National Audit Office

REPORT

Supporting mobile connectivity

Department for Science, Innovation & Technology

SESSION 2023-24
22 FEBRUARY 2024
HC 555

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National Audit Office

Supporting mobile connectivity

Department for Science, Innovation & Technology

Report by the Comptroller and Auditor General

Ordered by the House of Commons
to be printed on 20 February 2024

This report has been prepared under Section 6 of the National Audit Act 1983 for presentation to the House of Commons in accordance with Section 9 of the Act

Gareth Davies
Comptroller and Auditor General
National Audit Office

15 February 2024

HC 555 | £10.00

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Key facts

92.7%

percentage of the UK landmass with 4G coverage as at September 2023, up 1.3 percentage points from 91.4% in 2020, and against a target to achieve 95% 4G coverage by December 2025

£1bn

planned total spending over 20 years to 2039-40 to deliver and maintain 4G coverage through the Shared Rural Network (SRN) programme

2030

date by which the Department for Science, Innovation & Technology (DSIT) wants standalone 5G (5G infrastructure that does not require 4G infrastructure) to be available in all populated areas

Tenfold	increase in consumption of mobile data per person in the UK between 2013 and 2021
£532 million	share of planned £1 billion spending on the SRN programme to be funded by the UK's four mobile network operators
£501 million	share of planned £1 billion spending on the SRN programme to be funded by DSIT
£1,352 million	estimated quantifiable benefits arising from the SRN programme
Around £400 million	DSIT's funding commitment since 2017 to determine uses of 5G technology and support its adoption
Between £41 billion and £159 billion	DSIT's estimate of cumulative productivity benefits between 2021 and 2035 from the widespread adoption of standalone 5G

Summary

1 The government considers that access to good-quality mobile connectivity is key to growing the economy. Good mobile connectivity allows people to access the internet and communicate while on the go and in locations where a wired connection does not exist. It helps to ensure that people across the UK can make choices about where to live and work, and are not left out of future technological revolutions because of poor infrastructure. Between 2013 and 2021, consumption of mobile data per person in the UK increased tenfold. Although the future pace is uncertain, demand is expected to continue to grow as greater use is made of data-intensive services and as new technologies enable new uses.

2 The Department for Science, Innovation & Technology (DSIT) is responsible for government policy on digital connectivity, and Building Digital UK (BDUK), an agency of DSIT, is responsible for delivering infrastructure programmes to improve connectivity.[1] Ofcom, the regulator and competition authority for the UK's communications industries, issues licences to the UK's four mobile network operators (MNOs) to use radio spectrum.

3 While the government considers that a competitive market plays a key role in increasing capacity and meeting future customer needs, it may choose to intervene where there is a weaker commercial case for investment, such as in remote areas. One such example is the Shared Rural Network programme, in which DSIT and BDUK are working with MNOs to deliver reliable 4G coverage to 95% of the UK landmass by December 2025. One element of this programme builds commercial 4G coverage onto the Home Office's Emergency Services Network, which we reported on most recently in 2023.[2] DSIT also funds programmes that aim to create favourable conditions for investment in technologies for the UK's future connectivity needs. It has set out its plans in its 2023 wireless infrastructure strategy.

1 In February 2023 responsibility for digital connectivity moved from the Department for Digital, Culture, Media & Sport to the Department for Science, Innovation & Technology (DSIT). Throughout this report, we refer to the accountable department as DSIT, irrespective of the period under discussion.
2 Comptroller and Auditor General, *Progress with delivering the Emergency Services Network*, Session 2022-23, HC 1170, National Audit Office, March 2023.

4 This report examines whether DSIT is on track to deliver UK-wide reliable mobile connectivity that meets the country's needs now and in the future. Part One of the report sets out the UK mobile landscape. The report then examines whether:

- DSIT and BDUK have set up effective arrangements for delivering UK-wide 4G connectivity through the Shared Rural Network programme (Part Two);
- BDUK is on track to deliver this (Part Three); and
- DSIT is developing a good basis for meeting the UK's future connectivity needs (Part Four).

5 This report does not examine DSIT's progress in delivering gigabit broadband through Project Gigabit, which we reported on in 2020, or the extent to which DSIT's broadband and mobile programmes complement each other.[3] We have considered how DSIT has learned lessons from digital infrastructure projects. The government requires MNOs to remove high-risk vendor infrastructure from their networks.[4] We have considered how DSIT is managing the risk that this requirement affects MNOs' capacity to deliver DSIT's programmes, but we have not examined MNOs' progress in meeting this requirement. The report does not cover broader issues such as: DSIT's role in managing the impact of MNOs switching off their 3G and 2G networks, which the Local Government Association reported on in September 2023;[5] the retirement of analogue telephone landlines by 2025 and their replacement with digital technology using an internet connection;[6] and digital exclusion issues, including affordability, which were examined in a 2023 House of Lords inquiry.[7]

Key findings

Establishing the Shared Rural Network programme

6 **DSIT set a clear objective for increasing mobile coverage.** In 2020, DSIT set out its plans for the Shared Rural Network (SRN) programme, which aims to broaden consumer choice for mobile services in rural areas. Building on a 2017 government manifesto commitment, it set a target for 95% of the UK landmass to have 4G coverage from at least one MNO by December 2025, up from 91.4% in 2020. DSIT aims to cover 280,000 additional premises and 16,000 kilometres of roads through the programme (paragraphs 2.2 and 2.3).

3 Comptroller and Auditor General, *Improving broadband*, Session 2019–2021, HC 863, National Audit Office, October 2020.
4 Secretary of State for Digital, Culture, Media & Sport, *Designated Vendor Direction under section 105Z1 of the Communications Act 2003, given to [a Public Communications Provider], 12 October 2022.*
5 Local Government Association, *2G/3G switch off impact survey,* September 2023.
6 House of Commons Library, *The withdrawal of landlines and switch to digital calls*, research briefing 9471, January 2024.
7 Communications and Digital Committee, *Digital exclusion*, Third Report of Session 2022-23, HL 219, June 2023.

7 **DSIT secured a private sector commitment to cover just over half of the planned £1 billion cost of improving mobile coverage in remote areas**. MNOs supply mobile infrastructure where profitable, but infrastructure costs and lower population density make some areas less attractive commercially. Under the SRN programme, the UK's four MNOs agreed to improve connectivity in 'partial not spots' (PNS – areas where there is coverage from at least one, but not all four, MNOs) at an estimated cost to the MNOs of £532 million. The government will provide £501 million of funding over 20 years to 2039-40 to reduce 'total not spots' (TNS – areas not covered by any operator) and to develop the 'extended area service' (EAS – building commercial 4G coverage onto the Home Office's Emergency Services Network in remote areas). To help deliver the EAS and TNS elements, DSIT signed a grant agreement with Digital Mobile Spectrum Limited (DMSL), an organisation wholly owned in equal part by all four MNOs. Ofcom licence obligations commit each MNO to increase its 4G coverage to 88% of the UK landmass by June 2024, and to 90% by 2027 (paragraphs 1.11 and 2.4 to 2.6).

8 **BDUK has had insufficient information about some elements of the SRN programme but is taking steps to address this.** BDUK is responsible for oversight of the programme and requires timely information for effective decision-making and risk management. MNOs run and fund the PNS element of the programme themselves. Although they provide BDUK with updates on progress, they do not routinely provide, for example, data on the level of coverage achieved, or forecasts. To monitor coverage achieved, DSIT has relied on Ofcom data, but this is only retrospective. For projections of future coverage, BDUK started in 2022 to hold more frequent progress reviews with the MNOs on the PNS element of the programme. On the TNS element, BDUK sought in 2023 to improve the financial information it received from DMSL since it considered that the information it had previously agreed to receive contained insufficient detail on which to take financial planning decisions. It aimed to formalise this improvement by January 2024 through an amendment to the grant agreement. It had not been able to confirm to us that it had done so by mid-February, when we finalised this report (paragraphs 2.6 to 2.12).

9 **The SRN programme aims to address the digital divide between urban and rural areas but some of the most difficult and expensive infrastructure is in areas with the least clear benefits.** The business case identified a range of benefits, such as supporting tourism and business productivity in rural areas. DSIT estimated that the programme would result in quantifiable benefits of £1,352 million. However, the business case included limited evidence of the specific benefits of extending mobile coverage into remote or sparsely populated areas, including locations where building masts may be more difficult or expensive, or where there may be an impact on the environment. A clearer narrative about the outcomes DSIT is aiming for in these locations, who will benefit, and why the investment is needed, would help it communicate its case for investment (paragraph 2.13).

Progress with the Shared Rural Network programme

10 By 2023, the SRN programme had contributed to a 1.3 percentage point increase in coverage. Ofcom reported that, as at September 2023, 92.7% of the UK landmass had 4G coverage from at least one MNO, up from 91.4% in 2020 and against a target of 95% by December 2025. This increase is predominantly due to additional coverage funded by the MNOs, including their delivery of the PNS element of the programme. DSIT was unable to provide details of progress in meeting coverage targets for premises and roads, and is working with Ofcom to develop the necessary data, but it told us that the MNOs are confident that they will achieve these targets (paragraphs 3.2 and 3.7).

11 The programme is behind schedule, partly because preparatory work took longer than expected. In late 2023, three MNOs advised BDUK that they were each likely to miss their Ofcom licence obligation to provide 88% 4G coverage by June 2024 and wanted to discuss an 18-month extension to the PNS element of the programme. The other MNO announced in January 2024 that it had met its obligations ahead of schedule. BDUK and DSIT are assessing the impact of any delays to MNOs meeting their licence obligations on the achievement of the December 2025 95% target. Preparatory work on the government-funded elements of the programme, including agreeing site sharing between the MNOs and the Home Office, finalising mast locations and procuring services, also took longer than expected. As a result, DSIT's funding of expenditure by the MNOs and Home Office on masts in 2022-23 and 2023-24 was almost £62 million (79%) lower than planned. As at January 2024, one EAS mast was operational for commercial 4G coverage, and the Home Office had made nine sites in total available to MNOs, compared to 75 planned by this date. Site acquisition on the TNS element is on track against a timetable agreed in 2023, with the first masts due to become operational in January 2025 (paragraphs 3.8 to 3.14).

12 Local delivery of the programme has proved more difficult than planned timetables allowed for. Based on their previous experience of other digital programmes, DSIT, BDUK, DMSL and the MNOs recognised delivery risks, such as the need to secure agreement from local planning authorities, landowners and communities to the installation of masts, and the remoteness of the sites involved, but these challenges proved more difficult than their planned timetables allowed for. Securing planning permissions has taken longer than expected in some cases because, in part, local authorities have lacked the resources to handle large numbers of applications, and the COVID-19 pandemic hindered processing of applications. In addition, local stakeholders are campaigning against masts in some areas because they are concerned about potential impacts. MNOs, DMSL, BDUK and DSIT are working with stakeholders to attempt to resolve these issues (paragraphs 3.4 to 3.6).

13 The MNOs may no longer be able to deliver the level of coverage required within their current grant funding because costs have risen significantly. Delivery challenges and other cost pressures mean that costs are higher than expected. On the EAS element, estimated costs have increased by around £44 million due to irrecoverable VAT and inflation. BDUK decided not to proceed with 15 EAS sites on the basis of value for money and is keeping other potential sites under review. On the TNS element, in late 2023, DMSL indicated that delivery of the planned number of sites and the 1% increase in coverage required from this element was set to exceed the current level of grant funding, although the number of sites required and their costs were still uncertain. Under the terms of the grant agreement, additional costs are to be borne by the MNOs. However, if costs are excessive, the Ofcom licence agreements with the MNOs allow for relief of their individual obligations to deliver 90% coverage by 2027, putting the achievement of the government's 95% coverage target at risk (paragraphs 3.15 to 3.17).

14 The SRN programme may require upgrades in the future to ensure that it continues to deliver the connectivity that rural areas need. DSIT requires MNOs to meet Ofcom's minimum performance threshold for 4G coverage, with a download speed of 2 Mbps (megabits per second). BDUK expects that this performance will be achieved across the network, with an average speed of around 7 Mbps, although some areas may experience lower speeds than this average. However, Ofcom set this threshold in 2018 and the use of technology has advanced. For example, a download speed of 2 Mbps does not enable uses such as group video calls and quick data downloads. DSIT is also concerned that reported coverage does not always reflect the consumer experience. It has therefore asked Ofcom to keep under review its definition of good 4G coverage and to take steps to improve its coverage reporting. DSIT expects a speed of 2 Mbps to meet current mobile coverage needs but recognises that advances in technology could lead to users requiring higher performance in the future. It is confident that upgrading the network will be technically feasible where doing so represents value for money (paragraphs 3.18 to 3.21).

The government's plans for future mobile connectivity

15 DSIT's 2023 wireless infrastructure strategy for meeting the UK's future connectivity needs has been welcomed by MNOs and other stakeholders. Unlike the SRN programme that directly funds infrastructure to remedy market failure, the strategy sets out DSIT's intention to kick-start investment and innovation as the commercial case for investment in 5G infrastructure is uncertain. Since 2017, it has committed around £400 million to initiatives to determine how 5G can be used and to promote its adoption. These include around £140 million on trials to examine how the UK can take advantage of 5G, and £250 million to encourage diversity in the 5G equipment supply chain. The 2023 strategy provides a further £36 million for UK regions to promote growth through investment in 5G, and up to £100 million for research into more advanced technologies. DSIT has estimated that widespread UK adoption of standalone 5G could deliver cumulative productivity benefits of between £41 billion and £159 billion from 2021 to 2035.[8] MNOs and other stakeholders told us that DSIT's strategy recognises the government's role in reducing barriers to investment, such as through amendments to planning legislation (paragraphs 4.4 to 4.9).

