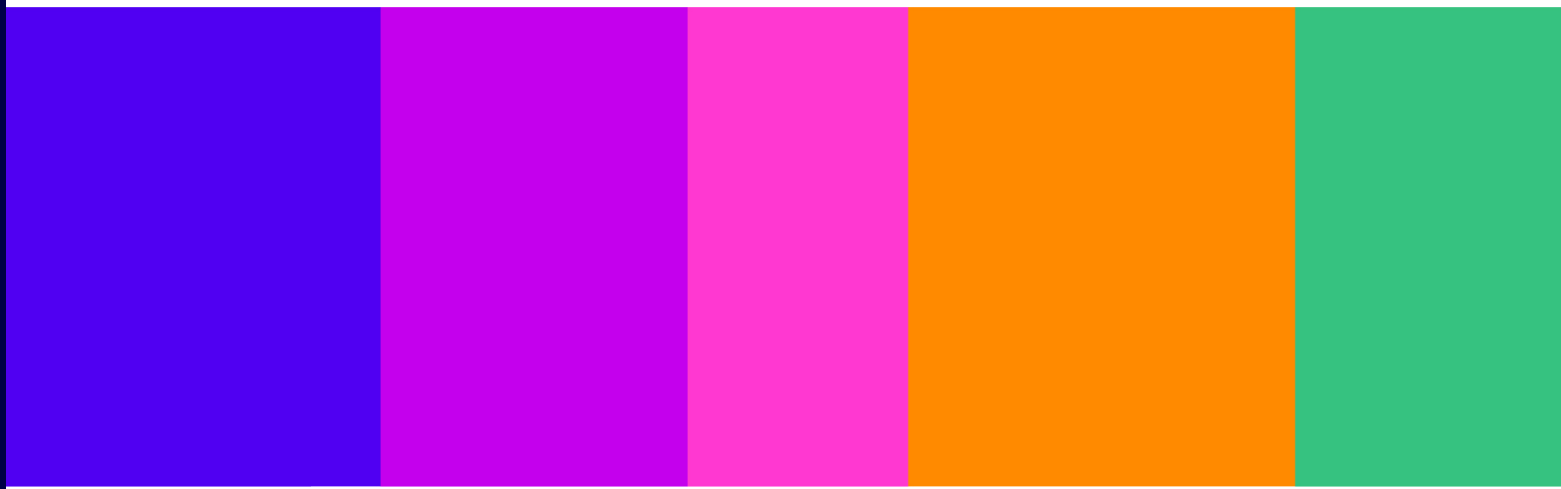


Shared Rural Network Coverage Obligations

Assessing the mobile network operators' compliance with their geographic coverage obligations

Statement

Published 12 September 2024



Contents

Section

1. Overview	3
2. Introduction.....	5
3. Evidence-gathering.....	9
4. Analysis and key findings	15
5. Wider outcomes for consumers	20
6. Next steps.....	23

1. Overview

- 1.1 The Shared Rural Network programme is an agreement between the mobile network operators and the UK Government, signed in March 2020, to extend good quality mobile coverage.¹
- 1.2 Each of the mobile network operators agreed to their 900 MHz and/or 1800 MHz licences being varied to give effect to these commitments in the form of new coverage obligations. These coverage obligations include requirements for each mobile network operator to provide good quality data and voice coverage to 88% of the UK landmass by 30 June 2024, with associated thresholds in each UK nation.
- 1.3 Ofcom is responsible for monitoring the delivery of the coverage obligations established for the Shared Rural Network programme, and we have now completed our analysis to assess the MNOs' compliance with the requirements that fell due on 30 June 2024.

Summary of our key findings:

On the basis of our analysis, we found that:

- BT EE, VMO2 and Vodafone have met the 88% UK-wide threshold and their individual thresholds for each UK nation.
- Three had not met the 88% UK-wide threshold and its individual threshold in Scotland (72%) at the point these obligations fell due.

We also found that the coverage increases delivered because of the SRN programme have significantly reduced the scale of “partial not spots”, and consequently increased the areas where all MNOs provide coverage. These common or “full” coverage areas have increased from 66% of the UK landmass at the start of 2020 to over 78% of the UK landmass today.

Next steps

- 1.4 On 22 August, Three informed us that they believed they had met the outstanding obligation thresholds as of that date. We expect to publish an update on our assessment of Three's progress and any next steps in the coming months.
- 1.5 The mobile network operators are required to maintain compliance with the coverage obligations that fell due on 30 June 2024 after this deadline has passed. We expect to continue to monitor their ongoing compliance through the work we regularly undertake for the purposes of our Connected Nations reports and online mobile coverage checker.
- 1.6 The Shared Rural Network programme also includes additional obligations that are due to be met by January 2027. We will continue to prepare for that further compliance assessment, and report on outcomes after these further obligations fall due.

¹ Good quality coverage is defined as the ability to sustain a 90 second voice call and access data speeds of at least 2 Mbps, with a methodology to assess this based on a 4G signal of at least -105 dBm.

The overview section in this document is a simplified high-level summary only. The decisions we have taken and our reasoning are set out in the full document.

