CONNECTED FUTURE

Getting back on track

A review of government progress delivering mobile connectivity on roads and railways

NATIONAL INFRASTRUCTURE COMMISSION

Contents

Executive summary

Digital connectivity is a necessity for everyday life, crucial for the growth of the economy and improving quality of life. This means that it needs to be available everywhere people live, work and travel. While mobile connectivity has improved across the country the rail network still lags behind. As the coverage and capacity of digital connectivity improves elsewhere in the country, the gap between an increasingly connected society and a disconnected railway will become even more stark. Government must address this.

In its 2016 *Connected Future* study, the Commission set out recommendations to government on delivering mobile connectivity across the UK. The government endorsed these recommendations and has made progress on broadening 4G coverage and enabling the early rollout of 5G technologies.[1] However, the Commission's 2019 Annual Monitoring Report identified that the government had so far failed to deliver on two of the seven recommendations: to improve mobile connectivity on the UK's road and rail networks. This study carries out an in depth review of progress in these areas and identifies actions to deliver further improvements.

While progress has now been made in bringing mobile connectivity to the majority of the UK's road network, there remains some way to go in providing mobile connectivity on the UK's railways and progress appears to have slowed significantly. The government must take swift action to address the barriers preventing the delivery of improved mobile connectivity on the rail network to secure the economic and quality of life benefits of nationwide mobile connectivity.

Key findings and priority actions for government

The Commission's review found that there has been clear continuous progress to deliver mobile connectivity on the UK's road network. Motorways now have near universal mobile coverage for both voice calls and 4G data, and work is progressing on the rest of the network. The Commission will continue monitoring road connectivity through its Annual Monitoring Report to assess whether coverage and capacity improvements continue in future.

Consistent data

Action 1: Ofcom should publish consistent mobile coverage data for roads and in car coverage to enable progress to be more accurately tracked on an annual basis. This data should clearly disaggregate motorways, A roads and B roads, and different types of coverage including 5G. This should be published by December 2020 for the next *Connected Nations* report.

In contrast, progress in improving mobile connectivity on the rail network has been limited, and work appears to have stalled since government endorsed the *Connected Future* recommendation.

The current rate of progress will not be enough to ensure that basic mobile services are available on key main line and commuter routes by 2025. The Commission has identified four priority areas in which government should take action to unlock progress.

Leadership and direction

Action 2: government should, before publication of the National Infrastructure Strategy, establish a single ministerial lead within the Department for Transport for improving mobile connectivity on the railway.

Action 3: the Department for Transport should publish a clear programme, timeframe and a set of standards for delivering mobile connectivity on main line routes and addressing the institutional and commercial barriers highlighted by the Commission. This programme should incorporate currently planned trials and should be published no later than December 2020.

Access to trackside land

Action 4: the Department for Transport should instruct Network Rail to clarify arrangements and facilitate access for third parties to deliver a trackside connectivity network on railway land, including access to trackside facilities and making use of planned railway possessions. These arrangements should be published no later than December 2020, in time for future competitive processes.

Commercial barriers

Action 5: government should set out plans for running competitive processes for delivering mobile connectivity improvements on specific main line routes (or sections of routes). These competitive processes should draw lessons from the active trials being undertaken on routes across the country. Competitive processes on at least four main line routes should begin no later than June 2021.

Filling evidence gaps

Action 6: Ofcom should report at least every two years on the extent and quality of mobile coverage on the railways to ensure that progress is accurately tracked. This data should clearly disaggregate different types of coverage, including 5G.

Introduction

As part of the Commission's role in holding government to account for delivery, the Commission will carry out in depth reviews to secure government action on endorsed recommendations where progress has been slow. This is the first of these in depth reviews, examining progress on delivering the Commission's recommendations in the *Connected Future* study.

Connected Future

In March 2016, the Commission was asked to advise government on the steps the UK should take to become a world leader in the deployment of 5G mobile telecommunications networks, and ensure that the UK can take early advantage of the applications those networks may enable.

Connected Future was published in December 2016.[2] The Commission's central finding was that mobile connectivity has become a necessity. Great advances have been made since the advent of the mobile phone, but government must now play an active role to ensure that basic services are available wherever people live, work and travel. The UK's roads, railways and city centres must be made 5G ready as quickly as possible.