16 DSIT's thinking on how new technology can be used and who needs it must evolve further if it is to meet its future connectivity ambition. DSIT has set a new ambition for standalone 5G in all populated areas by 2030, signalling a move away from 4G in order to enable high specification applications. However, achieving this ambition will require significant investment from MNOs and, although there are potential uses of 5G for businesses and public services, fewer direct benefits are expected for individual consumers. Similarly, it is not yet clear where standalone 5G will be needed or whether government funding will be required to avoid remote areas being left behind. For these reasons, DSIT has not defined 'all populated areas' or the level of performance needed. MNOs told us that, as the wireless infrastructure strategy develops, DSIT will need to clarify what outcomes the government is seeking, what connectivity will be needed to achieve these outcomes, and the role that 5G will play alongside 4G, wired broadband and other technologies. DSIT will be reliant on accompanying action from government departments, Ofcom, local authorities and devolved administrations, which will have their own priorities and resource constraints. DSIT has considerable experience from previous infrastructure programmes, including the SRN, to help it address these issues (paragraphs 4.3 to 4.7, 4.12, 4.19 and 4.20).

8 There are two main types of 5G: non-standalone 5G, which makes use of existing 4G infrastructure, and standalone 5G, which uses 5G infrastructure throughout, and enables substantially higher speeds and the ability to connect thousands of devices in a small area.

Conclusion on value for money

17 Demand for mobile data access is expected to grow as greater use is made of data-intensive services and as new technologies enable new uses. Alongside a similar-sized commitment by the private sector, DSIT and BDUK have committed around £500 million to the SRN programme. However, delays in building new masts mean that it is currently unclear if the programme will meet its target of increasing 4G coverage to 95% of the UK landmass by December 2025, and there are concerns about the programme's affordability. Although BDUK is taking steps to increase the information it receives from MNOs, its information to monitor progress is still insufficient. DSIT has not fully articulated the outcomes it is seeking to achieve from improving connectivity in remote areas, who will benefit, and the quality of connectivity needed. Under the terms of the grant agreement, additional costs are to be borne by the MNOs. However, if costs are excessive, Ofcom licence agreements allow for relief of the MNOs' individual coverage obligations, putting achievement of the government's coverage target at risk. Value for money will be eroded if the programme delivers infrastructure that does not meet UK consumers' growing needs.

18 DSIT has considerable experience of digital infrastructure projects, including the SRN, which it must draw on as it takes forward its future connectivity strategy. It is not yet clear how much investment (in 5G or otherwise) will be made by the private sector, and what support will be needed from the government. As its strategy develops, DSIT will need to resolve what it is aiming to achieve in different parts of the UK and economic sectors, and communicate how connectivity can deliver these outcomes, taking account of changes in user demand and advances in technology over the next decade.

Recommendations

a **DSIT and BDUK should ensure that their arrangements for oversight of MNOs on the SRN programme enable effective decision-making.** BDUK should ensure that it receives timely and detailed financial and performance data across the programme to allow it to monitor progress, have clear sight of reliable forecasts, assess delivery risks, and obtain assurance about the likely outturn costs. DSIT and BDUK should consider whether any further changes to the grant agreement are required to facilitate information sharing, and whether additional financial reviews are needed to understand and verify the reasons for any increases in the cost of the programme.

b **DSIT and BDUK should ensure that there is sufficient focus on delivering the 4G performance that consumers and businesses need.** They should:

- carry out a detailed analysis of the outcomes they are seeking to achieve from improving connectivity in remote areas and who will benefit, and use this analysis to determine the level of service required;
- continue to work with Ofcom to improve processes for measuring coverage to ensure that 4G coverage data reliably reflect user experience, particularly in those remote areas covered by the SRN where Ofcom has carried out limited testing;
- monitor how consumers and businesses are using 4G in SRN areas to ensure that intended benefits are being realised, and use this information to inform plans for supporting future connectivity; and
- assess how any actions they take to address the affordability of the SRN programme affect outcomes for consumers.

c **As it develops the wireless infrastructure strategy, DSIT should:**

- set out target dates for taking key decisions about the outcomes it is seeking, the connectivity that will be needed to realise them, and the input DSIT will need from other government bodies to deliver opportunities to use 5G in key sectors;
- determine the combination of enablers that will be required to deliver this connectivity (for example, 4G, wired connectivity, standalone 5G, other new technologies) and where they will need to be deployed to meet users' needs;
- collect the data needed to assess to what extent the market will meet the UK's future connectivity needs, and the government funding that may be required; and
- learn lessons from its experience on previous digital infrastructure programmes, including the risk that advances in technology coupled with the practical and commercial barriers to deploying infrastructure in remote areas could perpetuate the rural urban divide.

Part One

The UK mobile network landscape

1.1 This part of the report sets out the UK mobile network landscape and the government's role in supporting mobile connectivity.

What is mobile connectivity?

1.2 For most people in the UK, accessing the internet is part of daily life. In 2022, UK adults spent an average of four hours a day on the internet. There are two ways to access the internet: through a wired connection, where information is sent through wires and cables to a device; or through a wireless connection, where information is sent over radio waves. Mobile connectivity allows people to access the internet while on the go and in locations where a wired connection does not exist. Ofcom has reported that 4% of households are only able to access the internet via a mobile data connection, and that these people are more likely to be financially vulnerable. Between 2013 and 2021, consumption of mobile data per person in the UK increased tenfold (**Figure 1** overleaf).

The UK mobile network

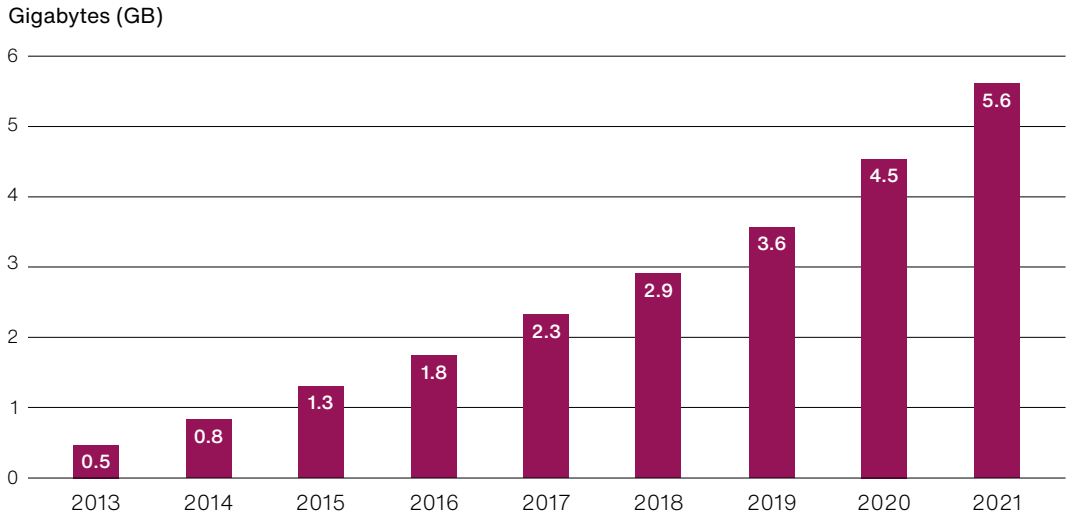
1.3 Mobile connectivity requires a network of phone masts (**Figure 2** on page 15). Each mast includes at least one antenna that transmits and receives radio waves. Information is transmitted over the radio waves between mobile devices and the antenna, enabling people to use voice and data services, such as accessing the internet. 'Backhaul' is the part of the network that connects the mast to a mobile network operator's core network. Backhaul can be through fibre, copper, or wireless. Masts also require electricity to power the equipment.

1.4 The UK mobile network is provided by four national mobile network operators (MNOs): EE, Three, Virgin Media O2 and Vodafone. The MNOs own and operate the mobile network infrastructure and hold licences to use certain frequencies in the radio wave spectrum. In addition, several other mobile operators, which do not own networks, provide retail services to customers by obtaining access to an MNO's network at wholesale rates and reselling this access.

Figure 1

Average monthly per person consumption of mobile data in the UK, from 2013 to 2021

The consumption of mobile data has increased year on year, with a tenfold increase between 2013 and 2021



Note

1 Data collected by Ofcom through the Ipsos Iris Online Audience Measurement Service report, with a sample of 10,000 adult internet users.

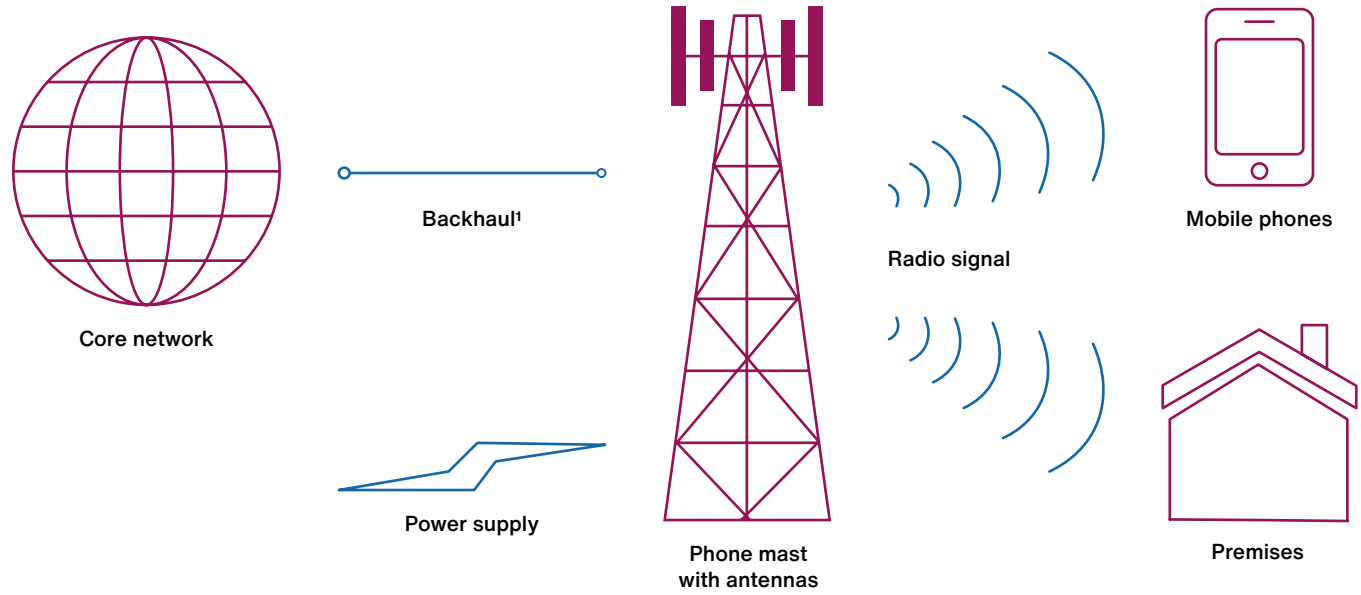
Source: National Audit Office analysis of Ofcom data

1.5 Five generations of mobile technology have been launched to date. 3G networks, which followed earlier technologies, launched in the early 2000s and supported higher-speed data services, as well as voice calls and text messages. 4G, launched in the 2010s, improved on 3G and provided faster and higher-capacity data services. In 2023, 99.9% of UK premises received an outdoor 4G signal from at least one MNO. Basic 5G (non-standalone), which MNOs are currently deploying across the UK, is capable of providing faster speeds and greater capacity.[9] Higher-quality 5G (standalone) enables substantially higher speeds and the ability to connect thousands of devices in a small area. The next generation of mobile technology, 6G, is in early development.

9 Non-standalone 5G makes use of existing 4G infrastructure, and standalone 5G uses 5G infrastructure throughout.

Figure 2
Mobile network infrastructure

Radio signals from antennas on phone masts connect mobile phones and premises to a mobile operator's network



Note
1 Backhaul is the part of the network that connects the mast to a mobile network operator's core network.

Source: National Audit Office analysis of Ofcom documents

1.6 The UK is in line with other leading countries (including the USA, Germany and South Korea) in terms of the percentage of the population that has access to 4G connectivity. Some other countries, including Finland, France and Germany, have government-funded programmes to improve coverage in areas where it is poor. Other countries have mobile networks that perform better than the UK's. For example, in 2021, mobile users in Japan could access 4G 98% to 99.7% of the time, depending on MNO, compared to 81% to 94% in the UK; in Finland, 47% to 70% of people had 5G coverage, compared to 18% to 30% in the UK.[10]

10 Ofcom, *Mobile Strategy Review – International Case Studies*, January 2022. Data shows Opensignal's 4G network availability measure (the percentage of time that users can connect to the 4G network); this is not a measure of the geographic extent of coverage.