2. Introduction

The 'Shared Rural Network' programme

- 2.1 The Shared Rural Network (“SRN”) programme is an agreement between each of EE Limited (“BT EE”²), Hutchison 3G UK Limited (“Three”), Telefónica UK Limited (“VMO2”³) and Vodafone Limited (“Vodafone”) - collectively the “MNOs” - and the UK Government, signed in March 2020, to extend mobile coverage.⁴
- 2.2 The SRN agreement is intended to see up to £1 billion invested in rural mobile connectivity by 2027, with a roughly even split between public and private investment. It was prompted by (and was a response to) Ofcom’s earlier proposals to include coverage obligations in our award process for the 700 MHz and 3.6-3.8 GHz bands.⁵
- 2.3 In summary, the split between the MNO-funded and the Government-funded SRN components is as follows:
- a) **MNO-funded component** - The MNOs each committed to achieve 88% landmass coverage by 30 June 2024, using their own investment to deliver new coverage focussed predominantly in partial not spots (“PNS”).⁶ In addition to this UK-wide coverage threshold, each MNO also agreed to MNO-specific⁷ coverage thresholds in each of the UK nations by the same deadline.
 - b) **Government-funded component** - The publicly funded elements of the programme are due to complete by 31 January 2027, and require each of the MNOs to reach 90% landmass coverage across the UK (with MNO-specific coverage thresholds in each of the UK nations), by deploying:
 - i) as far as possible on ‘EAS’ sites built by the Home Office for its Emergency Service Network and subsequently made available to the MNOs;⁸ and
 - ii) on additional publicly funded sites providing at least 1% coverage in total not spots (“TNS”).⁹
- 2.4 There are also additional requirements for each MNO to bring new coverage to a set number of premises, and road length, which also fall due in January 2027.

² EE Limited, which holds the spectrum licence containing its SRN obligations, is part of the BT group.

³ Telefónica UK Limited, which holds the spectrum licence containing its SRN obligations, is part of Virgin Media O2.

⁴ <https://www.gov.uk/government/news/shared-rural-network>

⁵ [Ofcom’s March 2020 stacall cacacacacacaaccacacacacatemnt](#), paragraph 1.4.

⁶ Partial Not Spot means a geographical area within the UK falling within at least one, but not all, the MNOs’ coverage footprints (in this case the 2020 Baseline Coverage Footprints).

⁷ These MNO specific thresholds reflected their different starting points in each of the UK nations.

⁸ In this context EAS sites means: (i) any of the c290 extended area service sites that the Home Office intended to build to improve coverage in remote areas at the time of the SRN agreement and (ii) any alternative or additional extended area service site which is publicly funded in the same way whose location is specified by Government by 31 March 2024, excluding any such site the deployment of which would materially duplicate the coverage from any site in Total Not Spots for which land has already been acquired by the Licensee.

⁹ Total Not Spot means geographical areas within the UK falling outside all the MNOs’ coverage footprints (in this case, the 2020 Baseline Coverage Footprints).

The coverage obligations supporting the SRN

- 2.5 Ofcom gave effect to the coverage commitments that the MNOs made to the UK Government under the SRN programme by varying their spectrum licences (with the MNOs' consent).¹⁰ These licences covered frequencies in the 900 MHz and 1800 MHz bands. Specifically, Ofcom varied the following licences, which are [published](#) on Ofcom's website:
- BT EE's licence no. [0249666](#);
 - Three's licence no. [0931984](#);
 - VMO2's licence no. [0249663](#); and
 - Vodafone's licence no. [0249664](#).
- 2.6 The MNOs' licences refer to these obligations as the "2020 coverage obligations". For brevity, in the rest of this document we refer to the 2020 coverage obligations, collectively, as the "**SRN obligations**", and individually as follows:¹¹
- We refer to the SRN obligations which fell due on **30 June 2024** as the "88% Geographic Coverage Obligation" and the "Initial Nations Requirement(s)".
 - We refer to the SRN obligations which will fall due on **31 January 2027** as the "90% Geographic Coverage Obligation", the "Subsequent Nations Requirement(s)", the "EAS Coverage Obligation", the "Total Not Spots Requirement", the "Premises Requirement" and the "Roads Requirement".

The coverage obligations which fell due on 30 June

- 2.7 Since this document concerns the SRN obligations which fell due on 30 June 2024, we describe them in more detail below.

The 88% Geographic Coverage Obligation

UK-wide threshold

- 2.8 By 30 June 2024, each MNO must provide, and thereafter maintain, good quality coverage to an area covering at least 88% of the geographic landmass of the UK.
- 2.9 In order to count towards compliance, the MNOs' coverage must meet the conditions for qualifying as the "Required Service" (as defined in the licence) and meet various conditions concerning the location of any added coverage or the site providing such coverage. Below, we provide further detail about these conditions.

'Good quality geographic coverage'

- 2.10 For the purpose of the SRN obligations, "**good quality geographic coverage**" means "an electronic communications network that provides with a confidence level of more than 95% a mobile telecommunications service to users (i) with a sustained downlink speed of not less

¹⁰ Note that at the time of agreeing the relevant licence obligations, we made clear to the MNOs that we considered these obligations could not be traded away. Consequently, if the rights and obligations arising from a relevant licence were to be traded (or for example impacted by a merger), we would ensure that the SRN obligations were included in another suitable licence.

¹¹ These definitions mirror those set out in the Annex to Ofcom's [2020 Coverage Obligations - Notice of compliance verification methodology](#).

than 2 megabits per second, and (ii) on which a 90 second voice call can be made without interruption”. As specified in the licence, this “is equivalent to providing an outdoor LTE telecommunications service at a predicted mean signal strength of at least -105 dBm”.

Conditions concerning site and coverage location

- 2.11 As mentioned above, the 88% Geographic Coverage Obligation is intended to improve coverage mainly in rural PNS areas.
- 2.12 Consequently, as part of the SRN agreement, the Government agreed with the MNOs that certain conditions relating to this objective would be included in their licence obligations. Specifically, each MNO must ensure that any additional coverage relative to its “2020 Baseline Coverage Footprint” (which is based mainly on September 2019 coverage) is either:

*“(A) provided in Partial Not Spots;
 (B) gained by deploying on sites located in Partial Not Spots; or
 (C) gained by deploying on sites located in a Full Coverage Area, provided that any such coverage which is added in Total Not Spots does not exceed 0.3% of the geographic landmass of the United Kingdom”.*

- 2.13 Each MNO must also ensure that any additional coverage which is provided in Total Not Spots does not limit its ability to meet the Total Not Spots Requirement (which will fall due on 31 January 2027).

