Connectivity on our main rail routes

2.22 Mobile coverage on UK railways is reliant on existing MNO cellular networks, which generally utilise base stations located some distance away from railway lines.[47] This has resulted in poor mobile coverage and capacity on rail routes to date. The challenges include:

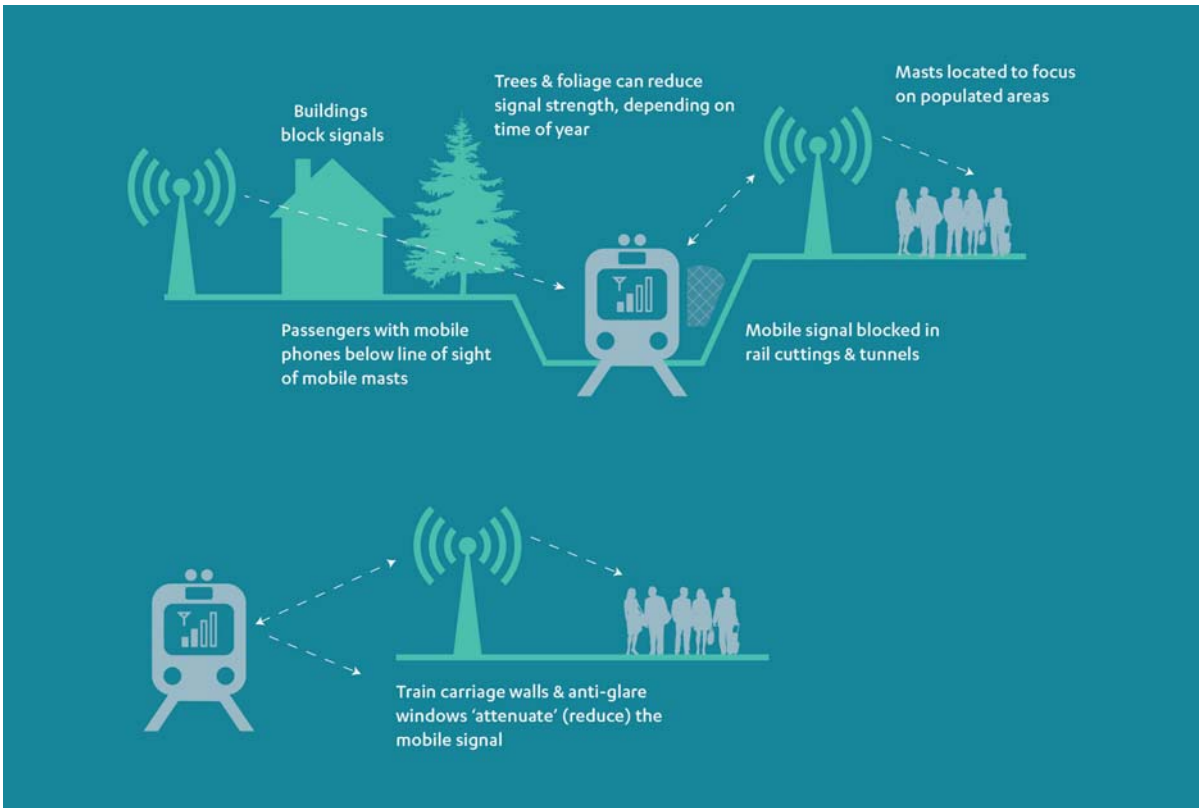
- Around 40 per cent of railways are in tunnels or cuttings, causing base station signals to be blocked. These difficult geographies mean that even with near-ubiquitous geographic coverage MNOs would be unlikely to provide sufficient coverage and capacity to deliver a quality service to passengers without trackside infrastructure;
- Train carriages and windows can strongly attenuate wireless signals, impeding reception further;
- Large numbers of people concentrated in small areas on carriages, often moving at high speeds, and in close proximity to other trains;
- The mobile market provides few incentives for MNOs to invest in improving rail coverage;[48]
- Coordination issues can occur due to the number of stakeholders involved, which can be exacerbated by poorly aligned incentives to roll out mobile networks along the railways.[49]

2.23 As a result of these challenges, passengers are often unable to make or receive phone calls reliably and frequently receive poor data connectivity, reducing satisfaction and productivity. Lack of sufficient rail corridor connectivity also risks impeding the realisation of a number of Digital Railways initiatives because features such as digital in cab signalling, operational improvements as well as real time information for passengers rely on good, reliable trackside coverage.

Project SWIFT

Project SWIFT (Superfast Wi-Fi In-carriage-for Future Travel) is an example of a UK railways Wi-Fi trial between Glasgow and Edinburgh. It is being undertaken by CISCO together with partners including Innovate UK and Network Rail. SWIFT aims to deliver high quality and high speed Wi-Fi broadband to rail carriages running between Glasgow and Edinburgh. It is an 18 month project that will demonstrate high speed connectivity (handover durations of 2ms) that improves passenger experience, enhances commercial opportunities and improves train management through increased operational data. SWIFT will utilise the existing high quality trackside fibre that is in place between Edinburgh and Glasgow and put in place a dedicated track to train infrastructure of small cell devices mounted on masts and connected to the fibre, using unlicensed spectrum.

Figure 6: The challenges of providing train connectivity



2.24 In response to these long standing issues, the Department for Transport announced an 'On-Train Wi-Fi' policy last year, which made clear the government's commitment to improving mobile connectivity for rail passengers.[50] This programme is timely and welcome; passenger demand for on-train broadband services is evident[51], and the benefits of improved trackside connectivity could be very large, for both passengers and rail operations.