The role of the UK government

1.7 The Department for Science, Innovation & Technology (DSIT) is responsible for the UK's digital infrastructure, including mobile connectivity. In February 2023, responsibility for digital connectivity moved from the Department for Digital, Culture, Media & Sport to DSIT. Throughout this report, we refer to the accountable department as DSIT, irrespective of the period under discussion. Building Digital UK (BDUK), an executive agency of DSIT, delivers the government's digital infrastructure building programmes, including the £5 billion Project Gigabit programme to deliver gigabit-capable broadband to at least 85% of UK premises by 2025.

1.8 Ofcom is the regulator and competition authority for the UK's communications industries, including telecoms. Ofcom is responsible for managing the use of radio spectrum in the UK and awards licences to MNOs for using spectrum. Ofcom monitors network availability, determines standards and measures coverage.

1.9 Other government departments play a role in supporting mobile connectivity. For example, the Home Office's Emergency Services Network (ESN) will replace voice-only radio communications with 4G-based technology, with mobile coverage across all defined major and minor roads in Great Britain. We reported on progress with the ESN in March 2023.[11] The Department for Levelling Up, Housing & Communities is responsible for local government and planning. It has set out the importance of digital connectivity to the UK's productivity.[12] The Department for Transport plays a role in supporting connectivity on the UK's rail and road networks.

1.10 Telecommunications policy is a reserved matter for the UK government. However, the devolved administrations deliver activities that help ensure that their nations secure the benefits of digital connectivity. For example, in 2018, the Scottish Government launched the Scottish 4G Infill programme, a £29 million programme to bring mobile connectivity to 55 areas that previously had no 4G coverage; it has also published a 5G strategy.[13]

11 Comptroller and Auditor General, *Progress with delivering the Emergency Services Network*, Session 2022-23, HC 1170, National Audit Office, March 2023. In 2015, the Home Office contracted with EE Ltd (EE) to provide priority access to its mobile network and increase network coverage, including the construction of 675 new masts. The Home Office will construct a further 292 masts in remote areas, which EE will then connect to its network.
12 HM Government, *Levelling Up: Levelling up the United Kingdom*, February 2022.
13 Scottish Government, *Forging our digital future with 5G: A strategy for Scotland,* August 2019.

1.11 While a competitive market plays a key role in increasing capacity and meeting future customer needs, the government may intervene where there is a weaker commercial case for investment, such as in remote areas.

- DSIT and BDUK are working with MNOs to deliver reliable 4G coverage to 95% of the UK landmass by December 2025 through the Shared Rural Network (SRN) programme. This follows the earlier Mobile Infrastructure Project, which concluded in 2016, where DSIT entered into a contract with a mast installation company but delivered only 75 out of a planned 575 new masts. Part Two and Part Three of this report examine whether DSIT established the SRN programme effectively, and the programme's progress.
- DSIT also funds programmes that aim to create favourable conditions for investment in technologies that meet the UK's future connectivity needs and, following on from previous strategies, it has set out its plans in its 2023 wireless infrastructure strategy.[14] We examine DSIT's plans for supporting future connectivity in Part Four of this report.

14 Department for Science, Innovation & Technology, *UK Wireless Infrastructure Strategy,* April 2023; Department for Digital, Culture, Media & Sport, *Future Telecoms Infrastructure Review*, July 2018; HM Treasury and the Department for Culture, Media & Sport, *Next Generation Mobile Technologies: A 5G Strategy for the UK,* March 2017.

Part Two

Establishing the Shared Rural Network programme

2.1 This Part examines how the Department for Science, Innovation & Technology (DSIT) established the Shared Rural Network (SRN) programme. It examines whether the objectives and expected benefits are clear, whether DSIT established effective delivery mechanisms, and the effectiveness of Building Digital UK's (BDUK's) oversight of the programme.

Programme objectives

2.2 The government considers 4G to be a key component of the UK's digital communications infrastructure, providing economic and social benefits. Some remote areas of the UK have poor 4G coverage where investment in infrastructure is less profitable commercially. This has created a digital divide between urban and some rural areas. In 2020, 91.4% of the UK landmass had 4G coverage from at least one Mobile Network Operator (MNO), while 69% was covered by all four MNOs, up from 6% in 2014 (**Figure 3**). In 2020, 8.6% of the UK had no 4G coverage at all, mainly in Scotland and Wales (**Figure 4** on page 20).

2.3 In 2017, the government made a manifesto commitment to extend mobile coverage to 95% of the UK's landmass by 2022, and to provide an uninterrupted mobile phone signal on all major roads. Building on this commitment, in March 2020, DSIT announced the SRN programme, which was based on a proposal from the MNOs. By December 2025, DSIT aims to broaden consumer choice for mobile services in rural areas by increasing the percentage of the UK landmass with 4G coverage from at least one MNO from 91.4% to 95%, and extending coverage to 280,000 additional premises and an additional 16,000 kilometres of UK roads (Figure 4).

Structure and delivery mechanisms

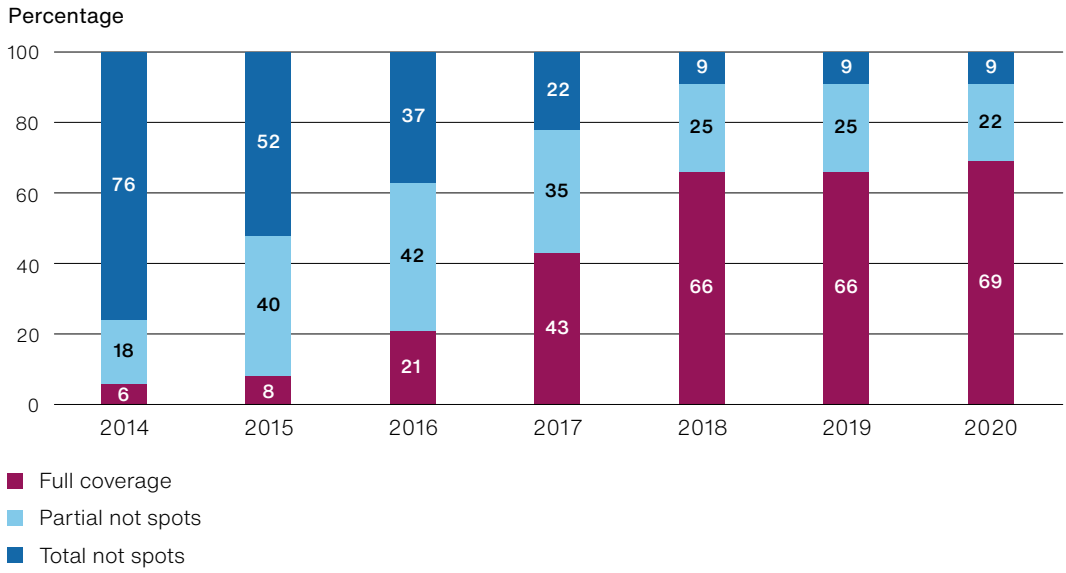
2.4 The SRN programme consists of three elements.

- **Partial not spots (PNS):** aiming to increase coverage in areas where there was at least one, but not all four MNOs, offering 4G coverage at the outset of the programme. The SRN aims to provide coverage from all four MNOs in more areas.

Figure 3

Percentage of the UK landmass with 4G coverage, 2014 to 2023

4G coverage from all mobile network operators (MNOs) increased rapidly from 6% of the UK landmass in 2014 to 69% in 2020



Notes

1 The UK's mobile network is provided by four national MNOs: EE, Three, Virgin Media O2 and Vodafone.

2 Areas with no coverage from any MNO are called 'total not spots' and areas with coverage from at least one, but not all four, MNOs are called 'partial not spots'. 'Full coverage' refers to areas with coverage from all MNOs.

Source: National Audit Office analysis of Ofcom data

- **Extended area service (EAS):** the Home Office is making available up to 292 masts in remote parts of the UK that it is building as part of the Home Office's Emergency Services Network, with the aim of providing the emergency services with 4G coverage (paragraph 1.9). The Home Office will upgrade these masts so that the other three MNOs can then install the equipment they need to provide commercial 4G coverage.

- **Total not spots (TNS):** aiming to provide 4G coverage in the hardest-to-reach areas of Scotland that did not previously have any 4G coverage.

2.5 DSIT secured a private sector commitment to cover just over half of the budgeted programme costs. The programme was estimated to cost a total of £1.033 billion over 20 years to 2039-40, comprising £501 million of government funding for the EAS and TNS elements, and £532 million of funding from the MNOs to improve connectivity in PNS areas (**Figure 5** on page 21).

Figure 4

UK and national targets for the Shared Rural Network (SRN) programme

The SRN programme has coverage targets for the UK as a whole, each UK nation, premises and roads

	4G coverage from all mobile network operators (MNOs)		4G coverage from at least one MNO	
	Pre-SRN	Target post-SRN	Pre-SRN	Target post-SRN
	(%)	(%)	(%)	(%)
UK	68.9	84	91.4	95
England	84.0	90	97.4	98
Northern Ireland	78.9	85	96.8	98
Wales	60.2	80	89.6	95
Scotland	44.4	79	80.9	91
Roads	–	–	–	16,000 additional kilometres
Premises (indoor)	–	–	–	280,000 additional premises

Notes

1 Pre-SRN figures are based on data collected by Ofcom in September 2020.

2 For road and premises coverage, only the targets for additional kilometres and premises with coverage from at least one MNO are available.

Source: National Audit Office analysis of Ofcom data and Department for Science, Innovation & Technology and Building Digital UK documents

Figure 5

Estimated costs for the Shared Rural Network (SRN) programme

The £1 billion estimated cost is shared roughly equally between the mobile network operators (MNOs) and the Department for Science, Innovation & Technology (DSIT)

	MNOs	DSIT	Total
	(£mn)	(£mn)	(£mn)
Partial not spots (PNS)			
Planned expenditure by MNOs	532	0	**532**
Extended area service (EAS)			
DSIT funding to the Home Office to upgrade the EAS sites to accommodate the MNOs' equipment for providing a commercial 4G service	0	127	**127**
DSIT grant to MNOs over about 20 years to 2039-40 to install and operate their equipment on EAS sites	0	53	**53**
Total not spots (TNS)			
DSIT grant to MNOs over about 20 years to 2039-40 to acquire sites and then install and operate their equipment on these sites	0	301	**301**
DSIT programme management costs	0	20	**20**
Total	**532**	**501**	**1,033**

Note

1 The SRN programme consists of three elements. The PNS element aims to increase coverage in areas where there was at least one, but not all four, MNOs offering 4G coverage at the outset of the programme. The EAS element involves the Home Office making available up to 292 masts that it is installing as part of its Emergency Services Network. The MNOs will then upgrade these masts to provide commercial 4G coverage. The TNS element aims to provide 4G coverage in the hardest-to-reach areas of Scotland that did not previously have any 4G coverage.

Source: National Audit Office analysis of Ofcom data and Department for Science, Innovation & Technology and Building Digital UK documents

2.6 In line with lessons from the previous Mobile Infrastructure Project (paragraph 1.11), DSIT has not entered into contracts with the MNOs and is using alternative mechanisms to incentivise delivery (**Figure 6**).

- To help deliver the EAS and TNS elements of the SRN programme, in March 2020, DSIT signed a grant agreement with Digital Mobile Spectrum Limited (DMSL), an organisation wholly owned in equal part by all four MNOs. Under this agreement, DMSL receives grants for the EAS and TNS elements, dependent on the achievement of milestones and evidence of costs incurred by the MNOs. DMSL passes the grant funding on to the MNOs. DMSL is responsible for overseeing the EAS and TNS elements, managing grant funding and reporting progress.
- MNOs are responsible for increasing 4G coverage. Ofcom licence obligations commit each MNO to increase its 4G coverage to 88% of the UK landmass by 30 June 2024, and to 90% by 31 January 2027, and to meet related coverage targets for each of the Nations, roads and premises (Figure 4). MNOs receive grant funding for acquiring and building TNS sites, and for installing and operating their equipment on TNS and EAS sites.
- Since April 2021, Building Digital UK (BDUK), an executive agency of DSIT, has been responsible for the programme's overall delivery on behalf of DSIT.
- In March 2020, DSIT signed a Memorandum of Understanding with the Home Office. In return for funding from DSIT, the Home Office makes EAS sites available to MNOs to install and operate their commercial 4G equipment, and provides BDUK with information on progress, costs and risks.

2.7 At the outset of the programme, DSIT and the MNOs expected that achieving the 4G coverage target of 95% by December 2025 would require successful delivery of the PNS and EAS elements, as most of the TNS element was scheduled to be delivered after this date. Delivery of the PNS element would enable the MNOs to meet their June 2024 coverage obligation of 88% each, while delivery of the TNS and EAS elements together would provide a further minimum 2% increase in the percentage of the UK covered (1% from the EAS and 1% from the TNS) for each MNO, enabling them to meet their January 2027 coverage obligation of 90%.