The Initial Nations Requirements

- 2.14 By 30 June 2024, each MNO must also provide, and thereafter maintain, good quality coverage to an area covering at least a specified percentage of the geographic landmass of each of the UK nations.¹² The MNO-specific percentages for each UK nation are shown in the table below.

Table 1: Initial Nations Requirements

	BT EE	Three	VMO2	Vodafone
England	93%	91%	92%	92%
Northern Ireland	89%	91%	91%	93%
Scotland	75%	72%	75%	76%
Wales	83%	83%	82%	82%

¹² We note that these requirements were negotiated between the MNOs and Government in 2020 and are not simply component parts of covering 88% of the UK landmass (i.e., it is possible to achieve 88% and not achieve some or all of these requirements).

The methodology for assessing MNOs' compliance

- 2.15 Ofcom is responsible for assessing compliance with the SRN obligations and published our methodology for doing so in March 2020: 2020 Coverage Obligations – Notice of compliance verification methodology (the "[Methodology](#)").
- 2.16 The Methodology was agreed with the MNOs in March 2020 as part of the wider SRN agreement and subsequently updated in July 2021 and February 2024 to reflect changes that the MNOs and the Government had made to the funding agreement supporting the MNOs' commitments (the "**Grant Agreement**").
- 2.17 The process for assessing compliance with the SRN obligations which fell due on 30 June 2024 is set out in Section 3 of the Methodology. In summary, this process involves considering two main sources of evidence: (i) the MNOs' coverage predictions resulting from the predictive radio planning tools used by each MNO for its own coverage planning purposes (the "**MNO models**") and (ii) the results of Ofcom's drive testing, which are intended to ensure that the accuracy of the MNOs' models is reasonable.

Structure of this document

- 2.18 The rest of this document is structured as follows:
- In Section 3, we describe the evidence that we have gathered to conduct our analysis.
 - In Section 4, we set out the main steps that we have taken to analyse the evidence and our key findings.
 - In Section 5, we provide a high-level view of some of the wider coverage impacts of the work undertaken by the MNOs.
 - In Section 6, we describe our next steps in light of our findings.

3. Evidence-gathering

Introduction

3.1 As mentioned above, the process for assessing compliance with the 88% Geographic Coverage Obligation and the Initial Nations Requirement(s) involves considering two main sources of evidence: the coverage predictions from the MNO models and the results of Ofcom's drive testing. In addition, we have obtained further information about where and how the MNOs' coverage improvements have been delivered to help ensure that that our drive testing approach was sampling an appropriate mix of different coverage upgrade locations.

The coverage predictions from the MNOs' models and further site-specific data

March 2023 letters to the MNOs

3.2 On 14 March 2023, we wrote to each of the MNOs to understand how they were planning to demonstrate compliance with the SRN obligations falling due on 30 June 2024. In particular, we asked them to specify:

- whether they intended to use the 4G coverage models which they were using to report coverage for our Connected Nations reports, or planning to make any material updates to these models;
- the nature (and implementation timescales) of any updates to their 4G coverage models which they planned to make before 30 June 2024;
- whether they expected any coverage counting towards compliance with the relevant SRN obligations to be 5G-only coverage (i.e., coverage provided only by 5G technology) and, if so, the scale of any such coverage.

3.3 The MNOs' responses indicated that no fundamental changes to their prediction models were planned for this period. They also indicated in their responses (and subsequent discussions) that at the time the MNOs did not expect to rely on 5G coverage to meet the SRN obligations falling due on 30 June 2024.¹³

March 2024 formal information requests

3.4 On 11 March 2024, we issued a formal information request to each MNO, requiring the provision of specified information relating to their 4G coverage. We focused on 4G only because all the MNOs had indicated that they did not expect any coverage counting towards compliance with the 88% Geographic Coverage Obligation and the Initial Nations Requirement(s) to be 5G-only coverage.

3.5 In summary, we required the MNOs to provide information about:

¹³ Some MNOs indicated that they might rely on 5G coverage in the future. We will consider updating our methodology at that point.

- their overall 4G coverage footprint across the UK;
- the signal strength for areas included within their overall 4G coverage footprint, based on a grid of 100m x 100m pixels, referenced against the OSGB ¹⁴ national grid system;
- the “best serving site”¹⁵ for each 100m x 100m pixel area included within their 4G coverage footprint, including their location; and
- the works undertaken since September 2019, or planned to be completed by 30 June 2024, to extend their 4G coverage footprint.

3.6 We also required the MNOs to specify which relevant frequency bands contributed to their overall 4G coverage footprint, noting that we were interested in each of the frequency bands used by the MNOs’ models to predict their total 4G coverage (i.e. those bands which the MNOs rely upon to meet their SRN obligations). For the avoidance of doubt, we clarified that we were not requesting information about bands used for capacity purposes only.¹⁶

3.7 The primary goal of this initial information request was to aid our preparations for evaluating compliance with the SRN obligations. This included ensuring that our analysis framework aligned with MNO data sources.

June 2024 formal information requests

3.8 On 12 June 2024, we issued a second formal information request to each MNO, requiring the provision of refreshed, up-to-date information relating to their 4G coverage on 1 July 2024.

3.9 In relation to the works undertaken since September 2019 to extend their 4G coverage footprint, we requested the MNOs to specify this with reference to the categories set out in Table 2 below.¹⁷

Table 2: Site developments undertaken since September 2019

	Site development categories
i.	No developments since Sept 2019 - Site pre-dating Shared Rural Network or only contributing to Baseline Footprint
ii.	New unilateral site
iii.	New shared site (MNO delivered)
iv.	New Wireless Infrastructure Provider (WIP) site
v.	Joining an existing MNO site

¹⁴ <https://getoutside.ordnancesurvey.co.uk/guides/beginners-guide-to-grid-references/>

¹⁵ The “best serving site” is the site which provides the strongest signal for a given location, on a given frequency.

