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Connected Nations 2018

Annex A: Methodology section

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About this document

This is the methodology section of the Connected Nations report explaining the process, data sets and assumptions used in compiling and presenting data.

A1. Methodology

A1.1 This annex explains our approach to obtaining and analysing information from operators for the purposes of our Connected Nations report.

A1.2 The report uses data gathered from the communication operators in each sector, as well as information already held by Ofcom.

Fixed broadband networks

Coverage

A1.3 Our data on coverage of fixed broadband services is collected from a number of operators (see A3 fixed network providers). In 2018 operators were asked to provide data for each address where a service was provided. This was provided with a reference date of 1 September 2018.

A1.4 For the overall coverage of fixed broadband we have identified the number of UK residential and small business premises. For 2018 we have used a premise base of 29.3 million.

A1.5 We use premises data from the Ordnance Survey (OS) Addressbase® Premium dataset[1] (August 2018, Epoch 60) and the OS Addressbase® Islands dataset[1] (August 2018, Epoch 60). This is combined with additional geographic classifications from the ONS National Statistics Postcode Lookup (NSPL)[2] (August 2018) and Urban and Rural categories derived from the Locale classification.[3]

A1.6 The identification of premises is based on delivery point locations, excluding PO boxes and large organisations. Additionally, unless otherwise specified, the analysis only includes premises that are recorded as approved and constructed.

A1.7 This approach is the same applied throughout the Connected Nations report series. In addition to the delivery point base, which is derived from the Royal Mail Postcode Address File® data set, premises may be identified by Local Authorities as an addressable location. These records are not counted in the premise base.

A1.8 Since the last full Connected Nations report in December 2017, we have provided two additional updates, which used:

- OS Addressbase® Premium and Islands January 2018, Epoch 55 for the Spring Update[4]
- OS Addressbase® Premium and Islands March 2018, Epoch 57 for the October Update[5]

[1] https://www.ordnancesurvey.co.uk/business-and-government/products/addressbase-products.html
[2] http://www.ons.gov.uk/ons/guide-method/geography/products/postcode-directories/-nspp-/index.html
[3] http://www.bluewavegeographics.com/images/LOCALE_Classification.pdf
[4] https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-update-spring-2018

A1.9 The availability of address-level data allows us to create a comprehensive data set describing the characteristics of all available services and operators present at premises across the UK. Many operators provided a unique property reference number (UPRN), a common identifier available for use in the UK. Other operators provided address information that would need to be processed and linked to our premise base. Over 52 million records were received from operators and 99.6% of our uniquely identified premise base was matched using UPRN or building address reference.

A1.10 Of the remaining 0.4% of premises not matched by UPRN or building address information, a postcode level estimate was applied where, providing that a postcode unit contained at least one matched premises, any non-matched premises were assigned the best available coverage. This method was applied to 115,000 premises (0.4% of the total of uniquely identified premises).

A1.11 Our base for residential and small and medium enterprises used in coverage calculations is 29.3m premises.

A1.12 Where we report on the availability of superfast broadband for SMEs, we have used an address match process to link our premise base to a business classification. For 2018 our SME premises base, with between one and 249 employees is 2.7 million. Data is based on the Blue Sheep Business Universe.[6]

Calculating availability

A1.13 Each operator provides information on the technology available together with predictions of download and upload speeds. After the address matching process these characteristics are assigned to each premise to enable further detailed analysis to be undertaken. We apply thresholds in our analysis to investigate different patterns of provision. For coverage we have used the maximum predicted download speed available at a premise to determine in which broadband category a premise is represented.

A1.14 Since the first Connected Nations report in 2011, we have tracked the progress of superfast broadband roll-out. We use 30 Mbit/s download speeds as the threshold for defining superfast services. We use the term 'Ultrafast' for services offering download speeds of 300Mbit/s or higher.

A1.15 We also monitor the proportion of premises that do not have access to a decent broadband service, defined as a service capable of delivering a download speed of at least 10Mbit/s and an upload speed of 1Mbit/s. Additionally, in this update we include all unmatched and unclassified premises as not having access to a decent broadband service.

A1.16 During 2018 we collected information from 12 additional communication providers who deliver fibre to the premise services. The inclusion of their data contributed additional full fibre coverage to over 100,000 premises across the UK.