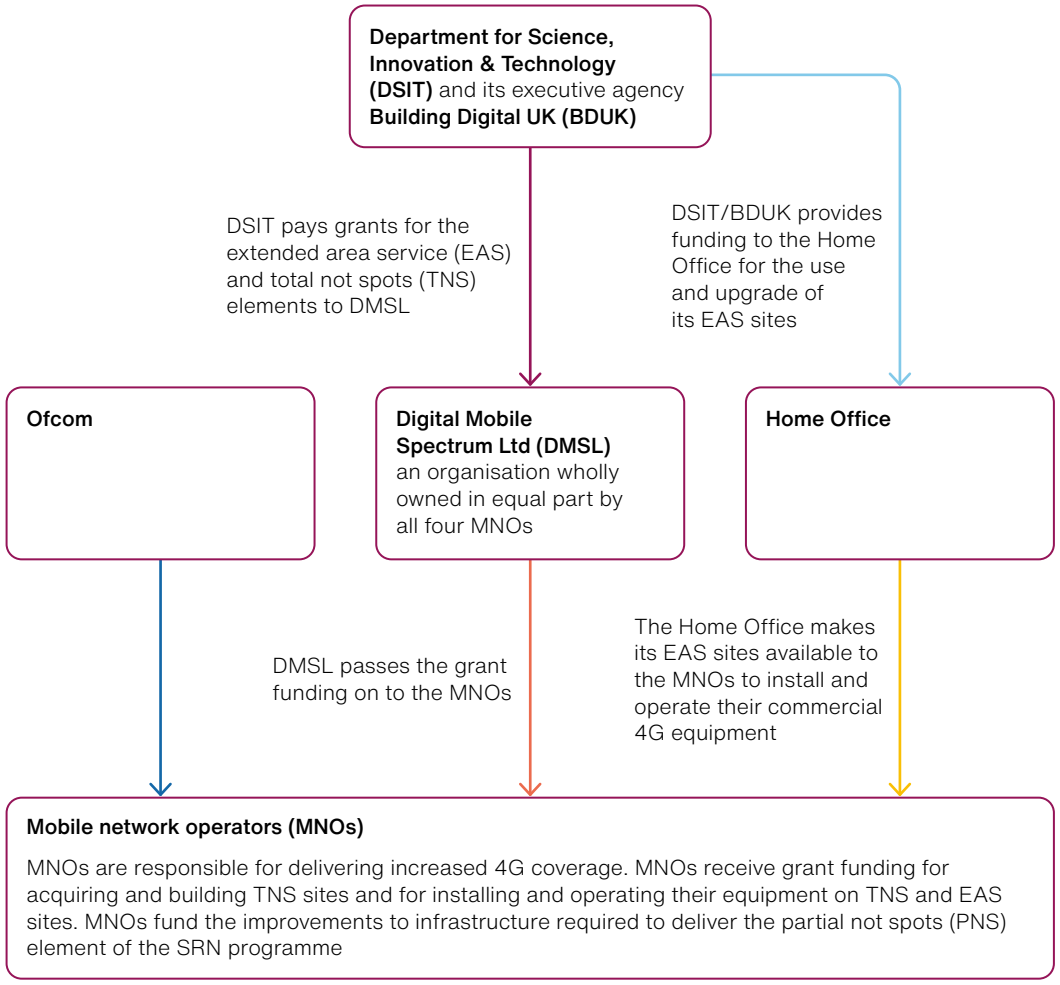
Oversight arrangements

2.8 In November 2021, BDUK set up the SRN Programme Board to oversee the SRN programme. The board usually meets monthly and reports to the BDUK Board. Members include senior BDUK and DSIT officials, with appropriate cross-government representation, including HM Treasury and the Infrastructure and Projects Authority.

Figure 6

Delivery mechanisms for the Shared Rural Network (SRN) programme

The different elements of the SRN programme have different delivery mechanisms, with mobile network operators (MNOs) responsible for delivering increased 4G coverage



Notes

1 The SRN programme consists of three elements. The PNS element aims to increase coverage in areas where there was at least one, but not all four, MNOs offering 4G coverage at the outset of the programme. The EAS element involves the Home Office making available up to 292 masts that it is installing as part of its Emergency Services Network. The MNOs will then upgrade these masts to provide commercial 4G coverage. The TNS element aims to provide 4G coverage in the hardest-to-reach areas of Scotland that did not previously have any 4G coverage.

2 Since April 2021, BDUK has been responsible for the programme's overall delivery on behalf of DSIT.

Source: National Audit Office analysis of Ofcom, Department for Science, Innovation & Technology and Building Digital UK documents

2.9 In autumn 2022, an internal review of the SRN Programme Board raised concerns about this board's effectiveness, including whether those attending were at the appropriate level to take necessary decisions, and the level of challenge the board exercised. In April 2023, a further review identified areas to address, including the scope, meeting frequency and membership of this board and how information is presented to it. DSIT told us that it is making changes to improve governance. For example, from January 2024, the Home Office and DMSL will be invited to attend part of the SRN Programme Board meetings to update on delivery, and Ofcom will join meetings as an observer.

2.10 BDUK has limited information about some areas of the programme. Information is shared and reported through different routes and by different parties for each of the three elements of the SRN programme (**Figure 7** on pages 25 and 26). In autumn 2022, an internal review identified the flow of information to BDUK as one of the blockers to the programme's delivery. On the PNS element, MNOs take their own decisions on where to build masts and fund this activity themselves to meet the coverage obligations in their Ofcom licences. MNOs provide updates on achieved and future progress, but do not routinely provide BDUK with data on the level of coverage achieved or forecast, or on the number of masts completed and their locations. BDUK monitors progress on the PNS using Ofcom's Connected Nations data, which are published three times a year, and, from summer 2023, monthly progress reports from Ofcom. However, Ofcom's data are retrospective and contain no forward-looking information.

2.11 BDUK has taken steps to improve its visibility of the PNS element. Until spring 2022, each MNO provided BDUK with its future delivery plans for the PNS as part of an annual performance review. The spring 2022 annual reviews indicated that some MNOs might not meet their licence obligations to increase coverage to 88% of the UK landmass by June 2024. BDUK and the MNOs agreed to increase the frequency of the reviews to every four to six months, and to provide BDUK with more detailed data on planned future coverage levels.

2.12 For the TNS element, DSIT's grant agreement is with DMSL, not the MNOs. DSIT sets the information that DMSL must provide as a condition of the grant agreement. In May 2021, DSIT appointed an independent assessor for five years to give independent assurance on delivery of the TNS element. However, the assessor had trouble obtaining the information that it needed from DMSL and the MNOs. In May 2023, the assessor reported that information from DMSL had improved, but that MNOs remained reluctant to provide detailed data on their progress. During 2023, DSIT sought to improve the financial information it received from DMSL because it considered that the information it had previously agreed to receive contained insufficient detail on which to take financial planning decisions. It aimed to formalise this improvement by January 2024 through an amendment to the grant agreement. It had not been able to confirm to us that it had done so by mid-February, when we finalised this report.

Figure 7

Information flows under the Shared Rural Network (SRN) programme

Information is shared and reported through different routes and by different parties for each of the three elements of the SRN programme: partial not spots (PNS), total not spots (TNS) and extended area service (EAS)

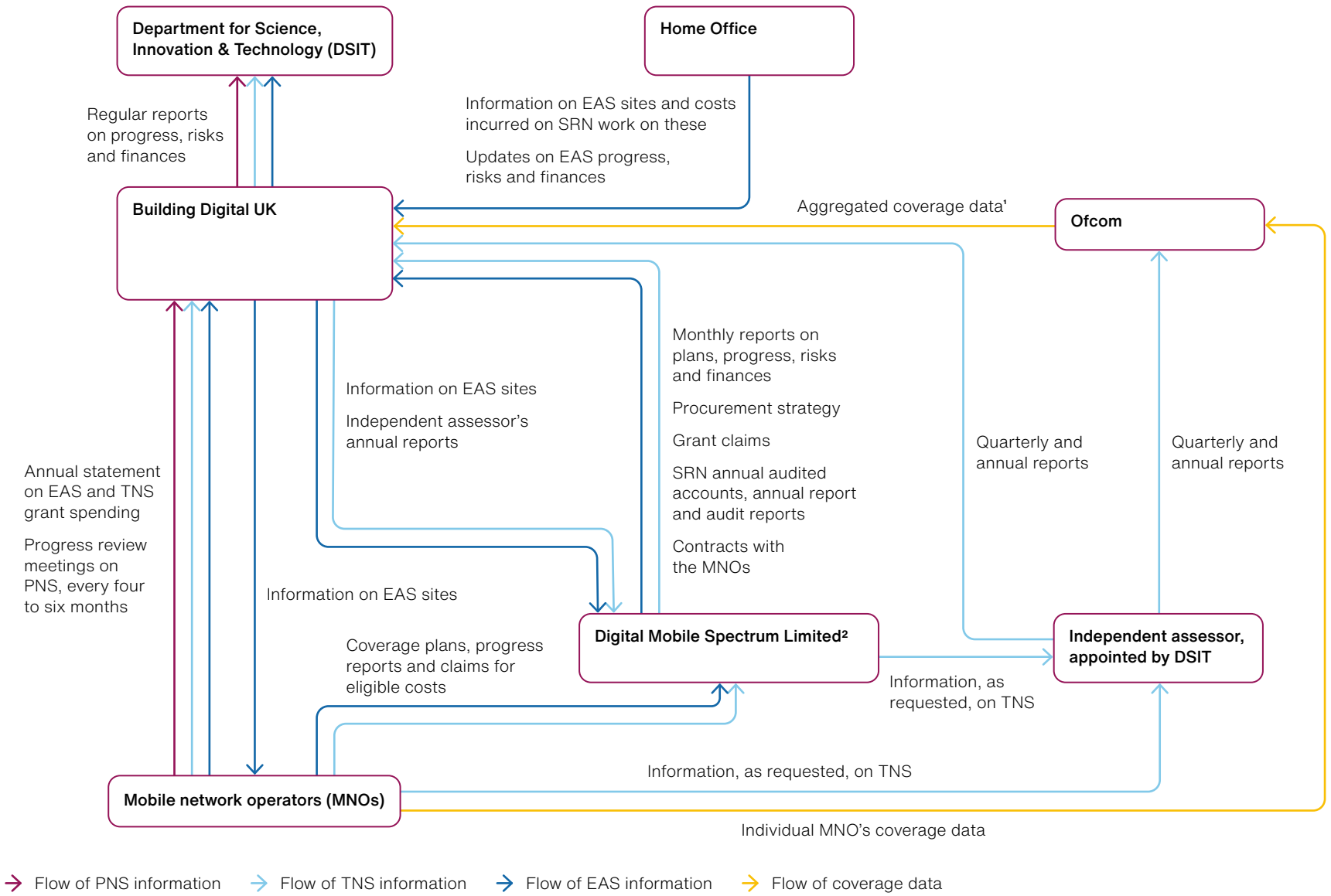


Figure 7 *continued*
Information flows under the Shared Rural Network (SRN) programme

Notes

1 Ofcom's coverage data are based on modelled estimates from the MNOs, which Ofcom validates. The coverage data are not disaggregated by the three elements of the SRN programme.

2 Digital Mobile Spectrum Limited (DMSL) is an organisation wholly owned in equal part by all four MNOs. DMSL is responsible for overseeing the EAS and TNS elements of the programme for the MNOs, managing grant funding, and progress reporting. It is not involved in the PNS element and does not receive information from the MNOs about their PNS work.

3 The SRN programme consists of three elements. The PNS element aims to increase coverage in areas where there was at least one, but not all four MNOs, offering 4G coverage at the outset of the programme. The EAS element involves the Home Office making available up to 292 masts that it is installing as part of its Emergency Services Network. The MNOs will then upgrade these masts to provide commercial 4G coverage. The TNS element aims to provide 4G coverage in the hardest-to-reach areas of Scotland that did not previously have any 4G coverage.

Source: National Audit Office analysis of Ofcom, Department for Science, Innovation & Technology and Building Digital UK documents

Expected benefits

2.13 The SRN aims to address the digital divide between urban and some rural areas. DSIT's business case identified a range of benefits such as supporting tourism and business productivity in rural areas. It identified the general economic and social benefits of mobile connectivity, and estimated quantifiable benefits of £1,352 million, with a benefit cost ratio of 1.6. However, it included limited evidence about how these general benefits applied to rural, remote or sparsely populated areas, including locations where building masts may be more difficult or expensive, or where there may be an impact on the environment. A clearer narrative about the outcomes DSIT is aiming for in these locations, who will benefit, and why the investment is needed, would help it communicate its case for investment. The business case also did not confirm the specific geographical areas that would benefit from better coverage, and those that would not.

Part Three

Progress of the Shared Rural Network programme

3.1 This Part examines the progress made in delivering the Shared Rural Network (SRN) programme including progress against meeting targets, and the programme's costs and benefits.