¹⁶ For example, an MNO’s coverage footprint might typically be dominated by lower frequency spectrum below 1 GHz, which travels further than higher frequencies. Mid-band spectrum at 3 GHz can be important for capacity, but may not contribute uniquely to overall coverage levels where lower frequency spectrum is already present.

¹⁷ We asked for information on works since September 2019 since that was the point at which MNOs provided initial information on their “2020 Baseline Coverage Footprints” as part of negotiating the SRN agreement.

Site development categories	
vi.	Joining an existing Wireless Infrastructure Provider (WIP) site
vii.	Additional spectrum on an existing site
viii.	Additional EIRP ¹⁸
ix.	LTE Reference Signal Power boosting
x.	Height Increases to an existing site
xi.	An Extended Area Service site deployed by the Home Office as part of the Emergency Service Network, for which any added 4G coverage has been publicly funded under the Grant Agreement
xii.	An Extended Area Service site deployed by the Home Office as part of the Emergency Service Network, for which any added 4G coverage has not been publicly funded under the Grant Agreement
xiii.	A site publicly funded under the Grant Agreement which provides coverage in a Total Not Spot (excluding the Extended Area Service sites mentioned under xi. and xii. above)
xiv.	Other works (for example, this might include changes in antenna type or antenna tilt).

3.10 We gathered this information to build an understanding of where and how the MNOs had added coverage, and to satisfy ourselves that our drive testing approach was sampling an appropriate mix of different coverage upgrade locations. This information also helped us identify any publicly funded coverage enhancements that should not count towards compliance with the 88% Geographic Obligation.

Our drive-testing campaigns

3.11 Ofcom has been measuring the mobile coverage which the MNOs report to us for almost 10 years. Typically, this involves regular ‘drive-test’ campaigns that help us ensure that the information we publish in our Connected Nations reports is accurate within a reasonable margin of error, which we define as +/- 3 decibels (dB).

3.12 This is because the MNOs’ coverage predictions are based on computer models that take account of a range of details in an MNO’s network (for example, the mast height and power levels they are using) and physical factors (for example, the propagation characteristics of different spectrum bands and the impact of local topography). While we recognise that such coverage predictions cannot be completely accurate for every location, we expect the

¹⁸ “EIRP” means equivalent isotropic radiated power which is the product of the power supplied to an antenna and the absolute or isotropic antenna gain in a given direction relative to an isotropic antenna.

information provided to us by the MNOs to be accurate for the UK as a whole, and across different regions and types of terrain.

- 3.13 Our standard drive-testing is undertaken using mobile technology (for example, 4G or 5G) measurement ‘scanners’ installed into vehicles, which capture a range of information including mobile signal strength in a given location across the UK road network.
- 3.14 This allows us to gather measurement samples of the real signal that we see for each MNO in a wide variety of locations, across different regions and terrains. This data can then be used for aggregated comparisons with the coverage information the MNOs supply to Ofcom, in the form of coverage predictions.
- 3.15 We undertake our measurement work using our fleet of spectrum assurance vehicles, which are also responsible for responding to and resolving interference events across a whole range of spectrum uses. We have an established process for ensuring our measurement equipment is calibrated in a consistent way, and a defined methodology for ensuring we have enough measurement ‘samples’ to characterise coverage in an individual pixel (see section 4). We also expect the MNOs to have undertaken similar or more extensive validation of their own predictions, before these are provided to us.

Autumn 2023 drive-testing campaign

- 3.16 In Autumn 2023, we undertook more than 14,000 miles of drive-testing, including a significant amount of rural areas, to inform our preparations for assessing compliance with the SRN obligations.
- 3.17 This built on the regular work we have been undertaking to evaluate the MNOs’ coverage models in recent years and allowed us to focus our measurement approach in some more rural locations. A key purpose of this initial work was to provide an early view of any challenges in gathering sufficient measurement points in relevant rural areas and partial not spot locations. This helped ensure that we had appropriate processes in place for the 2024 assessment (and provided an early view of MNOs’ models performance in these locations).
- 3.18 Our drive-testing route for 2023 is shown in Figure 1 below.

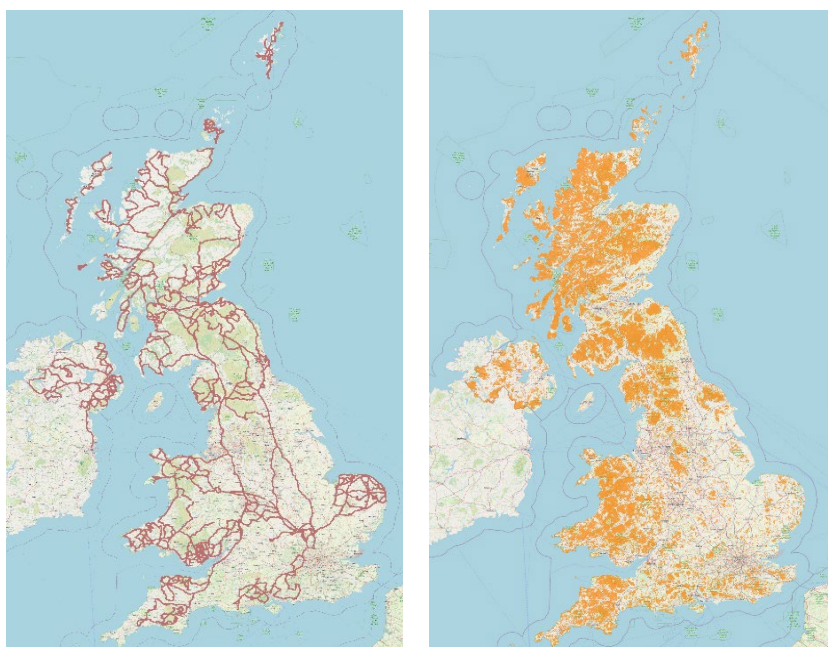
Figure 1: Overview of Ofcom’s Autumn 2023 drive-testing campaign route