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[5] https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-update-2018-october

[6] http://www.allmapdata.com/products/digital-map-data/business-poi/blue-sheep-poi/

Performance metrics, speeds and data use

A1.17 We gathered data from many of the fixed broadband internet service providers (see A3 fixed network providers) on both their retail services and the services they provide to other ISPs as a wholesale service. This was provided with a collection date of 1st to 30th May 2018. This is one month earlier than in previous reports to align the timing of performance and coverage data.

A1.18 Our analysis of broadband speeds is based on the information provided by these ISPs regarding the sync speed of each active line. This gives a measure of the maximum possible connection speed achievable between the ISP's access network and the consumer premises. Line speed measurements are typically a few Mbit/s lower than sync speed measurement, and they typically vary throughout the day depending on the level of congestion in the ISP's network.

A1.19 This data was collected at the address-level and by line identifier and involves a more complex matching process. In addition to matching records via the UPRN or address to our premise base, we also need to match wholesale providers including BT Group, Sky, TalkTalk and Vodafone) to the Openreach infrastructure using either a line identifier (where these are common) or via address matching. Of the 25.3 million records received, 94.6% (23.9m) could be allocated to geographic locations using a UPRN address or postcode matching process. Due to changes in data systems across providers a proportion of lines could not be matched accounting for 1.3m records (5% of all records).

A1.20 Moreover, a premise is considered in our analysis if any line associated with that premise has a measured speed greater than zero. A total of 23.7m records met this criterion and were used in line performance and data usage calculations. Of these records 23m could be assigned to a geographic location. Overall UK figures include all 23.7m records, whilst geographic analyses by rurality and region use the 23m records.

A1.21 Our estimate of take-up is based on the total number of lines reported, compared to all premises.

A1.22 Our analysis of data use is calculated from the amount of data downloaded and uploaded on each line as reported by operators. We also collected data on the total data use between the hours of 6pm and midnight, to assess data use at 'peak times'. Our analysis considers all lines where the amount of data downloaded was greater than zero.

Mobile

Coverage

A1.23 Our data on the coverage of mobile networks were collected from the four mobile network operators, EE, O2, Three and Vodafone (see A3 mobile network operators) as 100m x 100m pixels referenced against the Ordnance Survey Great Britain (OSGB) grid system, for their coverage as at 1st September 2018 for 2G, 3G and 4G networks. Premises coverage is calculated from the base of 29.3 million premises derived from the OS Addressbase®

Premium dataset[7] (September 2018 version, Epoch 60), OS Addressbase® Islands dataset[7] (August 2018, Epoch 60).

A1.24 In addition, geographic identifiers are added from the ONS NSPL[8] (August 2018 version) and Urban and Rural categories are added from the Locale classification[9]. Roads data is taken from Ordnance Survey[10] and Northern Ireland Land & Property Services Open Data sources[11].

A1.25 As highlighted in our Connected Nations October update[12], we noted some differences in EE's 3G signal strengths and Ofcom's drive testing measurements. Separately, we also identified an underprediction of signal levels for Vodafone's 4G services. EE and Vodafone have subsequently revised the data that is provided to us in producing this report. Also in this report, we have used re-submitted 3G coverage data from EE and we have applied a signal strength offset of +6 dBm to 4G coverage data previously submitted by Vodafone to recalculate coverage for June 2017, May 2018 and January 2018.

A1.26 We apply the technology-specific thresholds to each of 100m x 100m pixels to determine whether a sufficiently strong signal is available to successfully make a phone call or send or receive data. These pixels are aggregated to provide an estimate of either the landmass or the number of premises that are covered by the corresponding mobile technology.

A1.27 In 2018 measurement work to identify the minimum coverage level (the technology-specific threshold) required to deliver a good quality of experience to consumers on the 4G network has been undertaken. We have identified minimum coverage levels for 2G and 3G networks, which allows us to present a consistent view of coverage on all these networks to consumers.

A1.28 For 2G, 3G and, now, 4G networks, we define coverage based on the minimum signal strength required to deliver a 98% probability of making a 90 second telephone call successfully. In the case of 4G specifically, our definition also delivers a 98% chance of getting a download speed of at least 2Mbit/s.

A1.29 We use the signal strength thresholds shown in Figure 1 when estimating coverage.