Progress in meeting targets

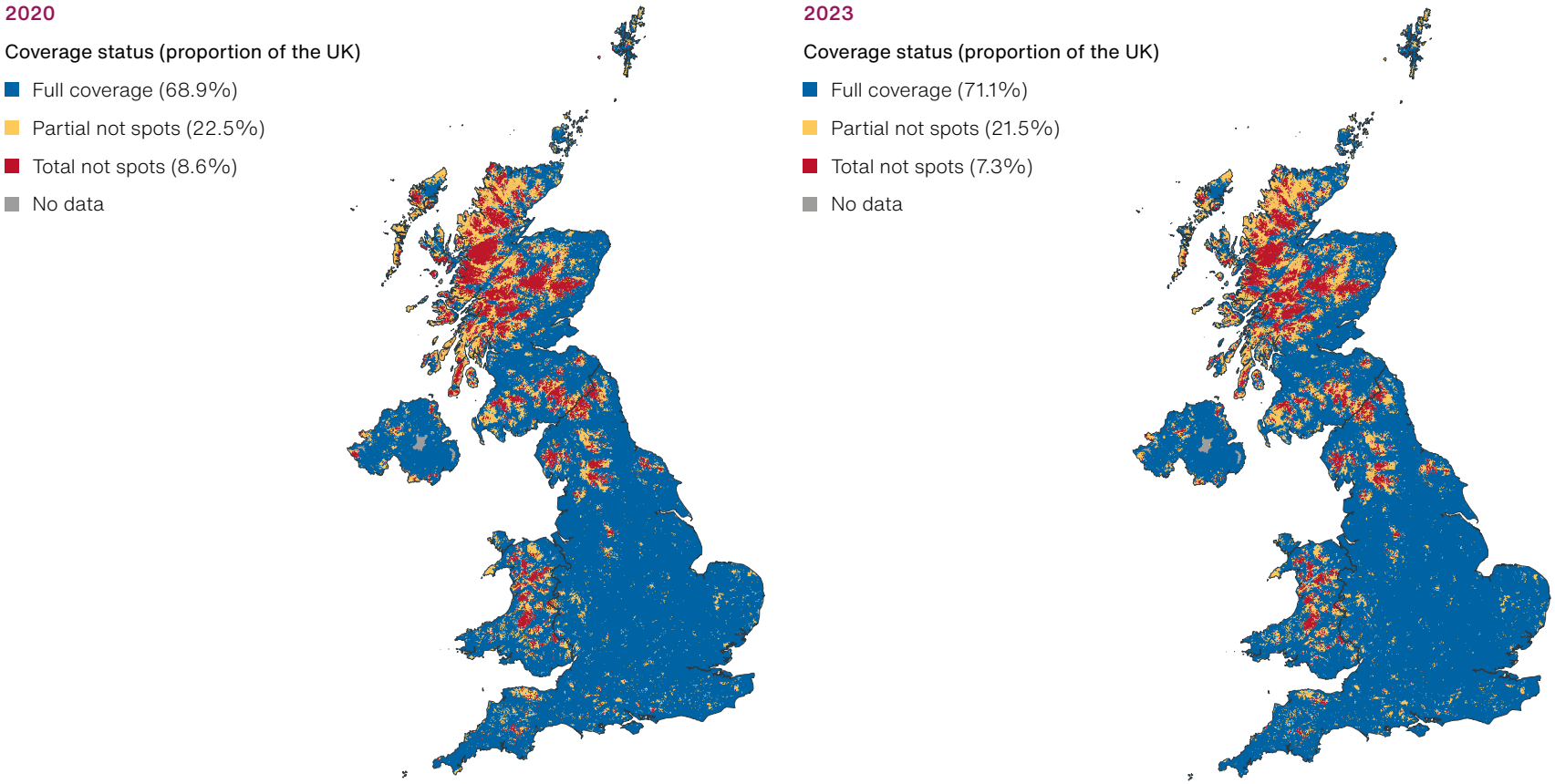
3.2 Ofcom reported that, in September 2023, 92.7% of the UK landmass had 4G coverage from at least one mobile network operator (MNO), up 1.3% from 91.4% in 2020 (**Figure 8** overleaf and **Figure 9** on page 29) and compared to the Department for Science, Innovation & Technology's (DSIT's) target of 95% by December 2025 (paragraph 2.3). The greatest increases have been in Scotland and Wales, but coverage in these nations remains significantly below the December 2025 national targets (**Figure 10** on page 30) because much of their improved coverage is planned to be delivered by the extended area service (EAS) and total not spots (TNS) elements later in the SRN programme.

3.3 The percentage of the UK landmass with 4G coverage from all four MNOs ('full coverage') had increased to 71.1% as at September 2023 (Figure 8) against a target of 84% by the end of the SRN programme (Figure 4). As at December 2023, DSIT was unable to provide details of progress on the programme's roads and premises targets (paragraph 2.3) but was working with Ofcom to develop the necessary data. DSIT told us that the MNOs were confident of achieving these roads and premises targets.

Figure 8

4G total and partial not spots in 2020 and 2023

Since 2020, the percentage of the UK landmass with no 4G signal from any operator has fallen from 8.6% to 7.3%



Notes

1 Areas with no coverage from any mobile network operator (MNO) are termed 'total not spots' and areas with coverage from at least one, but not all four, MNOs are termed 'partial not spots'. 'Full coverage' refers to areas with coverage from all MNOs.

2 Coverage data are based on modelling by MNOs. Ofcom collect the data as 100 metre x 100 metre pixels against the Ordnance Survey Great Britain grid system. These data have been aggregated to a 1,000 metre x 1,000 metre grid, selecting the modal value within each pixel.

3 Ofcom defines a good 4G signal as the ability to make a 90 second phone call and achieve a download speed of 2 Mbps (megabits per second).

4 'No data' refers to areas where Ofcom does not record coverage, such as lakes.

5 Data for 2020 are from September 2020. Data for 2023 are from September 2023.

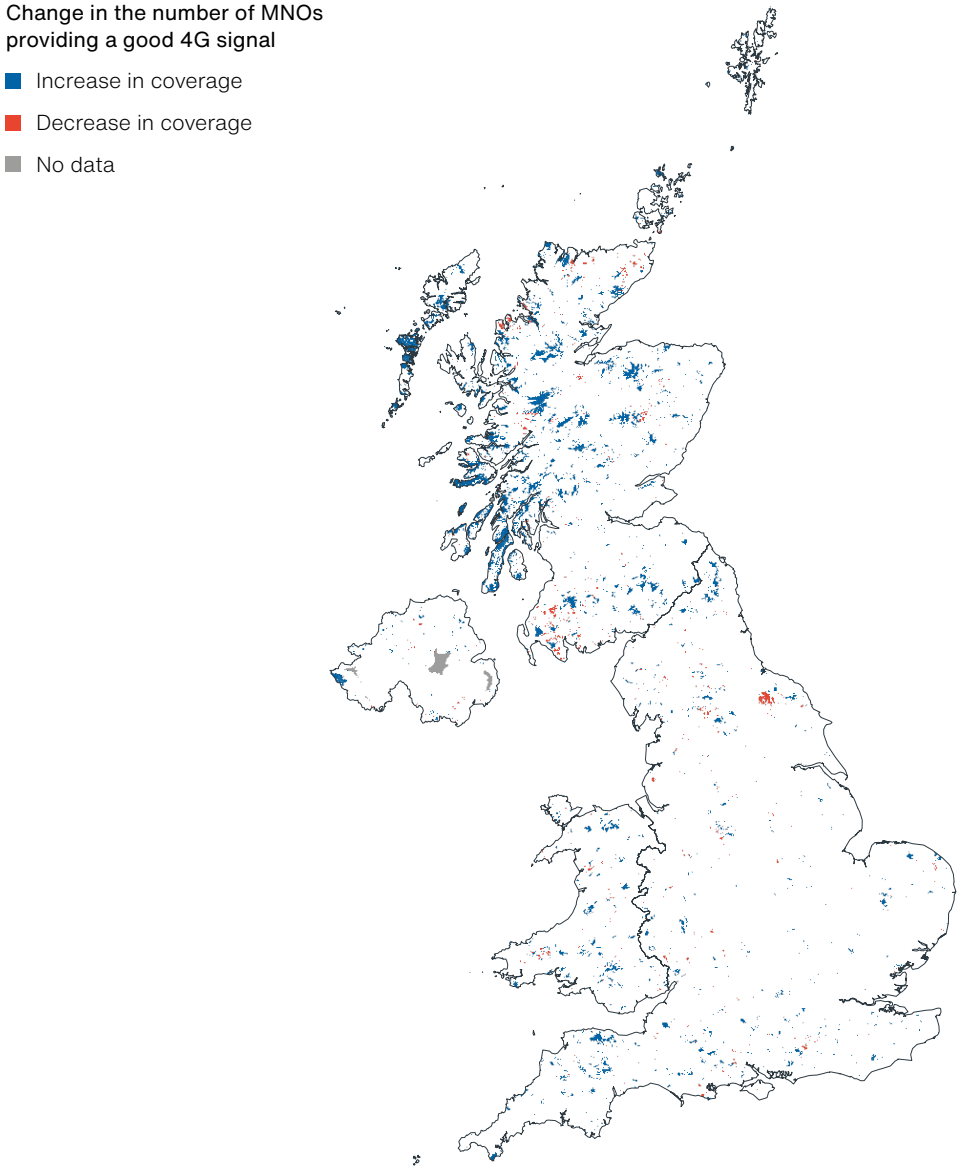
6 Percentages may not sum to 100% due to rounding.

Source: National Audit Office analysis of Ofcom data. Office for National Statistics licensed under the Open Government Licence v.3.0. Contains OS data © Crown copyright and database right 2023

Figure 9

Change in 4G coverage between 2020 and 2023

Since 2020, mobile network operators (MNOs) have increased their overall coverage across the UK



Notes

1 Since 2020, the number of MNOs providing coverage has increased in some areas but decreased in others.

2 Coverage data are based on modelling by MNOs. Ofcom collect the data as 100 metre x 100 metre pixels against the Ordnance Survey Great Britain grid system. These data have been aggregated to a 1,000 metre x 1,000 metre grid, selecting the modal value within each pixel.

3 Ofcom defines a good 4G signal as the ability to make a 90 second phone call and achieve a download speed of 2 Mbps (megabits per second).

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5 Data for 2020 are from September 2020. Data for 2023 are from September 2023.

Source: National Audit Office analysis of Ofcom data. Office for National Statistics licensed under the Open Government Licence v.3.0. Contains OS data © Crown copyright and database right 2023

Figure 10

4G coverage, from at least one mobile network operator, by nation at 2020 and 2023, against Shared Rural Network (SRN) targets for December 2025

The greatest increases in 4G coverage have been in Scotland and Wales, but they also have the furthest to go to hit December 2025 targets

Note

1 Some of the increase in coverage in Scotland will be due to the Scottish Government's Scottish 4G Infill programme, a £29 million programme to bring mobile connectivity to 55 areas that previously had no 4G coverage.

Source: National Audit Office analysis of Ofcom data

3.4 According to the MNOs, they have faced challenges in delivering the increase in coverage to September 2023:

- The MNOs were unable to reach an agreement on the shared use of their infrastructure.
- The COVID-19 pandemic affected the programme's delivery.
- Difficult site access and poor weather conditions presented challenges in remote areas.
- Securing planning permission has been challenging in some cases. The programme involves the submission of large numbers of individual planning applications by MNOs, around 1,000 by January 2024, according to Building Digital UK (BDUK). As the programme only covers specific parts of the UK, a relatively small number of local authorities receive multiple applications and lack resources to handle them. MNOs have typically faced two- to four-month delays in securing permission, with some sites taking over 12 months.

- In some areas, local stakeholders have campaigned against masts because they are concerned about potential impacts, including environmental impacts such as the use of diesel generators on some sites, and the proposal of masts in wild and remote areas where some stakeholders consider that there will be little to no benefit for rural communities. Some landowners have been unwilling to give MNOs access to their land for similar reasons.

3.5 Many of the challenges experienced at a local level, such as the remoteness of the sites and the difficulties in getting agreement from local planning authorities, stakeholders and communities to the installation of masts, have been encountered on other government digital infrastructure programmes, such as the Mobile Infrastructure Project (paragraph 1.11) and the Superfast Broadband programme.[15] DSIT, BDUK, and the MNOs aimed to allow time for these challenges, allowing four years from March 2020 for delivery of the partial not spots (PNS) element and six for delivery in the more remote TNS sites. However, these challenges have proved more difficult than their planned timetables allowed for. For example, the COVID-19 pandemic hindered local authorities' processing of planning applications.

3.6 MNOs, BDUK and DSIT are working with stakeholders to resolve local issues. For example, they have held discussions with local stakeholders in national parks and have written letters of support for over 100 planning applications to the relevant local planning authorities. However, DSIT told us that it is difficult for it to influence independent local planning decisions, particularly in the devolved nations.

Progress with the partial not spots (PNS) element

3.7 The increase in UK 4G coverage since 2020 is predominantly due to additional coverage funded by the MNOs, including their delivery of the PNS element of the programme. DSIT and BDUK have been unable to provide us with the number of masts and increased coverage delivered to date through the PNS, as MNOs do not routinely provide BDUK with these data (paragraph 2.10).

3.8 Progress on the PNS element has been slower than planned. In October 2023, three MNOs (Three, Virgin Media O2 and Vodafone) advised BDUK that they were each likely to miss their Ofcom licence obligation to provide 88% 4G coverage by June 2024 (paragraph 2.6) and wanted to discuss an 18-month extension. In January 2024, EE announced that it had met its June 2024 obligation ahead of schedule. DSIT and BDUK are assessing the impact of any delays to MNOs meeting their June 2024 licence obligations on the achievement of the government's target of 95% by December 2025.

15 Comptroller and Auditor General, *Improving broadband,* Session 2019–2021, HC 863, National Audit Office, October 2020.