Summer 2024 drive-testing campaign

- 3.19 From late June to early August 2024, we conducted further drive-testing in a sample of locations across different UK nations for the purpose of ensuring that the accuracy of the MNOs' model is reasonable.
- 3.20 As specified in our March 2023 letter to the MNOs, we adopted a drive-testing methodology in line with that used for verifying coverage data submitted for Ofcom's Connected Nations reports.
- 3.21 Since we expected a significant part of the coverage added since September 2019 to be in rural areas, we gathered data across more rural areas (and more minor roads) than we typically do for the purpose of our Connected Nations reports. This was to ensure our drive testing measurements would be representative of the areas where coverage is being added.
- 3.22 We sampled a significant volume of partial not spots, and undertook checks to ensure that drive-testing was conducted across many of the locations MNOs told us they were adding coverage. We did this to ensure that we were 'spot-checking' what the MNOs had told us and that where additional new coverage was being claimed, we could see evidence of this on the ground.
- 3.23 Our drive-testing route is shown in Figure 2 below, alongside a plot of sample areas where coverage was added under the SRN programme. Our 2024 test campaign covered approximately 18,000 miles, with around 30% of measurement locations taken from B or minor roads.

Figure 2: Overview of Ofcom's summer 2024 drive-testing campaign route (left) and areas where coverage has been added (right) ¹⁹



¹⁹ The map highlights sample areas where coverage has been added in the PNS and TNS areas under the SRN programme. Specifically, it shows areas that were initially outside the coverage footprints of all MNOs but now have coverage from at least one MNO, or had coverage from at least one MNO and now have coverage from additional MNOs.

3.24 We plan to make the measurement data from this extensive drive test campaign available on our website in the coming months, through our existing [mobile measurement open data release programme](#).

4. Analysis and key findings

Overview of our approach

Introduction

- 4.1 In accordance with the Methodology (paragraphs 3.1-3.6), our compliance assessment has involved a combination of desk-based assessment against the MNO's coverage predictions and drive testing in a sample of locations across the different UK Nations. The purpose of this work is to check that the accuracy of the MNO's coverage predictions is reasonable.

The MNOs' 4G coverage predictions

- 4.2 We have been keeping track of the coverage levels which the MNOs report to us (for the purposes of Ofcom's Connected Nations reports and online mobile coverage checker) throughout the period from 2020. We have also reported on MNO's progress in our annual Connected Nations reports.
- 4.3 In response to our March 2023 letter, all the MNOs indicated that they did not expect any coverage counting towards compliance with the 88% Geographic Coverage Obligation and the Initial Nations Requirement(s) to be 5G-only coverage. For this reason our analysis focuses on 4G coverage only.
- 4.4 In our June 2024 formal information requests, Ofcom required each MNO to supply the details of the coverage provided by 4G technology, specifying which frequency bands are used to predict such coverage by the MNO model, as a result of all on-air sites. Ofcom requested this information to be provided in the format used for the purposes of Ofcom's Connected Nations report, in which the MNOs use the Ordnance Survey National Grid reference system and indicate relevant signal strength within each 100m x 100m pixel on the UK grid. This enables us to assess whether there is good quality coverage in any given pixel.²⁰
- 4.5 In addition to the signal strength predictions, we requested information which identifies the site providing the best signal strength for each pixel contributing to meeting the SRN obligations and supplementary information which included the location information for the sites providing this 4G coverage.
- 4.6 In response, all MNOs provided their UK-wide and Nation-specific 4G coverage footprints and associated site location information. This data indicates the extent to which the MNOs claim to be providing good quality coverage, by identifying the number of pixels with good quality signal strength within the UK and each of the nations.

²⁰ As set out above (in Section 2), the threshold for good quality coverage is -105 dBm, so in any given pixel, signal strength equal to or better than -105 dBm amounts to good quality coverage. Any pixel with predicted signal strength weaker than -105 dBm would not meet the good quality coverage threshold.

Our approach to assessing the MNOs' coverage predictions

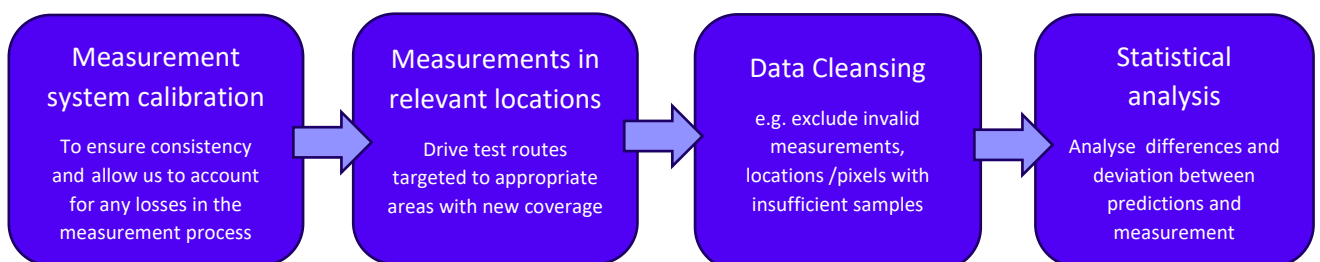
'Pixel counting' checks

- 4.7 We undertook desk-based analysis to confirm the landmass coverage statistics provided by the MNOs.
- 4.8 We assessed each of the approximately 24 million 100x100m pixels defining the extent of UK landmass and counted those identified as having a signal strength of -105 dBm or better. This enabled us to verify the MNO's overall landmass coverage percentages and individual national thresholds, in line with the approach we take for our Connected Nations reports.