The Commission set out seven recommendations in the *Connected Future* report to improve mobile connectivity. The government endorsed these recommendations in full, stating that "government agrees that in the future it will be important to have greater connectivity on the UK's transport networks to support new ways of travelling and working."[3]

Review of government progress

There have been successes on the majority of the recommendations from *Connected Future* – 91 per cent of the UK's landmass now has coverage from at least one operator, while areas without any 4G coverage have declined from 21 per cent of the UK's landmass in 2017 to nine per cent in 2019.[4,5] Meanwhile, 5G services have been launched by all four mobile network operators over the past year and are now operating in over 40 towns and cities across the UK.[6]

The Commission's 2019 Annual Monitoring Report flagged the Commission's concern around the slow rate of progress on improving mobile connectivity on the UK's road and rail network. As the coverage and capacity of digital connectivity has improved elsewhere, there is now a stark gap between an increasingly connected society and a disconnected railway. With little visible progress on these recommendations, the 2019 Annual Monitoring Report committed that the Commission would carry out an in depth review of progress to strengthen mobile connectivity on the UK's road and rail network, assessing how the evidence has developed and identifying actions for government to improve progress on these missing pieces of mobile coverage.[7]

Following the 2019 Annual Monitoring Report, the Commission has conducted a review of government progress since the publication of *Connected Future* in 2016, as well as analysis of new evidence and literature developed since 2016. The Commission has also undertaken an extensive programme of engagement with stakeholders in government departments, public bodies, regulators and private providers. Emerging conclusions were tested with stakeholders to ensure they accurately reflected the barriers facing the delivery of improvements, and six key priority actions identified.

Mobile connectivity on roads

There has been steady progress to deliver mobile connectivity on the UK's road network. Motorways now have near universal mobile coverage for both voice calls and 4G data, and work is progressing on the rest of the network. The Commission will continue monitoring road connectivity to assess whether coverage and capacity improvements continue in future. In future, the government should continue to improve connectivity on the road network, including by ensuring that mobile coverage data is consistently tracked for motorways, A and B roads. This will help to deliver full coverage in future and prepare the UK's roads for 5G roll out.

Connected Future recommendation

The Commission's 2016 recommendation, endorsed by government, was as follows:

> Our motorways must have mobile telecommunication networks fit for the future. It is vital that our motorways are able to meet both the long term operational needs of connected vehicles and the connectivity needs of the passengers. This will necessitate the timely installation of an open and accessible mobile telecommunication and backhaul network that is fit for the future.

The recommendation stated that the necessary infrastructure should be in place on motorways 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.

Progress to date

While coverage is not complete across all A and B roads, the Commission has found that, using the latest data, there has been clear and continuous improvement in mobile connectivity across the road network.

Ofcom's *Connected Nations* data shows that there is near universal coverage inside the vehicle from at least one operator on motorways and A roads for both voice and 4G data.[8][9] Outside the vehicle, 88 per cent of motorways and A roads have good 4G data coverage from all operators, whereas within vehicles, 62 per cent of motorways and A roads have 4G data coverage from all four operators.

On A and B roads, data since 2017 shows that there were initially rapid improvements in 4G coverage (shown in Figure 1 below) and lower speed data, but that improvements have slowed since September 2018. These improvements coincided with obligations on mobile network operators to deliver mobile voice services to 90 per cent of the UK landmass by the end of 2017.[10]