Progress with the extended area service (EAS) element

3.9 As at January 2024, one EAS mast, a pilot site at Lockerbie in Scotland, was operational for use by the public, and the Home Office had made nine sites in total available to MNOs. The Home Office had planned that 75 masts would be available by this date. Delays to site availability were due to delayed delivery of the sites under the Home Office's Emergency Services Network programme,[16] planning delays, and protracted negotiations between BDUK, the Home Office and the MNOs over the site-sharing agreement, which gives the MNOs access to the EAS sites to install their equipment. The agreement was signed in December 2022, over two years later than planned.

Progress with the total not spots (TNS) element

3.10 DMSL reported to BDUK that, as at October 2023, they were on track against the build plans they had agreed with BDUK in July 2023. The first planning application had been approved, but no TNS masts had been delivered. The first masts are due to complete construction in July 2024 and become operational in January 2025.

3.11 Preparatory work for the TNS element took longer than planned. DSIT did not allow the MNOs to use their own existing procurement processes and suppliers but, instead, required them to jointly procure the services needed to deliver the TNS masts in line with the Public Contract Regulations 2015 and state aid rules. It took time for the MNOs to agree common procurement processes and specifications. Individual procurements did not go smoothly, with some services procured in accordance with the Regulations, but later than planned, while, in other cases, joint procurement was unsuccessful, and the MNOs procured services using their own procedures and suppliers. Procurement of all TNS services will not be completed until July 2024, over two years later than the date of April 2022 planned in September 2021.

16 Comptroller and Auditor General, *Progress with delivering the Emergency Services Network*, Session 2022-23, HC 1170, National Audit Office, March 2023.

3.12 Finalising the location of TNS mast sites also took longer than initially planned. In July 2020, the MNOs produced a plan to install 4G equipment on 316 sites. The plan drew on desk-based work because travel across the country was restricted under COVID-19 regulations. Following an assessment of the plan's deliverability in terms of transmission connectivity and the availability of power, the MNOs concluded that the plan was not deliverable. In June 2021, the MNOs produced a new plan involving 315 sites, which BDUK approved in May 2022. However, further work by the MNOs during summer 2022 found that 37 sites (12%) would be undeliverable, 186 (59%) very difficult to deliver, and at least 36 (11%) would require the delivery of building materials and equipment using helicopters. The MNOs produced a further revised plan, which BDUK agreed in July 2023. Under this plan, the MNOs are due to deliver up to 265 TNS sites, 50 fewer than the 315 approved in May 2022, but are still to provide the increase in coverage of at least 1% required from the TNS element of the SRN programme (paragraph 2.7).

3.13 Under the July 2023 plan, the MNOs intend to make greater use than originally planned of microwave transmission, and less use of fibre connections, to link TNS masts back to their core networks. They also intend to make greater use of masts in non-TNS areas to provide coverage in TNS areas where such sites are better placed, for cost and coverage reasons, than sites located fully in TNS areas. However, the current grant agreement does not allow the MNOs to use grant funding for this new approach. In September 2022, BDUK agreed in principle to amend the grant agreement to allow for this. As at January 2024, the new amendment had not yet been signed, but the MNOs have, in the meantime, been planning their work in line with this new approach.

Costs of the programme

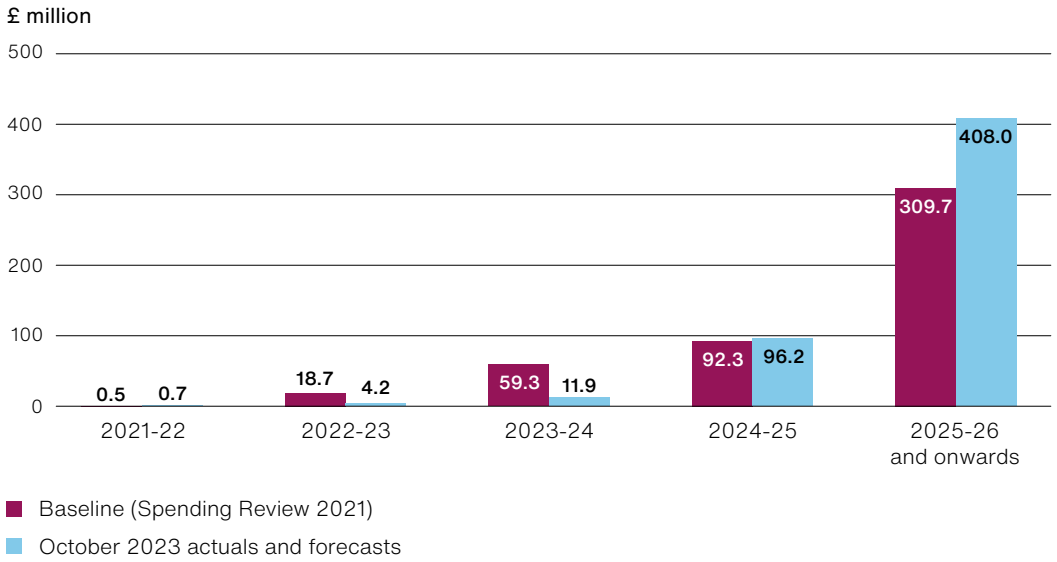
3.14 With progress slower than expected, DSIT's funding of expenditure by the MNOs and the Home Office on masts in 2022-23 and 2023-24 was almost £62 million (79%) lower than planned (**Figure 11** overleaf).

3.15 The programme has been subject to increases in the costs of installing and operating masts, for example, higher costs of steel and power. The MNOs absorbed these costs on the PNS element, and DSIT may expect them to do the same on the EAS and TNS elements. There is no provision in the grant agreement for increases to reflect inflation, and, under the terms of their Ofcom licences and the grant agreement, the MNOs are required to fund any additional costs they incur in meeting the coverage obligations. However, in certain circumstances, such as excessive costs, the licences allow for relief of the MNOs' individual obligation to provide 90% coverage by 2027. In July 2023, DMSL informed BDUK that the costs of delivering the revised number of 265 TNS sites were set to exceed the current level of grant funding. It also indicated in September 2023 that the costs of delivering the 1% increase in coverage expected from TNS would exceed this funding. However, both the number of sites required and their costs were still uncertain, and DMSL told us in January 2024 that the MNOs believed that the 1% coverage could be delivered with fewer than 265 sites.

Figure 11

Forecast funding from the Department for Science, Innovation & Technology (DSIT) for delivery of the Shared Rural Network programme, 2021-22 to 2025-26 and onwards

DSIT expects to spend less than planned in 2022-23 and 2023-24 and to increase payments in 2025-26 and onwards



Note

1 Figures represent funding by DSIT of Home Office and mobile network operators' capital and operating expenditure on masts. They exclude the costs incurred by the Home Office and DSIT in managing the programme.

Source: National Audit Office analysis of Department for Science, Innovation & Technology documents and data

3.16 DMSL aims to optimise costs through more joint deployment of fibre and power connections for sites and through sharing lessons from planning applications. However, the scope for DSIT and BDUK to address cost pressures is limited. If they were to choose to provide MNOs with additional funding, this would require HM Treasury approval and a variation to the grant agreement. Alternatively, the MNOs could potentially apply for relief from the coverage obligations in their Ofcom licences, putting at risk the achievement of DSIT's 95% 4G coverage target. Rescoping the TNS element could also threaten MNOs' delivery of the PNS. MNOs' Ofcom licences only obligate MNOs to complete the PNS if the TNS element is also funded. In August 2023, the independent assessor for the TNS (paragraph 2.12) recommended an independent financial review to verify the latest cost estimates, but, as at January 2024, DSIT and BDUK had not commissioned this review.

3.17 Irrecoverable VAT has added to the cost of the EAS element. After DSIT obtained preliminary advice from HMRC, DSIT and the Home Office assumed that VAT on the Home Office's expenditure on EAS would be recoverable and so did not need to be included in their budgets. However, in 2023, HMRC determined that the correct treatment is that the SRN elements of the EAS programme would be liable for VAT, and that this cannot be recovered by the Home Office. Estimated EAS costs have subsequently increased by around £44 million, due to irrecoverable VAT and inflation, and the Home Office and BDUK recognise that delivering their SRN obligations within current funding levels will be challenging. As at November 2023, BDUK had decided not to proceed with 15 of the 292 EAS sites on the basis of value for money and technical feasibility. It is also keeping potential EAS sites under review and looking for opportunities to challenge estimated costs.

Delivery of expected benefits

3.18 DSIT requires MNOs to meet Ofcom's 2018 minimum performance threshold for good 4G coverage: the ability to make a 90 second phone call and achieve a download speed of 2 Mbps (megabits per second).[17] This performance is sufficient for voice calls, messaging, internet browsing and one-to-one video calls. However, use of technology has advanced since the beginning of the SRN, and this download speed does not enable other uses that businesses may require, such as group video calls and quick data downloads (**Figure 12** overleaf). BDUK told us that the average download speed delivered by the SRN is likely to be around 7 Mbps, although some locations, such as those at the edge of coverage areas, may experience lower speeds than this average. Without good internet speeds, some of the benefits in the business case, such as home working and supporting small businesses, may not be realised.

3.19 Although DSIT expects a speed of 2 Mbps to meet current mobile coverage needs, in November 2022, DSIT reported to the minister of state that 2 Mbps was unlikely to be sufficient for future uses that require more bandwidth. In January 2023, it commissioned a feasibility study to examine the potential for upgrading SRN infrastructure to provide, for example, faster download times, and to inform future policy choices on what investment may be needed and where. DSIT expected to finalise the study report by January 2024. It had not been able to confirm to us that it had done so by mid-February, when we finalised this report. There is a risk that measures the MNOs are taking in some areas to reduce costs now, such as building fewer masts and making more use of microwave transmission (paragraphs 3.12 and 3.13), may make future upgrades more expensive, as such upgrades could involve converting some sites from microwave to fibre transmission and installing new power supply solutions. However, DSIT is confident that upgrading the network to meet future needs will be technically feasible where this represents value for money.

17 The performance requirements for the Shared Rural Network differ from those of the UK Government's universal service obligation, which provides homes and businesses with the legal right to request an affordable broadband connection which offers, among other things, a minimum download performance of 10 Mbps.

Figure 12
Data speeds required for different activities

Some common activities may not be supported on the Shared Rural Network (SRN) performance threshold of 2 Mbps (megabits per second) download speeds

	Activity	Capability
		2 Mbps (SRN performance threshold)
	Loading a web page	8 seconds
	Downloading a song	15 seconds
	Downloading a 30 MB app	2 minutes
	Streaming audio	High quality
	Streaming video	In standard definition (SD)
	Video call	In SD
	Group video call	No
	Online gaming	No
	Tethering[1]	No

Notes

1 Tethering involves sharing a mobile device's data connection with other, nearby devices.

2 A 4G connection also enables voice calls and text messages. The SRN programme will extend the areas in which calls and texts are possible.

Source: National Audit Office analysis of mobile network operators' documents

3.20 In April 2023, DSIT asked Ofcom to keep under review its definitions of good 4G and 5G coverage so that definitions reflect consumer expectations as usage and needs evolve. As at January 2024, Ofcom had not changed its definitions, nor DSIT the performance threshold that MNOs are required to meet on the SRN.

3.21 DSIT is concerned that the mobile coverage levels reported by Ofcom do not always reflect the consumer experience. Ofcom's data are based on modelled estimates provided by MNOs. Currently, Ofcom validates modelled data by conducting sample tests, collecting data with antennas attached to some of its vehicles. However, it does not test the capacity of the network, and its testing is restricted to roads, with none in pedestrian areas or within premises. As at March 2023, Ofcom had undertaken limited testing in areas where the SRN is seeking to improve coverage, such as the West of Scotland. In April 2023, DSIT asked Ofcom to improve the accuracy of the mobile coverage data it provides. Ofcom is looking at options, such as how it can use crowd-sourced data.

Part Four

Supporting future connectivity

4.1 This part evaluates the scope and early implementation of the Department for Science, Innovation & Technology's (DSIT) plans for 5G. It assesses DSIT's approach to future challenges in overcoming barriers to investment and deployment.

DSIT's support for future connectivity

Future demand for connectivity

4.2 Ofcom expects demand for connectivity to grow, but the rate of growth is uncertain. Between 2013 and 2021, consumption of mobile data per person increased tenfold (paragraph 1.2). Ofcom considers that growth may continue as mobile coverage expands and new applications drive increased data usage. It has estimated potential growth in total UK mobile data traffic up to 2035, examining scenarios that ranged between 20% to 25% (low growth) and 55% to 60% (high growth). The growth rate is uncertain because it is unclear what new applications will emerge, the extent of take-up, the level of investment by mobile network operators (MNOs) and how they will price their services.

4.3 New technologies may allow faster connection speeds and new applications that are not possible over today's networks. 5G is the latest generation of wireless technology. Non-standalone 5G (which MNOs are currently deploying in the UK) can be faster than 4G, while standalone 5G technology (which MNOs are trialling) combines faster connections and ultra-low latency (the amount of time it takes for a device to send a message and get a response). DSIT expects the benefits of standalone 5G to come from the wider opportunities of wireless connectivity, such as to business and public services, with fewer direct benefits for individual consumers. For example, standalone 5G may be well-suited for supporting industrial applications, such as remote-controlled machinery, or required by artificial intelligence applications.

DSIT support to date

4.4 Since 2017, DSIT has committed around £400 million with the aim of ensuring that the UK is well-placed to take advantage of the opportunities offered by 5G. Programmes include the following.