Verifying the accuracy of the MNOs' predictions for good quality coverage

- 4.9 We then undertook drive testing to assess the accuracy of the MNOs' predictions across the full range of signal strengths which they provided to us, and around this threshold for good quality coverage.
- 4.10 It is not possible for us to drive test every location in the UK, or even every pixel where coverage has been claimed to be added. Instead, our methodology focussed on establishing if the accuracy of the MNOs' models are reasonable. This includes reasonably accurate predictions across a range of environments, including in more rural terrain. In line with the approach that we take for our Connected Nations reports, we consider a margin of error (i.e. "median prediction error") to be reasonable where it falls within +/- 3dB. We have also checked whether the variability (i.e. standard deviations of the "median prediction error") was reasonable; and we considered the correlation²¹ between predictions and measured signal strength.
- 4.11 We evaluated the MNOs' predictions by comparing them against the data gathered through our drive-testing, in respect of every pixel for which we have gathered data. We did this in line with our established process²², which seeks to ensure that we have a representative set of samples, and that our drive-testing measurements correspond to the relevant site and frequency band for each MNO. This process is summarised in Figure 3 below:

Figure 3: Overview of our methodology for assessing MNO predictions



- 4.16 Further detail of our measurement methodology can be found here [Mobile Measurement Methodology](#)

Accounting for SRN (TNS and PNS) specific coverage location requirements

- 4.17 We also assessed the extent of coverage contribution in PNS and TNS areas to check whether the MNOs had met the conditions concerning the coverage location (and the

²¹ Pearson correlation coefficient measures linear correlation between two sets of data.

²² See our methodology [Mobile signal strength measurement systems \(ofcom.org.uk\)](#)

location of sites providing coverage), which are intended to ensure added coverage is focussed mainly on PNS areas (see Section 2).

- 4.18 Verifying the location of coverage and MNO sites involves an assessment (using computer software) of the underlying pixel by pixel coverage and site location data against an equivalent pixel map representing the 2020 Baseline Coverage Footprint.²³ In particular, we have taken the following steps:
- i) We have checked whether the UK-wide coverage that MNOs have added since September 2019 is in a partial not spot, or is gained by deploying on a site located in a partial not spot, in which case we have considered it as counting towards compliance;
 - ii) Where coverage falls in a total not spot, and is gained by deploying on a site located in a 'full coverage' area, we have considered it as counting towards compliance up to the limit of 0.3% of the UK set out in the licence conditions; and
 - iii) Where coverage falls in a total not spot and is gained by deploying on a site located in a total not spot, we have not counted it towards compliance.
- 4.19 Finally, in line with the relevant licence conditions, we also considered whether the coverage provided in Total Not Spots would affect the MNOs future ability to add an additional 1% of landmass coverage in Total Not Spot areas, and checked that this coverage had not been publicly funded under the SRN grant agreement.

Key findings based on our analysis

88% Geographic Coverage Obligation

- 4.20 As set out in section 2, by 30 June 2024, each MNO was required to provide, and thereafter maintain, good quality coverage to an area covering at least 88% of the geographic landmass of the UK. The data submitted by the MNOs in response to our June 2024 information request indicated to us that they had achieved the following levels of UK-wide coverage by that date:

Table 3: UK Wide Coverage Reported by MNOs as of 30 June 2024²⁴

BT EE	Three	VMO2	Vodafone
88.9%	86.5%	88.1%	88.7%

- 4.21 We undertook the analysis set out above in respect of the 88% Geographic Coverage Obligation. In essence, our assessment was based on the statistical analysis of the MNOs' predictions, compared against our drive test measurements. The key statistical performance

²³ The 2020 Baseline Coverage Footprint sets out whether a given 100x100m location in the UK was covered by 0, 1-3 or 4 MNOs, based on information provided to us by the operators at the time. In line with the definition of "2020 Baseline Coverage Footprint" set out in the relevant licence, this final baseline depended on whether certain sites that the MNOs were in the process of building in early 2020 had been switched on by 30 June 2021. Consequently, we provided MNOs with a final version of this 2020 Baseline Coverage Footprint in Autumn 2021.

²⁴ Data rounded to 1 decimal place.

indicators we have considered in our assessment are (i) the mean/median prediction error (“PE”)²⁵, (ii) its standard deviation (“SD”), and (iii) the correlation between predictions and measured signal strength. We consider that mean/median prediction error close to zero, standard deviation in the range of 8-9 dB or better and correlation closer to 1 are indicators of statistically reasonable predictions.

- 4.22 In Table 4, the results of our validation are provided for all MNOs for the main frequency band used to meet the 88% threshold by each of the MNOs (800 MHz).²⁶ Based on our analysis, we are satisfied that the accuracy of the MNOs’ coverage predictions is reasonable.

Table 4: Validation results of MNO’s predictions for 800 MHz frequency band

	MNO 1	MNO 2	MNO 3	MNO 4	All MNOs
Mean PE (dB)	-1.2	-0.3	0.5	0.5	-0.1
Median PE (dB)	-1.4	-0.2	0.3	0.5	-0.2
SD PE (dB)	8.6	8.5	8.4	8.9	8.6
Correlation	0.73	0.70	0.73	0.70	0.71

