network access constraints; digital signalling requires much less line-side equipment.
2. Train fitment delivery schedule built on the assumption that all future train procurements specify ETCS (European Train Control System), existing trains will be retrofitted at the rate of one train per fleet per week and operators are limited to one first-in-class trial at any one time.
3. The budget available for train fitment and infrastructure renewal work will be consistent with CP6, which is currently anticipated to be £830m per annum.
4. In order to draw comparisons between digital and conventional signalling, a digital SEU was established to provide equivalent unit costs and work volume calculations.

¹ Conventional volume is based on Network Rail experience. ETCS volume is estimated from industry norms (see appendix B for analysis).



- Unit cost estimates for digital signalling have been agreed with industry, for planning purposes, at £315k/SEU. This compares to a rate of £419k/SEU² for conventional signalling.

To ensure consistency, repeatability and confidence in the outputs, it is intended that future discussion and considerations revolve around the principles and that changes to the plan result from reconsideration of the principles.

The bow wave of signalling renewal activity and the implications on deliverability and cost

The current backlog of renewals is creating a bow wave of activity arising from a combination of a gradual build-up of delayed renewals and the cyclical nature of past infrastructure investments. The associated increase in costs notwithstanding, the core challenge is around the capacity of industry to meet the increase in demand caused by approaching end-of-life renewals. The conclusions of the analysis demonstrate that a conventional signalling approach is not capable of providing a deliverable or an affordable solution. Whereas, the higher volumes achievable through digital technology could deliver a plan that addresses a bow wave (see Section 4).

However, despite lower unit costs, the higher volumes necessary to meet the bow wave of renewal activity means that delivery costs will still exceed CP6 budget levels in CP7, CP8 and CP9. By contrast, even if the required increase in capacity could be found, the costs of delivering a conventional solution in the short to medium term would be no better or slightly higher than the cost of delivering a digital solution (see Figure 1 below).

Migration to a digital data based signalling system is a significant element of the cost incurred when renewing the network to ETCS. On-going hardware and software refreshes are expected to be significantly less expensive. In the long-term, once the transition to digital has been made, the long-run renewal cost of digital signalling could be reduced considerably.

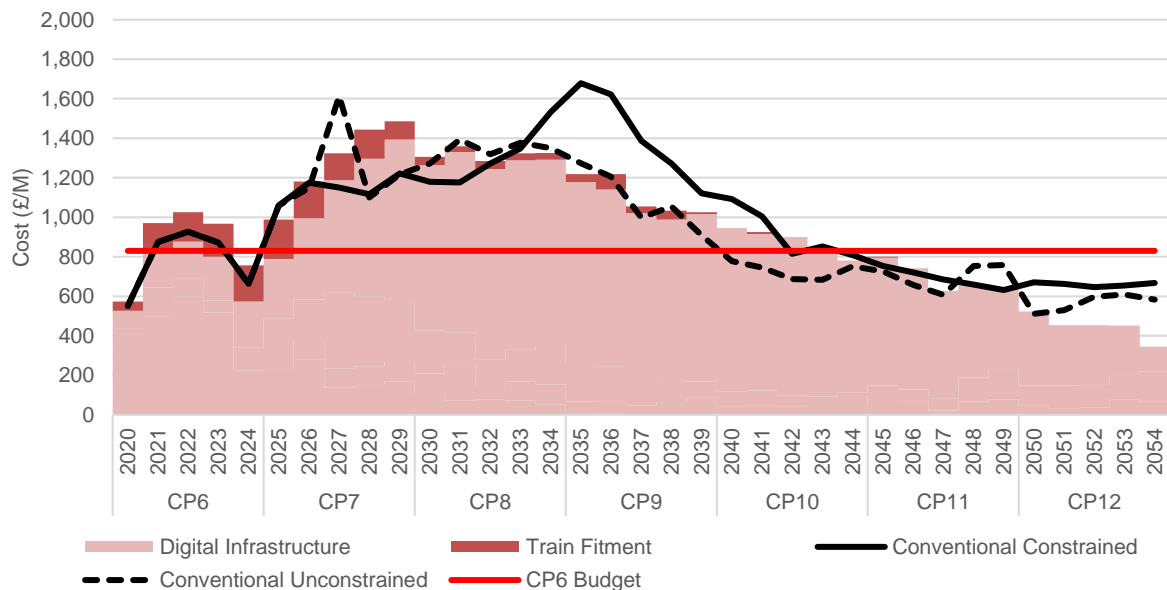


Figure 1: Cost profile comparing conventional with digital signalling (ETCS unit rate £315k)

Given the relative infancy of implementing digital signalling technology within the supply chain, there is an opportunity for investment in R&D to make a digital plan more affordable. European experience indicates that a benchmark rate of £190k/SEU could be achievable. A rate of £190k/SEU would make it possible to deliver the plan at close to CP6 budgetary levels (see Figure 2 below).

² £459k/SEU is an average figure based on returns from each of the routes for conventional re-signalling during CP4 and CP5. Further research supported by IP and most recent projects suggests £419k/SEU as a more representative figure for the purposes of the LTDP.