2.25 The programme is now under way and will utilise the rolling franchise competition process to make Train Operating Companies (TOCs) responsible for delivering in-train Wi-Fi, which must meet a set of minimum service levels prescribed by the DfT. TOCs will be free to negotiate their own solutions with service providers in order to meet the service level metrics, likely resulting in a variety of approaches.

2.26 An encouraging start has been made; several proof of concept trials have begun in conjunction with Network Rail Telecom, such as project SWIFT in Scotland and the Chiltern Railways/EE deal for Continuous On-Train Wi-Fi Services. The aim of these trials is to allow telecoms service providers to showcase potential solutions, and gain insights into the best ways forward.

2.27 There are broadly two approaches open to TOCs. The first is to work chiefly with MNOs to use their networks to backhaul mobile data from the trains using commercially available spectrum and current 4G technologies with "in fill" coverage (at, or close to, trackside) added where required to overcome connectivity issues, for example in tunnels. This is the approach adopted by EE/Chiltern Railways. The alternative approach is to focus on delivery of dedicated trackside infrastructure, installed along the railways and using either licensed or unlicensed spectrum. This is the approach adopted in the SWIFT trial.

2.28 Over the course of the franchise renewal process (which will run until 2028) it is anticipated that TOCs will negotiate commercial agreements with one or more telecommunication providers to deliver the minimum service level through a range of technological solutions.

2.29 It is important to note that the role of Network Rail Telecom will be central in ensuring the success of solutions chosen by TOCs. Track-side telecommunication assets and infrastructure are located in a hazardous and safety-critical environment. The experience and competence of Network Rail Telecom will, therefore, be essential in any solutions that seek to leverage Network Rail assets.

2.30 Though focus here has been on rail, a similar set of benefits could be realised through improved mobile connectivity on underground/light rail networks. The NIC note that Transport for London (TfL) are working on a plan to consolidate their telecommunications networks including those they run and those they buy in. This is the right approach, and TfL should look to produce their plan as quickly as possible.

Railways – considerations

2.31 Poor mobile coverage on our railways has been a perennial issue, but the provision of good quality connectivity to rail passengers could bring about a range of benefits, indeed, earlier this this year, it was described by the Transport Select Committee as an, "important, and potentially transformative, factor".[52] It is therefore welcome that the government is actively seeking to address longstanding mobile coverage and capacity issues on UK railways.

2.32 Looking to the future, and the capacity demands expected in the 5G era, it will be important to make timely decisions about the nature of the networks to be deployed in order to meet longer term passenger and operational needs. Central to these considerations will be the degree of coverage and capacity considered necessary.

2.33 At present, the minimum service level set by the DfT for on-train Wi-Fi aims to deliver a data speed per passenger equivalent to 100 Mbps backhaul per train for 95 per cent of the route (for 85% of passengers journeys). This level of connectivity is aimed at supporting basic internet services, such as email access, and Wi-Fi voice calls. Analysis produced for the NIC suggests that, whilst delivering a 100Mbps per train is a target that could potentially be met relatively quickly (by using a combination of MNO cellular networks with 'in-fill' where required) it is modest based even on today's user requirements.

2.34 Backhaul of 100Mbps per train equates to an approximate data speed target of 256kbps per passenger. However, these assumptions are not based on fully loaded trains – which may carry in the order of 800 people – and assume only 1 in 4 connected passengers for that figure to be possible. This could lead to passengers in some circumstances, for example on peak loaded trains, experiencing a poor service in the near term. Looking over a 10 – 15 year horizon, this basic connectivity level is unlikely to meet future demand.

2.35 There are requirements on TOCs to accommodate growth of 25 per cent per annum in demand, but this is less than half of the currently observed rate of mobile data growth.[53] Ofcom reported eightfold mobile data growth between 2011 and 2015, substantially exceeding their previous forecasts.[54] The growth assumptions underpinning the current approach may therefore significantly underestimate demand across the next decade and beyond.

2.36 Published analysis of 5G requirements suggests significantly greater demand, as do industry expectations. A widely accepted target for 5G connectivity is 50Mbps per user on an average basis[55], though with much greater peak demand. This suggests that a more realistic, future proof approach would be to target backhaul of tens of gigabits per train, and that this degree of connectivity would in particular be necessary on the busiest mainline and commuter routes.

2.37 Targeting this level of demand necessitates extensive deployment of trackside infrastructure along rail routes. This is likely to be the most viable way to achieve high data rates and enable low latency connections. It also has the potential significant advantage of making use of the existing trackside infrastructure such as ducts and poles, following the SWIFT model. It will also be vital to ensure that the mobile connectivity needs of new railway lines are given full consideration at the earliest stages so that appropriate trackside mobile infrastructure can be deployed efficiently as new railways are constructed.

2.38 Work commissioned by the NIC has estimated costs for such an approach to be in the order of £500-£600 million for the UK's main rail routes. Commercial approaches to funding these infrastructure costs appear likely to be feasible due to opportunities for infrastructure providers to secure revenue streams from improved trackside connectivity.

Recommendation 3: Rail passengers should have high capacity wireless connectivity. This should be achieved through a delivery model that utilises trackside infrastructure to provide an open and accessible mobile telecommunication and backhaul network that is fit for the future.

The government should set out its plans for how to deliver this by the end of 2017. As part of this work consideration should be given to who is best placed to install, manage, fund and own the network, noting the potential for private sector funding.

Ensuring that best use is made of the existing infrastructure, such as masts, poles, ducts power supplies and the fibre network alongside our railways so that it can be used to support the backhaul of mobile data will be essential.

Ultimately, the government should ensure that the necessary infrastructure is in place on the main rail and key commuter routes by 2025 at the latest if it wants to offer a reasonable level of connectivity on a timescale consistent with the deployment of 5G networks.

Ofcom should set out how a regulatory regime would support these different operating models.