- **5G testbeds and trials programme:** DSIT spent £140 million between 2017 and 2023 to build the case for investment in 5G technology. It explored potential use cases in sectors including agriculture, utilities, automotive, transport and logistics. DSIT identified examples of how the government could accelerate 5G adoption in sectors such as transport and healthcare.
- **Open networks programme:** This £250 million research and development fund aims to improve the security and resilience of networks by building diversity into the 5G supply chain, reducing reliance on a small number of high-risk vendors. It aims to do this by accelerating the development of interoperable infrastructure and incentivising MNOs to deploy it. The Infrastructure and Projects Authority rated this programme as 'amber' in its 2022-23 report on major government projects.[18]
- **Further funding to help, for example, local areas and MNOs coordinate the roll out of 5G infrastructure,** and test new ways of using satellite, wireless and fixed internet together for agriculture and tourism in remote areas.

4.5 DSIT's ambition for the majority of the population to have access to a basic 5G signal by 2027 was met early. In September 2023, Ofcom reported a high confidence that 92.7% of premises had 5G coverage from at least one network operator. 55.0% of the UK landmass receives a 5G signal from at least one MNO, and most 5G coverage is in urban areas (**Figure 13** overleaf). However, DSIT considers that the current 5G service, which is almost all non-standalone, is unlikely to meet the UK's future connectivity needs.

Wireless infrastructure strategy

Aims of the strategy

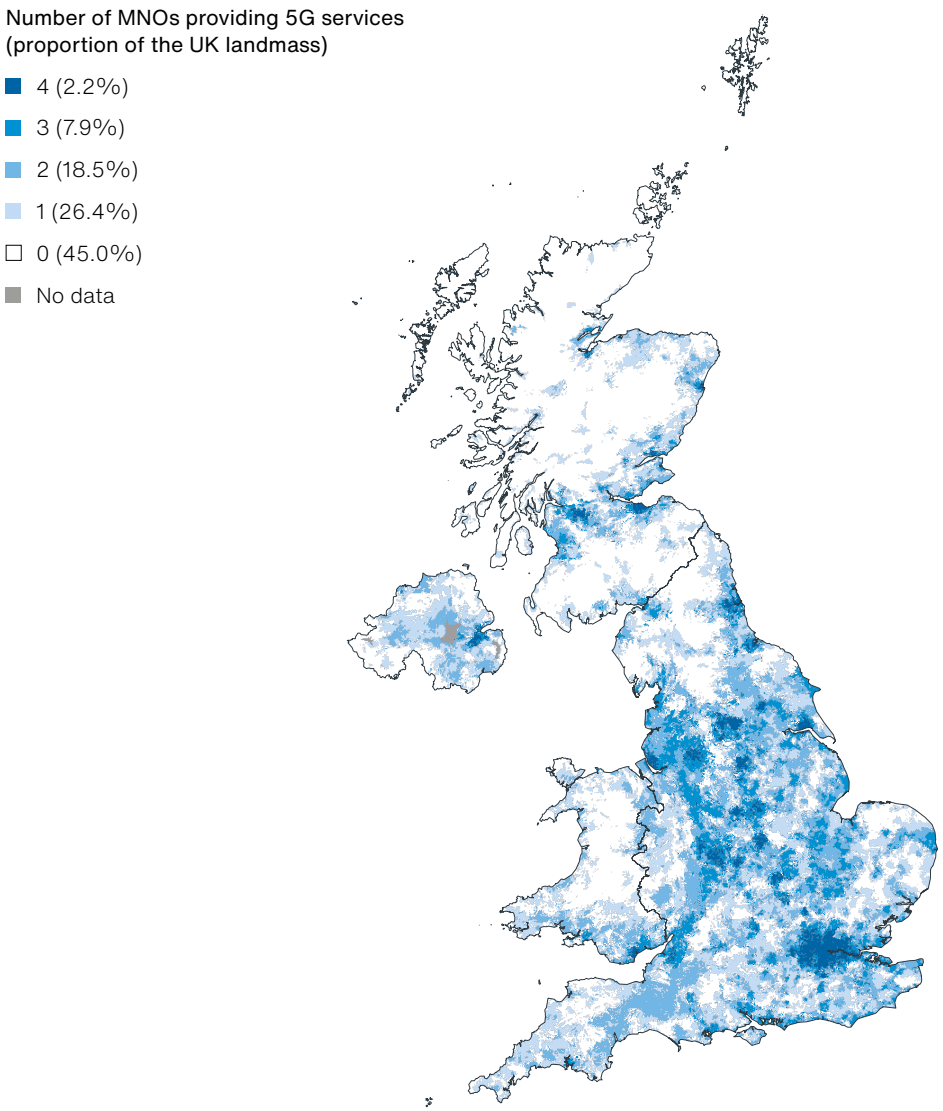
4.6 In April 2023, DSIT published its wireless infrastructure strategy to encourage deployment and adoption of 5G and advanced wireless connectivity, and to set out the government's strategy for 6G. DSIT expects widespread adoption of 5G to improve public services and estimates cumulative productivity benefits of between £41 billion and £159 billion between 2021 and 2035. The range reflects different assumptions about adoption of 5G and its use.

18 The 'amber' rating is defined as follows: "Successful delivery appears feasible but significant issues already exist, requiring management attention. These appear resolvable at this stage and, if addressed promptly, should not present a cost/schedule overrun."

Figure 13

Map of the number of mobile network operators (MNOs) providing 5G coverage in 2023

While 55.0% of the UK landmass receives a 5G signal from at least one MNO, only 2.2% of the country has coverage from all four MNOs, and coverage is concentrated on urban areas



Notes

1 Coverage data is based on modelling by MNOs. Ofcom collect the data as 100 metre x 100 metre pixels against the Ordnance Survey Great Britain grid system. These data have been aggregated to a 1,000 metre x 1,000 metre grid, selecting the modal value within each pixel.

2 Data are from September 2023.

3 'No data' refers to areas where Ofcom does not record coverage, such as lakes.

4 The map shows areas where Ofcom estimates a 'high confidence' of a good 5G signal. Ofcom does not report separately on standalone and non-standalone 5G coverage.

Source: National Audit Office analysis of Ofcom data. Office for National Statistics licensed under the Open Government Licence v.3.0. Contains OS data © Crown copyright and database right 2023

4.7 Unlike the Shared Rural Network (SRN) programme, which directly funds infrastructure to remedy market failure, for 5G, DSIT aims to encourage more innovation and investment by the private sector. This is necessary because the commercial case for investment in standalone 5G infrastructure is uncertain. It is not yet clear where standalone 5G will be needed and DSIT has not yet determined whether government funding will be required to avoid remote areas being left behind as new uses emerge. For these reasons, DSIT has set a new ambition for standalone 5G in all populated areas by 2030 (rather than a target for coverage of the UK's landmass as it has for 4G (paragraph 2.3)) but has not defined 'all populated areas' or the level of performance needed. Achieving this ambition will require significant investment from MNOs. In December 2023, Ofcom published initial data on standalone 5G coverage.

4.8 The main elements of the strategy include action to:

- ensure good connectivity for all;
- support industry investment in standalone 5G;
- realise the benefits of 5G, providing £36 million to fund 10 '5G Innovation Regions' across the UK;
- speed up adoption of 5G technologies; and
- provide up to £100 million to fund research into 6G and more advanced technologies (**Figure 14** overleaf).

4.9 MNOs welcomed DSIT setting out its ambitions and said that the strategy recognises that the government needs to play a role in addressing barriers to investment, such as planning processes. MNOs felt that the strategy now needs to be developed into firm plans and noted that DSIT is reliant on other government departments and bodies to achieve the strategy's objectives, though these may have their own priorities and resource constraints. Local government representatives and devolved administrations we spoke to considered that the strategy could better reflect their local circumstances, for example, different patterns of rural settlement.

Progress to date

4.10 DSIT has established an implementation plan for the early stages of the strategy, and most elements, including funding to support adoption of 5G in local areas and pilots to test smart infrastructure, are on time. Some work has been postponed, such as preparatory work underpinning the strategy's net zero commitments, which was due to complete by July 2023.

Figure 14

Main initiatives forming the April 2023 wireless infrastructure strategy

The wireless infrastructure strategy sets out the government's ambition for wireless connectivity for the rest of the decade, with six main initiatives

Ensuring good connectivity for all

Coverage reporting
Improving the accuracy of Ofcom's data on coverage

Shared Rural Network
Extending 4G coverage to 95% of the UK (parts 2 and 3)

2G/3G switch-off
Withdrawal of 2G and 3G services by mobile network operators (MNOs) by 2033

Rail connectivity
Improving Ofcom's data on mobile coverage on UK mainline rail routes

Power resilience
Working with regulators on service standards and building resilience for the future

Strengthening the investment climate

Market consolidation
Work underpinning the Department for Science, Innovation & Technology's decision to be open to mergers among MNOs

Market developments
Monitoring MNO competition and merger proposals

Net neutrality
Ensuring roles are fit for purpose and support operators in investment and innovation

Impact of new policies or regulations
Working across government to ensure new policies and regulation support wireless network investment

Digital connectivity in and around Freeports
Ensuring MNOs that install mobile cell sites in Freeports get business rates tax relief

Working with Department for Levelling Up, Housing & Communities on planning legislation
Amendments to Part 16 of the Town and Country Planning (etc.) Order 2015 about changes to masts

Realising the full benefits of 5G

Public sector procurement
A strategy for public procurement of advanced wireless technology

Major infrastructure projects
Ensuring digital connectivity requirements are planned in for future users

Digital Infrastructure Advisory Group
Identifying challenges to adoption and working with government on solutions

Supporting connected places
Helping local authorities ensure the security and resilience of their underlying infrastructure

5G Innovation Regions
£36 million for regions and local authorities to promote the development and scaled adoption of 5G in key local sectors

Driving adoption

Private networks policy
Encouraging businesses to adopt 5G and working with Ofcom to improve access to spectrum

Sector adoption
Promoting the benefits of 5G to businesses and improving skills and knowledge

Net zero
Working across government to assess how 5G can help the UK reach net zero targets

Improving UK shared spectrum offer
Addressing technical barriers to shared spectrum use

Second National Infrastructure Assessment
Setting out long-term strategic goals for 5G and wireless infrastructure

6G

Future telecoms and 6G research and development
£100 million to put the UK at the leading-edge of future telecoms and 6G

6G and international engagement
Building international consensus and cooperation

Spectrum innovation
With Ofcom, introducing Shared Access Licence automation to improve access to spectrum

Strategy delivery

Strategy implementation
Engaging with stakeholders and tracking implementation

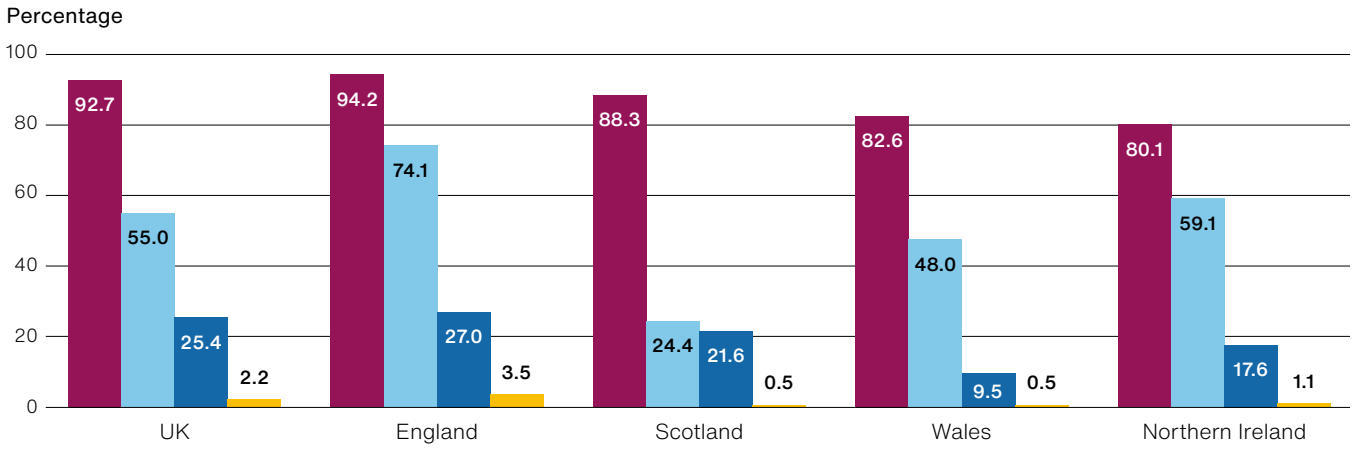
Source: National Audit Office analysis of Department for Science, Innovation & Technology documents

4.11 In September 2023, 5G from at least one operator was available to around 92.7% of premises but was lower in the devolved nations (**Figure 15**). Vodafone research shows that 46% of parliamentary constituencies that are both rural and among the 40% most deprived areas in the country are classified as 5G total not spots, compared with 2.7% in predominantly urban constituencies with a similar degree of deprivation.[19]

Figure 15

5G coverage of premises and landmass by nation, September 2023

5G coverage is lower in the devolved nations



Note

1 The chart is based on modelled coverage and shows Ofcom's 'high confidence' estimates for a good 5G signal. Ofcom does not report separately on standalone and non-standalone 5G coverage.