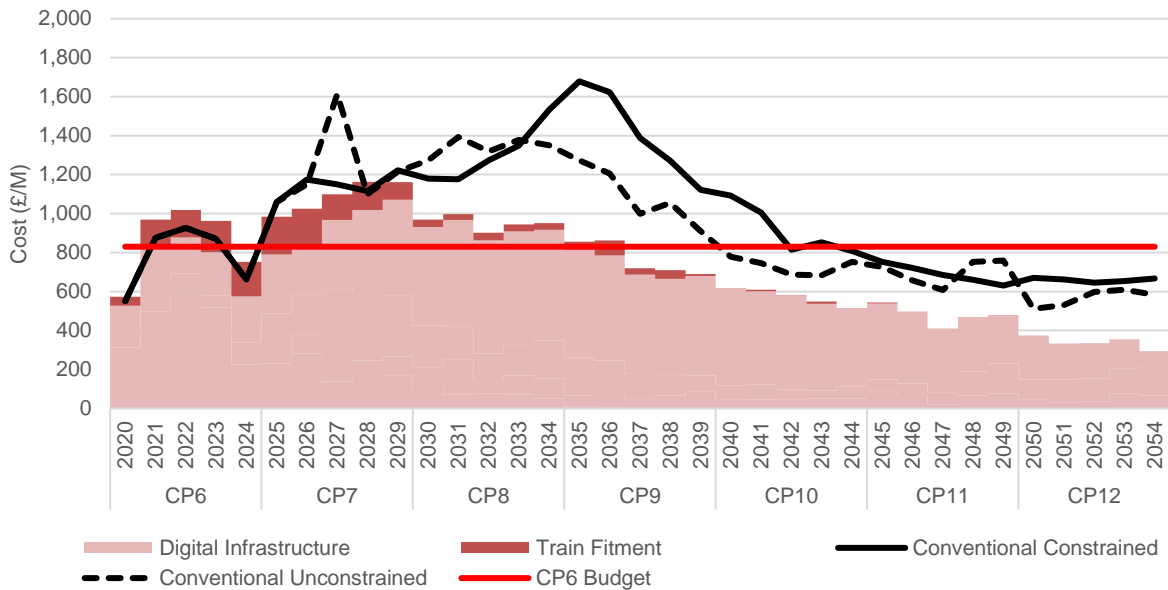


Figure 2: Cost profile comparing conventional with digital signalling (ETCS unit rate £190k)

The safety and operational benefits to the railway and its customers

The ETCS plan offers value for money over the medium to long term compared to the conventional signalling alternative. Even without including the potential performance benefits, a purely financial appraisal indicates that over a 30-year appraisal period the case for investment is financially positive; with an NPV that could range between £500m and £5bn in 2017/18 prices and a pay-back period falling between CP9 and CP11 depending on the underlying cost assumptions. This is a compelling case compared with other rail investment options, that are commonly evaluated over 60 years.

Digital signalling brings operational benefits that can be hard to quantify at present but should not be overlooked. Inclusion of potential performance related socio-economic benefits strengthens the case for ETCS; bringing forward pay-back and accelerating the long-term socio-economic NPV. Over a 30-year period, the total benefits (including the incremental cost savings and socio-economic benefits) could range from £7bn to £18bn, for the worst and best-case scenarios respectively

Digital signalling will also deliver a range of safety benefits when implemented. Current safety systems mitigate many of the risks associated with signals passed at danger (SPAD) and trains over-speeding, but they don't address all factors. Therefore, the application of a digital signalling renewal strategy offers a significant reduction in risk to the railway when compared to the retention of conventional signalling.

The key findings are as follows:

1. Evolution from current lineside signalling to next generation technology is required to sustain the network.
2. Digital could be delivered at a sustainable volume. However, although more affordable than conventional signalling, costs still exceed CP6 budget levels for the first three control periods.
3. Digital signalling will deliver higher performance and better safety.
4. There is potential to reduce digital signalling costs towards CP6 budget levels through innovation.
5. Migration to a digital data based signalling system will lead to lower long-term maintenance and renewal costs.
6. A digital signalling LTDP will promote the Rail Sector Deal and Innovation Strategies.
7. Train fitment and infrastructure renewal plans have been aligned successfully.
8. An integrated digital renewal plan acts as a baseline, further consideration will be necessary to understand enhancement opportunities.



A national renewal led plan for digital train control

This is a national renewal led plan that will deliver digital re-signalling schemes and a train fitment plan based on making best use of renewals funding (see the interactive PDF map for details of plans for NR Regions in England and Wales). Although short to medium term cost challenges between conventional and digital signalling are broadly similar, long term benefits for digital signalling could be significant. Furthermore, there is scope to improve the financial case for digital signalling by reducing unit costs through investment in R&D.

The question of sustainability and of finding a deliverable and affordable solution is not just a UK problem. Many European countries are experiencing similar issues and have expressed interest in collaborating with the UK to address these challenges.

To support the vision that all renewals and upgrades in CP6 and beyond should be digital or at the very least digital ready, the report proposes that the following be considered:

1. Commencement of a retro-fitment programme for passenger trains as identified in the LTDP.
2. Fitment of ETCS to all new trains/rolling stock at the point of manufacture as a matter of policy.
3. Commitment to the long-term funding of the freight fitment programme.
4. Development of the LTDP into routes plans, applying a change control process and co-ordinating centrally as a service to the routes.
5. Integration of the LTDP with enhancement planning to seek better value solutions and passenger outcomes.
6. A technology roadmap to coordinate and channel R&D funding to improve ETCS technology and process efficiency.

Once the plan has been accepted, the time and effort required to help industry and the supply chain prepare for what will be a rapid build-up and transition to digital technology should not be underestimated. Consideration needs to be given in CP6 on how to help stakeholders develop the necessary digital skills and capabilities prior to the ramp-up in activity in CP7.

The LTDP represents a robust plan that co-ordinates train-fitment and infrastructure renewals, enabling future upgrade to full digital operation with minimal cost, time, effort and disruption to the running of our railway.