- 4.23 Having also undertaken the verification process described above in paragraph 4.17-4.19, we are satisfied that BT EE, VMO2 and Vodafone have met the conditions concerning the locations of added coverage and the sites supporting this coverage.
- 4.24 We note that in respect of coverage which has been added in TNS areas which is gained by deploying on sites located in a Full Coverage area, our initial assessment found VMO2 had exceeded the 0.3% limit set out in the licence by approximately 0.25%. VMO2 subsequently informed us that the majority of such coverage locations are also provided with coverage from sites located in PNS areas (in line with the licence conditions). We have considered the further information provided by VMO2 and consider the 88% geographic coverage requirements are met.
- 4.25 We are also satisfied that MNOs have not relied on publicly funded coverage (e.g. EAS sites) to meet their obligations and that the additional coverage that they have provided in Total Not Spots does not at this point seem to limit their ability to provide another 1% of coverage in Total Not Spots by January 2027. We note, in particular, that the MNOs have collectively provided around 3.5% new coverage in areas that were Total Not Spots in 2020, and that more than 1% of landmass remains available as TNS. We will assess compliance with the Total Not Spot Requirement falling due on 31 January 2027 once this deadline has expired.
- 4.26 In conclusion, we have found that:

²⁵ The prediction error (in dB) is defined as the predicted signal strength subtracted from the measured signal strength with positive values indicating that predictions were generally more optimistic than measured values and vice versa.

²⁶ The 800 MHz band provides the largest coverage contribution to the 88% requirement for all MNOs. However, where MNOs have also relied on another frequency band for some of the coverage they provide, we have undertaken an equivalent assessment.

- a) BT EE, VMO2 and Vodafone have met the 88% threshold and the related conditions by 30 June 2024.
- b) Three had not met the 88% UK-wide threshold at the point the obligation fell due.

Initial Nations Requirements

- 4.27 As set out in section 2, by 30 June 2024, each MNO was required to provide, and thereafter maintain, good quality coverage to an area covering at least a specified percentage of the geographic landmass of each of the UK nations.
- 4.28 We also undertook the analysis set out in above in respect of the Initial Nations Requirements and confirm the following MNOs’ coverage predictions against their Initial Nations Requirements:

Table 5: MNOs’ Initial Nations Requirements and their reported coverage levels²⁷

MNO-specific thresholds and MNOs’ predictions	BT EE	Three	VMO2	Vodafone
Threshold for England	93%	91%	92%	92%
MNOs’ predictions for England	95%	95%	94%	94%
Threshold for Northern Ireland	89%	91%	91%	93%
MNOs’ predictions for Northern Ireland	89%	95%	93%	95%
Threshold for Scotland	75%	72%	75%	76%
MNOs’ predictions for Scotland	78%	71%	78%	79%
Threshold for Wales	83%	83%	82%	82%
MNO’s prediction for Wales	87%	84%	83%	82%

Summary of key findings

- 4.29 In summary, our main findings are as follows:
- a) BT EE, VMO2 and Vodafone have met the 88% UK-wide threshold and each of their individual nations thresholds;
 - b) As of 30 June 2024, Three had met its nations thresholds for England, Wales and Northern Ireland, but not for Scotland and it had not met the 88% UK-wide threshold.

²⁷ Reported coverage levels rounded to nearest full number.

5. Wider outcomes for consumers

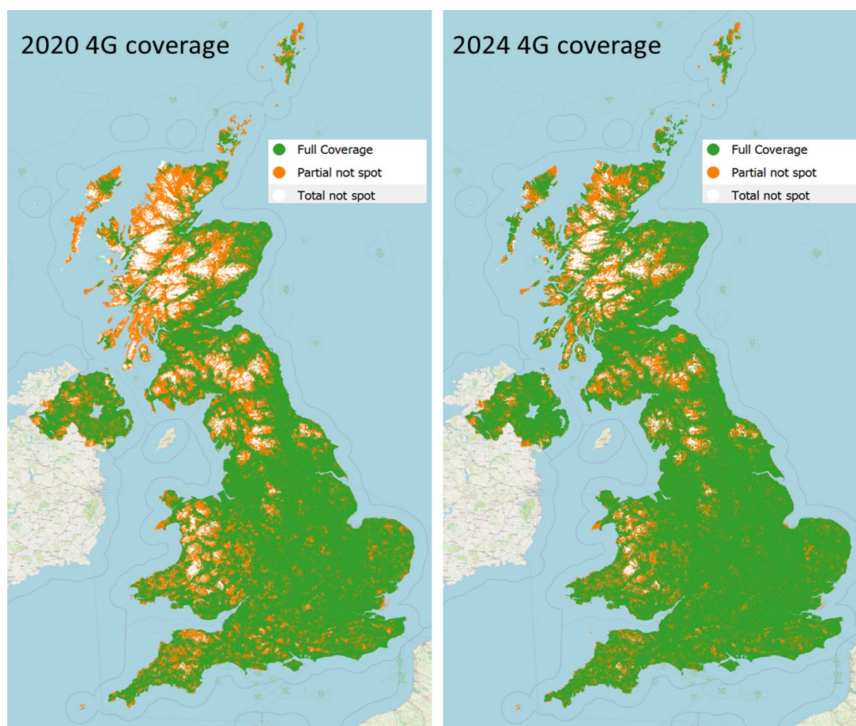
5.1 The preceding analysis focussed on the MNOs’ individual coverage obligations. Whilst this compliance assessment is our core focus, we have also undertaken work to understand how this coverage was delivered and the cumulative effect of this work.

Impact on partial coverage areas

5.2 A key objective at the start of the SRN programme was a reduction in the size and scale of partial not spots (and so increasing the areas of common coverage) as part of improving the mobile experience of people living in and moving through rural areas. Consequently, we have explored the cumulative impact of each MNOs’ progress on the “full coverage” and “partial not spot” footprints today, compared with the position in early 2020.

5.3 Our analysis indicates that MNOs have collectively added a significant amount of new coverage since the SRN work commenced in March 2020, and increased the areas of common or “full coverage” from 66% of the UK in early 2020 to more than 78% today. At the same time the scale of partial not spots have reduced from approximately 25% of the UK in 2020 to approximately 17% of the UK in July 2024.²⁸

Figure 4: Evolution of partial and total not spots, and full coverage areas (4G) from the beginning of the SRN programme (2020) to today (2024)



²⁸ The reduction in PNS is not commensurate with the increase in Full Coverage because some MNOs have also brought coverage to entirely new locations. As a result, Total Not Spots have also reduced from just under 9% in 2020 to just over 5% of the UK landmass today. Based on MNOs predictions, we have found that around 94.9% of the UK landmass now has coverage from at least one MNO.