However, disaggregating the data by nation shows that England performs strongest on all measures, with Scotland, Wales and Northern Ireland, which are more rural, still having poorer coverage.[11] It is not possible to understand how coverage has changed on motorways, A roads or B roads individually using Ofcom's existing public data.
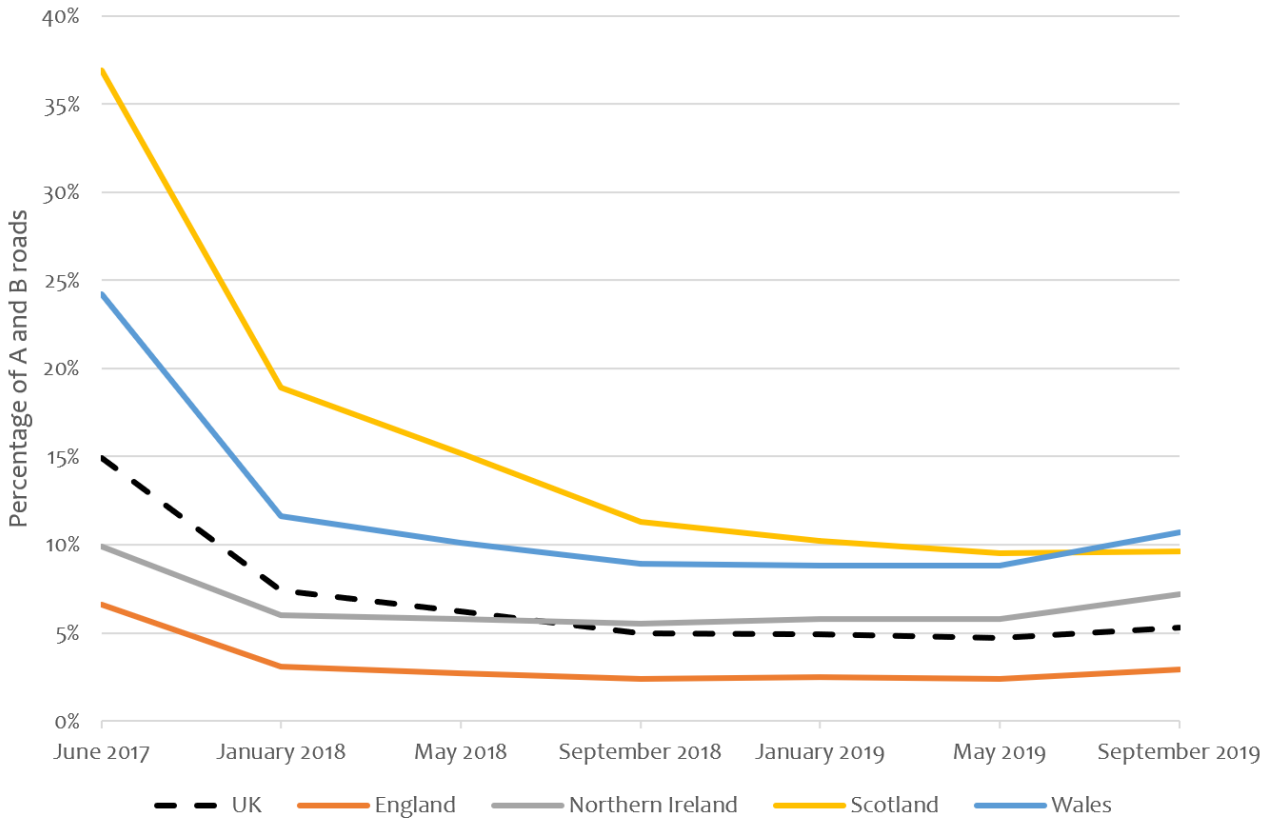

Figure 1: A and B roads not covered by any operator (4G coverage, in-car, A and B roads)[12]

Future improvements

Mobile coverage and capacity on the UK's roads will still need to improve in the future to ensure that roads do not lag behind the national rollout of 5G and can accommodate growth of connected and autonomous vehicles. Although the precise requirements of connected and autonomous vehicles are not yet clear, a lack of mobile connectivity on roads should not impede their adoption. There do not appear to be fundamental barriers to the delivery of further improvements in connectivity on motorways and the strategic road network. For example, the Commission understands from discussions with stakeholders that it is possible that elements of the existing mast network could form the backbone of a future high capacity network providing connectivity on roads.

The remaining coverage gaps on rural roads are likely to be addressed, at least in part, by the government's ongoing work to deliver mobile connectivity to rural areas where there is currently no coverage ('not spots'). This work will be carried out through the Shared Rural Network, an initiative between the government and the mobile network operators.[13]

The Shared Rural Network aims to improve geographic coverage to 95 per cent of landmass. The government estimates that at least 16,000km of roads, the equivalent of around four per cent of the British road network, will gain coverage or receive coverage from a greater number of operators.[14][15] To do so, the mobile network operators have agreed to share existing masts and infrastructure in areas where there is coverage from at least one operator, but not all operators. In turn, government will commit funding to subsidise mobile connectivity in areas where there is currently no operator.[16]

The full terms of the deal are expected to be finalised in early 2020.[17] The government estimates the four mobile network operators will contribute a total of £530 million, which will be matched by with £500 million from government.

Priorities for government action

Consistent data

The Commission will continue monitoring mobile connectivity on roads to assess whether coverage and capacity improvements continue in line with wider 5G rollout and to assess the impacts of the Shared Rural Network.

In order to track this progress, Ofcom should adopt a consistent approach to publishing coverage data (including 5G) for roads and in car coverage. The format in which Ofcom reports coverage on roads makes it difficult to meaningfully track progress and identify priority areas for improvement. Progress against this action will be tracked in future Commission Annual Monitoring Reports.

Action 1: Ofcom should publish consistent mobile coverage data for roads and in car coverage to enable progress to be more accurately tracked on an annual basis. This data should clearly disaggregate motorways, A roads and B roads, and different types of coverage including 5G. This should be published by December 2020 for the next Connected Nations report.