Source: National Audit Office analysis of Ofcom Connected Nations reports and data

19 Vodafone, *Connecting the Countryside. A WPI Strategy report for Vodafone UK*, November 2023. The data in the report only cover parliamentary constituencies in Great Britain and exclude those in Northern Ireland.

Challenges and risks

4.12 As its approach to new technology develops and the strategy is implemented, DSIT's challenge will be to apply lessons from its considerable experience on previous digital infrastructure programmes, including the SRN. Issues to resolve are set out below.

Ensuring good connectivity for all

4.13 DSIT has not yet determined whether government funding will be required to meet its strategy ambition to have 5G connectivity in all populated areas, including rural areas. DSIT does not currently plan to intervene in the 5G market by directly investing in constructing the network as it eventually did with the 4G SRN programme. It says this is because the commercial case for investment has yet to be confirmed, and because it is not yet clear where standalone 5G will be needed.

4.14 Connectivity along major rail routes remains poor. Passengers can struggle to make calls, stream videos or work online. DSIT needs more frequent data on rail mobile coverage to judge if action by the Department for Transport (DfT) to improve connectivity is effective. In 2020, the National Infrastructure Commission recommended that Ofcom should report on mobile coverage on the railways at least every two years.[20] Ofcom's last study on rail coverage was in 2019. DfT, working with Network Rail, is repeating this study, and plans to report results in 2025. In 2023, DSIT asked Ofcom to develop options for better reporting, including the feasibility of using in-carriage scanners and crowdsourced data.

4.15 The higher frequency spectrum used by 5G requires more mobile base stations, placed closer together. In some cases, local authorities may need to manage conflicts between supporting connectivity to support economic growth and addressing residents' concerns about masts in their areas. Early notification of applications may help local authorities manage these conflicts. DSIT proposes that greater use of shared infrastructure could minimise street 'clutter' and reduce MNO costs. In March 2022, the government amended planning regulations in England to allow taller and wider masts, with measures to minimise their visual impact, including in sensitive locations.

20 National Infrastructure Commission, Annual Monitoring Report, 2020.

Strengthening the investment climate

4.16 MNOs have concerns about their capacity to invest in standalone 5G, given their revenues have fallen while mobile data use has risen. DSIT has committed to working with Ofcom to review regulatory barriers to investment such as the licence fees that MNOs pay for radio spectrum, and requirements on internet service providers to treat all internet traffic on their networks equally. Vodafone and CH Hutchison Group (the owner of Three UK) consider that market consolidation could also enable greater investment in 5G and, in June 2023, announced their intention to combine their UK businesses. In January 2024, the Competition and Markets Authority (CMA) launched a formal investigation into the merger. The CMA will consider how the deal may affect competition in the UK, which could impact on the options and prices available to customers, as well as on investment in the quality of UK mobile networks. In the wireless infrastructure strategy, DSIT stated its openness to market consolidation, but noted that merger decisions are taken by the CMA.

4.17 Local authorities have limited resources to deal with planning applications quickly. Our report on the local government finance system in England in 2021 found that spending on planning and development services fell by 36% in real terms between 2010-11 and 2019-20.[21] As a result, local authorities report difficulty in recruiting and retaining planning experts and the Local Government Association does not expect a recent increase in planning fees to resolve this problem. MNOs told us that meeting planning permission requirements could slow the deployment of 5G infrastructure as it has on the 4G SRN programme (Part Three).

4.18 MNOs also told us that, based on the challenges they had experienced on the SRN programme, an updated Electronic Communications Code would help them negotiate more easily with landowners.[22] This code sets out the rights of telecommunications operators to install and maintain apparatus and networks on public and private land. In December 2022, Parliament passed legislation that introduced changes to the code, including rights to upgrade or share apparatus.[23] The government has introduced some changes to the code, such as dispute resolution, but DSIT must finish preparatory work, including changes to court rules and procedures, and preparation of regulations, before the last of the new code rules can come into force. DSIT plans to achieve this by the end of 2024.

21 Comptroller and Auditor General, *The local government finance system in England: overview and challenges*, Session 2021-22, HC 858, National Audit Office, November 2021.
22 The Electronic Communications Code is contained in Schedule 3A of the *Communications Act 2003.*
23 *The Product Security and Telecommunications Infrastructure Act* 2022.

Encouraging adoption to realise the full benefits of 5G

4.19 Although there are potential uses for standalone 5G, the demand and the commercial case are not yet clear. MNOs told us that, as DSIT develops the strategy, it needs to clarify the outcomes it is seeking, what connectivity will be needed to achieve these outcomes and where, and the role that 5G will play alongside 4G, wired broadband and other technologies.

4.20 Closer working across government may help DSIT build a case for 5G, but other departments may have competing policy priorities or resource constraints. For example, the Department for Health & Social Care (DHSC) announced that all new hospitals will have standalone 5G (or a wireless equivalent) but has not committed to installing it in existing hospitals. The strategy states that DSIT will work with departments, including DfT, the Department for Environment, Food & Rural Affairs and DHSC to develop and deploy 5G in their policy areas, building on pilots from the DSIT 5G Testbeds and Trials programme.

4.21 DSIT recognises that action is needed to resolve barriers to deployment. Steps it is taking include:

- a barrier-busting taskforce that works with local authorities where planning issues are a barrier to network deployment;
- supporting local authorities to identify sites that they own that could support wireless networks;
- working with DfT to ensure that street lights and CCTV columns can be used to deploy digital infrastructure; and
- developing an online portal to provide advice to local authorities on how to develop local digital infrastructure strategies.

4.22 The wireless infrastructure strategy also promoted the appointment of digital champions by local authorities, citing evidence that infrastructure is rolled out faster when local authorities have digital champions. The Local Government Association told us that it can see the benefits of digital champions but, given local authorities' financial constraints, has asked the government to provide funding.

Appendix One

Our audit approach

1 We reached our independent conclusions on whether the Department for Science, Innovation & Technology (DSIT) is on track to deliver UK-wide reliable mobile connectivity that meets the country's needs now and in the future, following analysis of evidence collected primarily between June 2023 and December 2023. We assessed its preparation for, and progress in, building the Shared Rural Network (SRN) and the challenges it will face in implementing its April 2023 wireless infrastructure strategy.

2 In February 2023, responsibility for digital connectivity moved from the Department for Digital, Culture, Media & Sport to DSIT. Throughout this report, we refer to the accountable department as DSIT, irrespective of the period under discussion, and we have examined documents and data for both departments.

3 At the start of the study, we developed our evaluative criteria and used these to shape our collection and analyses of evidence. We used these high-level evaluative criteria:

- DSIT and Building Digital UK (BDUK) have set up effective arrangements for delivering UK-wide 4G connectivity through the SRN programme;
- DSIT and BDUK are on track to deliver planned 4G connectivity; and
- DSIT is developing a good basis for meeting the UK's future connectivity needs.

4 In forming our conclusions, we drew on a range of study methods and evidence sources, which are set out in the paragraphs below. We also worked closely with colleagues from our internal expertise teams. These included colleagues with expertise in business case review, quantitative and qualitative analysis, and major project delivery.

Interviews and meetings

5 We held interviews with DSIT, BDUK and stakeholders between June and December 2023 (**Figure 16** on page 49). We analysed the interviews thematically, based on our evaluative criteria. We used interviews to explore topic areas and guide subsequent requests for and review of documentation. Our interview analysis was used in the report to derive our audit findings, or validate conclusions drawn from other evidence, for example, document analysis.

Document review

6 Between June and December 2023, we reviewed internal and publicly available documents from DSIT and BDUK and other stakeholders to inform our study. We used these documents to:

- define the scope of the audit and deepen our understanding of the government's mobile infrastructure programmes;
- inform further discussion with DSIT, BDUK and other organisations; and
- inform findings and triangulate findings from other sources, including interviews and data analyses.

We reviewed each document thematically, in line with our evaluative criteria.

7 We reviewed a wide range of DSIT, BDUK and Ofcom documents, including minutes of meetings; ministerial submissions; monitoring reports; business cases; grant agreements; budgeting and planning documents; financial, performance and risk reporting; public announcements; governance charts; and policy statements. We also reviewed strategy statements from the devolved nations.

8 We used internal experts to review the business cases and supporting documents for the SRN, Open Networks and 5G Testbed and Trials programmes against our framework for auditing business cases.

9 We assessed the documents we reviewed against our evaluative criteria. We used our reviews to inform our interview questions, draw conclusions and support findings drawn from other methods, such as interviews. Where necessary, we followed up with DSIT, BDUK and Ofcom to get clarification on the contents of the documents and to request further documents. We also extracted relevant data from these documents for analysis (see 'Quantitative analysis' below).

10 We reviewed the National Audit Office's back catalogue of reports, frameworks, good practice guides and lessons-learned reports for relevant guidance to aid in the scoping of the audit and in analysing our findings.

Quantitative analysis

11 In October and November 2023, we examined actual against planned expenditure incurred by the SRN programme to date, to assess progress against milestones and budget. This analysis underpins some of the data in the report and was used to support points of detail.

Figure 16
Interviews

We held interviews with Department for Science, Innovation & Technology (DSIT), Building Digital UK (BDUK) and stakeholders between June and December 2023

Organisation	Number and details	Why organisations were selected	Main topic/questions covered in interviews
Accountable organisations	Eight interviews with officials in DSIT and BDUK	DSIT is responsible for government policy on digital connectivity and BDUK is responsible for delivering infrastructure programmes to improve connectivity	The Shared Rural Network (SRN) programme; future connectivity, including the wireless infrastructure strategy (WIS)
Providers	One interview with Digital Mobile Spectrum Limited (DMSL)	DMSL is an organisation wholly owned in equal part by all four MNOs and receives grants from DSIT for elements of the SRN	Experience of the SRN programme; relationship with DSIT and BDUK
	One interview with each of the four national mobile network operators (MNOs)	The UK's mobile network is provided by four national MNOs	Experience implementing the SRN programme and views on DSIT's WIS
Other government departments	One interview with the Home Office	DSIT funds the Home Office to upgrade extended area service (EAS) sites in the SRN	Progress with EAS programme; interrelationship of EAS/SRN
	Two interviews with Ofcom	Ofcom is the regulator and competition authority for the UK's communications industries, including telecoms	Ofcom's role and responsibilities; progress of SRN; coverage data availability, methodology and limitations
	One interview with the Department for Levelling Up, Housing & Communities (DLUHC)	DLUHC is responsible for local government and planning	Impact of SRN on levelling up; the planning system for masts; implications of WIS for DLUHC
	One interview with the Infrastructure and Projects Authority (IPA)	The IPA is the government's centre of expertise for infrastructure and major projects	DSIT's digital infrastructure programmes
Devolved administrations	One interview with each of the three devolved administrations	The devolved administrations deliver activities that help ensure that their nations secure the benefits of digital connectivity	Experience of SRN programme; interrelationship with devolved nation plans and priorities for mobile connectivity
	One interview with Audit Scotland	Audit Scotland delivers financial and performance audits on public bodies and the management of public services, policies and major projects	Audits of mobile connectivity and related subjects; local context
Local government organisations	One interview each with the Local Government Association (covering England), Convention of Scottish Local Authorities (COSLA) and Welsh Local Government Association	Representing local government	Impact of SRN and future connectivity programmes on local government
	Officers/members in two local authorities	Local authorities handle planning applications and develop local digital infrastructure strategies	Experience of SRN and future connectivity work in their local authority
Association of Directors of Environment, Planning and Transport	One interview with the chair	The association represents directors in local authorities	Members' opinion/experience of roll-out of SRN and the implications of WIS

Source: National Audit Office

12 We used the data and definitions published in Ofcom's Connected Nations reports to report on mobile coverage. Ofcom publishes data three times a year, with accompanying methods appendices. The most recent report was published in December 2023, with data as of September 2023. These reports give a breakdown of 4G and 5G coverage for each UK nation and by different measures (including as a percentage of premises covered or a percentage of landmass, which is defined as including inhabited islands that are part of the UK, but not uninhabited islands). We analysed data from multiple reports to present the change in coverage over time. Ofcom has two measures of coverage: indoor and outdoor. Unless stated otherwise, the coverage statistics we report are outdoor coverage, as this is the basis for DSIT's coverage targets.

13 We also analysed spatial data in November 2023, supplied by Ofcom, to describe the distribution of coverage, and to chart progress of the SRN towards the coverage targets. Areas with no coverage from any mobile network operator (MNO) are termed 'total not spots' and areas with coverage from at least one, but not all four, MNOs are termed 'partial not spots'. Areas with coverage from all MNOs are termed 'full coverage'. The data are based on modelling by the MNOs of 4G coverage in September 2020 and September 2023, and 5G coverage in September 2023. Ofcom collects the data as 100 metre x 100 metre pixels against the Ordnance Survey Great Britain grid system. We aggregated the data to 1,000 metre x 1,000 metre squares, selecting the modal value within each square. Our analyses underpin the maps in the report. We used Ofcom's definition of a good 4G signal: the ability to make a 90 second phone call and achieve a download speed of 2 Mbps (megabits per second). We consulted our internal experts about the geographic data, to guide our analysis and to obtain their expert judgement.

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National Audit Office

Design and Production by NAO Communications Team
DP Ref: 012736-001

£10.00
ISBN: 978-1-78604-534-8