[7] https://www.ordnancesurvey.co.uk/business-and-government/products/addressbase-products.html
[8] http://www.ons.gov.uk/ons/guide-method/geography/products/postcode-directories/-nspp-/index.html
[9] http://www.bluewavegeographics.com/images/LOCALE_Classification.pdf
[10] https://www.ordnancesurvey.co.uk/business-and-government/products/os-open-roads.html
[11] https://www.opendatani.gov.uk/dataset/osni-open-data-50k-transport-line1
[12] https://www.ofcom.org.uk/__data/assets/pdf_file/0019/122194/connected-nations-october-2018.pdf

Figure 1. Mobile strength thresholds

Service		Metric	Outdoor	Indoor and in-car
2G		RxLev	-81dBm	-71dBm
3G		RSCP CPiCH	-100dBm	-90dBm
4G		RSRP	-105dBm	-95dBm
Voice:	2G	RxLev	-81dBm	-71dBm
	3G	RSCP CPiCH	-100dBm	-90dBm
	4G	RSRP	-105dBm	-95dBm
Data:	3G	RSCP CPiCH	-100dBm	-90dBm
	4G	RSRP	-115dBm	-105dBm

Data use

A1.30 This data was collected in May 2018 and included information on the amount of data uploaded and downloaded on each mobile cell in these networks. The geography of data traffic is defined by the location of the associated mobile cell base station.

Urban and rural classifications

A1.31 We have used the Locale[13] classification to identify premises as being in an urban or rural area. Locale is a third-party data source based on the analysis of 2011 census output areas (OAs). Each OA is assigned to one of seven Locale Groups using a combination of Government conurbation definitions, population density at the OA- and postcode sector-levels, urban sprawl boundaries, OS roadmaps and additional visual inspection.

A1.32 We assign the Locale classifications to either Urban or Rural based on the following:

- Urban: Codes A to C relate to settlements with populations over 10,000 and codes D to E relate to settlements with populations over 2,000
- Rural: F to G relate to settlements with populations under 2,000

A1.33 For fixed broadband analysis each premise is assigned to a census output area via its postcode. For mobile analysis, each pixel is assigned to a census output area through a spatial comparison of the pixel OSGB coordinate to the corresponding census output area polygon. The Locale urban and rural classification is then matched to these records via the census output area.

[13] http://www.bluewavegeographics.com/images/LOCALE_Classification.pdf

Fixed Wireless Access

A1.34 Our analysis of Fixed Wireless Access coverage includes data from 12 providers, five of whom provided data relating to their network in May 2018 and seven of whom provided data relating to their networks in September/October 2018. This data relates to the location and technical characteristics of their network infrastructure and details their service provision to customers.

A1.35 We apply a modelling method to this data to assess each provider's network coverage. The modelling method is based on ITU-R P.530 recommendations which are appropriate to the line-of-sight systems used by Fixed Wireless Access providers.

A1.36 We initially evaluate the probability of establishing line-of-sight links between a provider's mast sites, or access points, and potential customer premises. This considers the maximum range served by each access point based on the technical data submitted and then uses the databases described in A1.5 to determine the premises within reach of each access point. We then evaluate the viability of establishing a line-of-sight link by performing a geometrical analysis of the path between the access point and each premise; this uses information from a clutter database[14] to account for differences in the terrain and surface clutter along the link.

A1.37 If a link can be established, we then evaluate its ability to support different broadband speeds based on its length, i.e. the distance between the provider's access point and the potential customer's premises. Longer links typically have lower probabilities of receiving faster broadband speeds due to the antenna's power fading across longer distances and impacted by the atmosphere along the link.

A1.38 The results of our analysis indicate whether premises have a high, medium or low chance of receiving decent or superfast broadband speeds. We do not provide granular detail about the broadband speeds consumers may be able to receive from FWA networks because the quality of service delivered can be impacted by many external factors, for example environmental conditions or interference from nearby systems.

A1.39 Figure 2 lists the FWA providers we contacted in 2018; those highlighted in green are those providers which submitted network data which has been analysed and included in our results. We invite any FWA providers which have not yet submitted data or are not listed in the table to contact us at connectednationsreport@ofcom.org.uk.