5.4 In total, around 3 million 100x100m pixels (the equivalent of around 30,000 non-contiguous square kilometres) have gone from having no or partial coverage to full coverage across the 4 MNOs. Whilst for individual consumers, it is the coverage extent of their individual network provider that determines much of their experience, this means that there are now many more locations where consumers have more choice. It also means there are many fewer rural locations with patchy or limited coverage than in 2020.

Approaches to increasing coverage and links to consumer experience

- 5.5 The coverage added as part of the SRN programme to date has been delivered in a range of different ways. In some areas this could lead to a step change in consumer experience (for example where a new site has been accessed or new spectrum has been deployed) while in other cases impacts may be more incremental and felt across a smaller area.
- 5.6 By focussing our drive test approach in areas where MNOs had added coverage, we sought to ensure that we sampled a broad mix of these different upgrade approaches in undertaking our assessment.
- 5.7 We summarise the most common SRN related site developments reported to us by the MNOs in Table 6 below, for locations classified as partial not spots in 2020 (where the bulk of the coverage was added).^{29 30}

Table 6: Most common SRN related site developments in partial not spots

Type of Network Upgrade	Reported Volume in Partial Not Spots
New site shared between MNOs	>400
Additional power (EIRP) on an existing site ³¹	>300
Additional spectrum on an existing site	>250
Deploying radio equipment on an Extended Area Service (EAS) site (not funded under the SRN Grant Agreement)	>50
Additional spectrum on an existing site combined with additional EIRP	>50
Joining an existing site owned by a Wireless Infrastructure Provider	>50
New shared site combined with Reference Channel Power Boosting ³²	>30
Joining an existing site owned by another MNO	>30

²⁹ We have aggregated this data to provide a more general sense of the works undertaken, based on the most common sets of works reported to us. Note that we have counted each MNOs contribution individually, so a new shared site with 2 MNOs would count twice in our data.

³⁰ MNOs also provided us with information on a wider set of works undertaken in 'Full Coverage' areas. Some of this activity will have contributed to SRN, but as many of the deployments were in cities such as London and Birmingham, we have not included it in this overview of SRN activity. MNOs also reported some activity in Total Not Spot areas, although this mostly related to a very small number of sites (with more than 70 reported upgrades to EAS sites being the most common measure in TNS areas).

³¹ Equivalent Isotropic Radiated Power (see footnote 18).

³² Reference Channel Power Boosting is a mechanism for allocating a greater share of a site's overall power to the reference signal that helps a base station and device establish a connection.

Other optimisations (for example changes in antenna tilt, or antenna swaps)	>600
---	------

- 5.8 This overview does not provide a complete analysis of all the works that MNOs have undertaken, but is intended to help inform stakeholders by highlighting the different approaches taken, and the different ways in which coverage will have improved.

Future challenges

- 5.9 We note that whilst our assessment suggests that significant progress has been made expanding coverage across the MNOs, there remain locations where good quality coverage is still not present. We also acknowledge that whilst we have assessed the MNOs coverage predictions to be reasonable, in some locations the on the ground experience will differ from what is predicted, and that our analysis reflects the methodology established at the time of the SRN agreement in 2020.
- 5.10 Ensuring good mobile coverage in the places people live, work and travel remains a priority for Ofcom, and we will continue to monitor MNOs compliance with these commitments in the coming years. Ofcom is also continuing work to explore whether other forms of information about mobile coverage can be used to improve the accuracy of information made available to consumers.

6. Next steps

BT EE, VMO2 and Vodafone

- 6.1 We are today confirming that BT EE, VMO2 and Vodafone have met the 88% UK-wide threshold and their individual nation thresholds for each UK nation.
- 6.2 The coverage obligations that fell due on 30 June 2024 remain ongoing requirements. We will therefore continue to monitor the MNOs' compliance over time. We expect to do so through the work we undertake for the purposes of our regular Connected Nations reports and online mobile coverage checker.
- 6.3 We recognise that the MNOs' network rollout is not static and that since we obtained evidence from the MNOs to inform our analysis, some further coverage may have been delivered. We will report on any further progress in MNOs coverage levels in our annual Connected Nations report later this year.

Further analysis in respect of Three

- 6.4 As set out in section 4, as of 30 June 2024, Three had not met the UK-wide 88% geographic obligation and its required threshold for Scotland (72%).
- 6.5 On 8 August 2024, we asked Three to explain the steps it would take to increase its coverage to the relevant thresholds and to state the date by which it would meet such thresholds.
- 6.6 On 22 August 2024, Three informed us that, as of that date, they considered they had met the outstanding thresholds.
- 6.7 We note that based on the information Three provided in July 2024, we have so far found their coverage predictions to be reasonable. However, we will now carry out further analysis to verify Three's coverage (including our assessment of the SRN coverage location requirements). We expect to publish an update on our assessment of Three's progress and any next steps in the coming months.

2027 SRN coverage obligations

- 6.8 As set out in section 2 (paragraphs 2.3-2.4 and 2.6), the SRN obligations also include a set of requirements which will fall due on 31 January 2027.
- 6.9 In line with our [methodology](#) (paragraphs 4.9-4.10), Ofcom has already undertaken an assessment of a single model that the MNOs have provided to Ofcom to enable us to measure compliance with their requirement to add at least 1% coverage in TNS areas by 31 January 2027. We expect to undertake a further assessment of the MNOs' compliance with these additional SRN obligations at the point they fall due.