Mobile connectivity on the railway

Progress in improving mobile connectivity on the rail network has been limited, and work appears to have stalled since government endorsed the *Connected Future* recommendation. The current rate of progress will not be enough to ensure that basic mobile services are available on the UK's main line rail routes by 2025.

The Commission's in depth study has identified that the government needs to address four key areas to enable improved mobile connectivity on the railways: leadership and direction, access to trackside land, commercial barriers, and filling evidence gaps. The government now has the opportunity to make real progress over 2020, and this chapter sets out clear actions that the government could take over the next year to address the barriers identified.

Connected Future recommendation

The Commission's 2016 recommendation, endorsed by government, was as follows:

> **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 recommendation stated that the necessary infrastructure should be in place on key main line and 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.[18]

Progress to date

Since 2016, there have been a range of public and private initiatives to improve mobile connectivity on the railways. These include:

- trials of 5G technology on South Western Railway[19]

- Network Rail's proposed connectivity procurement on the Brighton Main Line[20]

- London North Eastern Railway's plans to improve coverage on the East Coast Main Line[21]

- testing technologies at Network Rail's Rail Innovation Development Centre[22]

- Transport for London's work to deliver mobile connectivity on the London Underground network, starting with trials on the Jubilee line.[23]

Despite these piecemeal trials and improvements, progress towards improving mobile connectivity on the rail network has been limited and, following a series of consultations, work appears to have stalled.[24] [25][26] The passenger connectivity component of the Trans Pennine Initiative was cancelled on grounds of cost, and further work has been deprioritised.[27] No overarching plan appears to exist for progressing rail connectivity, and without further work to resolve these issues connectivity for rail passengers will not progress.

Barriers to progress

The lack of progress on rail connectivity in the UK appears to be due to institutional and commercial barriers as well as a lack of clear leadership and direction. Delivering rail connectivity is not a technical problem. Various technological solutions exist to deliver mobile connectivity on the railway through trackside infrastructure, and these have been deployed successfully on intercity rail lines in countries, including Italy, Germany and China as well as on a number of urban metro systems including New York, Moscow and Hong Kong.[28][29][30] These examples have tended to be accompanied by a degree of public subsidy and, often, a single organisation responsible for running the track, trains and trackside assets.[31] While this may make it simpler to coordinate the delivery of trackside infrastructure, the strength of this effect is difficult to determine.

This in depth review has identified four areas in which government needs to improve progress:

- leadership and direction

- access to trackside land

- commercial barriers

- filling evidence gaps.

Actions to address these four barriers are set out below. Each action is intended to provide direction to government over the coming 12 months, and progress will be monitored in the 2021 Annual Monitoring Report.

Leadership and direction

A lack of clear, strategic leadership has been a contributing factor in the lack of progress on rail. Many of the complexities in this area are specific to the railway, its infrastructure and institutions, rather than the telecoms sector.

In 2017, following the publication of *Connected Future*, momentum was built within government to deliver improved mobile connectivity on the railways.[32] However, ministerial changes have slowed progress and the work has been deprioritised as resources have been allocated elsewhere. Responsibility for the area also falls between the Department for Digital, Culture, Media and Sport and the Department for Transport, and this split responsibility also appears to have limited ambition and progress.

There is an opportunity for the new government to provide clearer strategic leadership and direction. The identified barriers to delivering passenger mobile connectivity on the railway appear to be more strongly driven by institutional and commercial factors specific to the railway, rather than the wider telecoms sector. Clear ministerial leadership and ownership from the Department for Transport could better address these challenges.

Action 2: government should, before publication of the National Infrastructure Strategy, establish a single ministerial lead within the Department for Transport for improving mobile connectivity on the railway.

Since 2016, there have been a range of public and private initiatives to improve mobile connectivity on the railways. Individually these are welcome initiatives and should be continued, but there is no overarching strategy, and it is unclear how they could eventually add up to improving mobile connectivity across main line rail routes. A greater leadership role for the Department for Transport would enable the development of a clear programme and timeline for improving rail connectivity, to ensure that future public and private initiatives are well-directed. The Department for Transport should also seek to set out outcome-based standards for delivering mobile connectivity on the rail network. These standards should not dictate a specific technical solution, but should ensure that the different solutions are able to work coherently to deliver a consistent experience of improved mobile connectivity for rail passengers.

Action 3: the Department for Transport should publish a clear programme, timeframe and a set of standards for delivering mobile connectivity on main line rail routes and addressing the institutional and commercial barriers highlighted by the Commission. This programme should incorporate the currently planned trials and should be published no later than December 2020.

Access to trackside land

The lack of leadership and direction is compounded by the institutional complexities of delivering connectivity on rail. The Commission has consistently heard from stakeholders in the public and private sectors that access to trackside land is a major barrier to progress.

Network Rail is the asset owner for trackside infrastructure and is the gatekeeper for accessing trackside land.[33] Access to trackside land has to be carefully managed to balance competing needs and to ensure the safety of all railway users. However, stakeholders consistently report that the processes for securing access to trackside land are complex, opaque and resource intensive, and this has proved a significant barrier to mobile connectivity improvement works being carried out by third parties. The Commission understands that Network Rail is aware that there is a need for further clarity and will be seeking to address this as part of its 'Open for Business' programme.[34]

Action 4: the Department for Transport should instruct Network Rail to clarify arrangements and facilitate access for third parties to deliver a trackside connectivity network on railway land, including access to trackside facilities and making use of planned railway possessions. These arrangements should be published no later than December 2020, in time for future competitive processes.

Commercial barriers

As *Connected Future* identified, it is likely that installing trackside infrastructure (including masts and fibre) will be the best approach to delivering a continuous and/or high capacity connection.[35] However, the expense of installing trackside infrastructure and the potential risks involved in doing so mean that there are significant commercial barriers that are stalling progress.

The Commission understands that updated cost estimates for delivering mobile connectivity on the railway may be significantly higher than the estimates in *Connected Future*. While Network Rail, train operating companies, mobile network operators, passengers or independent infrastructure providers could all theoretically provide funding, discussions with stakeholders suggest that, in practice, none of these parties are independently willing or able to profitably pay the full cost of installing trackside infrastructure.

One option to address this is to share the cost through a 'neutral host' model. Under this model, an independent infrastructure provider builds, owns, finances and bears the risk of the trackside infrastructure. Connectivity providers (such as mobile network operators) can then pay to access this infrastructure, sharing masts and avoiding the upfront cost of installing the infrastructure.[36] Infrastructure sharing is common elsewhere in the mobile market and is the basis of the Shared Rural Network.

Even sharing costs through a neutral host approach, there is the risk that connectivity providers would not be willing to pay enough to access the infrastructure to make it profitable for the neutral host party. It is likely that only some routes, or sections of routes, will be commercially attractive. Commercial attractiveness will be driven by factors such as passenger numbers and the frequency of rail services.

To improve coverage beyond commercially attractive stretches of track, it is likely that, even using a neutral host model, any party (or parties) aiming to deliver trackside infrastructure would seek some level of public subsidy. Where subsidy is required, it will be important to ensure that third party providers have sufficiently strong commercial incentives to encourage mobile network operators (and other users) to pay to access the network.

Despite these challenges and risks, the Commission's engagement with a wide range of stakeholders and the number of active trials indicate that there remains market interest in both investing in and delivering passenger connectivity on the railway.

Government has not yet put the opportunity of delivering mobile connectivity on the railway to the market, outside of trials. The Commission believes that a competitive approach would allow third party commercial providers the opportunity to present innovative and cost effective approaches to delivering improved mobile connectivity on main line routes, or sections of routes. Running competitive processes will allow long overdue coverage improvements to progress while limiting public subsidy to only the places it is required. This is in line with recommendation four of the Commission's regulation study.[37]

There are likely to be a range of technical and commercial models available to delivering passenger connectivity on the railway, including private and public hybrid funding approaches. These competitive processes should be based around the outcome-based standards set out by government, outlined in Action 3. On some routes, it is possible that these competitive processes could take the form of a reverse auction, with potential suppliers bidding for minimum subsidy.

This approach should be informed by the ongoing active trials across the country and the lessons of the Trans Pennine Initiative passenger connectivity trials, in which market interest was impeded by rising costs as well as the terms and funding offered by government.[38] [39]

Action 5: government should set out plans for running competitive processes for delivering mobile connectivity improvements on specific main line rail routes (or sections of routes). These competitive processes should draw lessons from the active trials being undertaken on routes across the country. Competitive processes on at least four main line routes should begin no later than June 2021.

Filling evidence gaps

Improved information about the existing level of coverage will make it easier for policymakers to target improvements on the railways and track progress. Ofcom's recently published data on mobile signal strength and quality on the railway has provided the first public data in this area and is likely to help build consumer awareness of the issues around mobile connectivity on the rail network. While this is a positive step, it should not be a one off.

Action 6: Ofcom should report at least every two years on the extent and quality of mobile coverage on the railways to ensure that progress is accurately tracked. This data should clearly disaggregate different types of coverage, including 5G.

Endnotes

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