[14] https://www.getmapping.com/products/height-data/height-data-getmapping

Figure 2. Fixed Wireless Access providers contacted by Ofcom in 2018

Air Broadband	Gigabair	Orbital Net
Air Fibre	Gigabeam	Pine Media
Airband	Green Grass Broadband	Pure Broadband
APC Solutions (UK)	Hebrides.net	Quickline Communications
Back of Beyond Broadband	Highland Community Broadband	Rapid Rural
Badenoch Broadband	Highland Wireless	RedRaw
Beacon Broadband	HiWiFi	Reeth Rural Radio Net
Beeline Broadband	Husky Networks	ResQNet
Big Blue Rocket	I Need Broadband Ltd	Rural Comms
Bitstreme	Inifi	Save9
BLAZE Wireless	Internet Central	Secure Web Services
Bliss Internet	ITSwisp	Skyenet
Bluebox Broadband	JHCS	SkyLight Broadband
Bluewave internet	Jibba Jabba	Solway Communications
Bogons Ltd	Juice Broadband	Speednet Scotland
Boundless Networks	Karma Computing	Superhero Broadband
Briskona	Kencomp	Swindon Wireless
Broadway Partners	Legend Telecom	ThinkingWISP
Bush Broadband	Locheilnet	UltraNetworks
Buzcom	LonsdaleNET	Unify Wireless
Call Flow	Loop Scorpio	Userve Internet
Caudata	Lothian Broadband	Vfast internet
Clear Picture	Luminet	Village Networks
Cloud Wireless	M24Seven	Virair networks
Cloudnet Solutions	Marykirk Community Broadband	Vispa
Converged Communication Solutions	Millennium Telecom	Voip Unlimited
Countryside Broadband	Moorsweb	Voneus
County Broadband	Morespeed	W3Z Broadband
Cromarty Firth Wireless Networks	MyComms	Wessex Internet
Derbyshire Broadband	N.I Technology Ltd	West WiFi
Dyfed Superfast	N3	Wight Wireless
Fibre Wifi	Net1	Wildanet
Fibrecast	NotSpot	Wisper Broadband
Fram Broadband	Optimity	WiSpire

A2. Glossary

2G Second generation of mobile telephony systems, launched in the UK in 1992. Uses digital transmission to support voice, very low-speed data communications, and short messaging services.

3G Third generation of mobile systems, launched in the UK in 2003. Provides low-speed data transmission and supports multi-media applications such as video, audio and internet access, alongside conventional voice services.

4G Fourth generation of mobile systems, launched in the UK in 2012. It is designed to provide faster data download and upload speeds on mobile networks and can also support VoIP services

Access network An electronic communications network which connects end-users to a service provider; running from the end-user's premises to a local access node and supporting the provision of access-based services. It is sometimes referred to as the 'local loop' or the 'last mile'.

Base station This is the active equipment installed at a mobile transmitter site. The equipment installed determines the types of access technology that are used at that site.

Broadband A data service or connection generally defined as being 'always on' and providing a bandwidth greater than narrowband connections.

Decent Broadband A data service that provides download speeds of at least 10Mbit/s and upload speeds of at least 1Mbit/s.

Full Fibre coverage Services that provide a fibre optic cable from the exchange to the end user's home or office. In 2018 we have modified this definition to: where the network has been rolled out to a “lead-in” that will serve the consumer end premise and where the consumer would expect to pay a standard installation charge for that connection.

IP Internet Protocol. This is the packet data protocol used for routing and carrying data across the internet and similar networks.

ITU-R International Telecommunications Union Radiocommunication Sector. One of the three sectors of the ITU, responsible for radio communication.

ITU-T International Telecommunications Union Telecommunication Standardization Sector. One of the three sectors of the ITU, responsible standards in telecommunications.

Not-spot An area which is not covered by fixed or mobile networks.

Superfast broadband A data service that can deliver download speeds of at least 30 Mbit/s.

Ultrafast broadband A data service that can deliver download speeds of at least 300 Mbit/s.

Voice (Mobile) Mobile voice services where nearly all 90-second calls are completed without interruption from any of 2G, 3G or 4G mobile services.

VoIP Voice over Internet Protocol. A technology that allows users to send calls using internet protocol, using either the public internet or private IP networks.

A3. Obtaining information from providers

A3.1 Ofcom requested data from communication providers using our powers under section 135 of the Communications Act 2003 and Regulation 17 of the Statutory Instrument 2016/607.

A3.2 Under section 134A and 134B of the Act[15] Ofcom is required to prepare a report for "each relevant period", as defined in section 134A(4) of the Act, that deals with the electronic communications networks matters listed in section 134B(1), and the electronic communications services matters listed in section 134B(2), of the Act.

Fixed network providers

A3.3 The following fixed network providers supplied data for use in this report:

- B4RN
- Bridge Fibre
- BT Group
- Cablecom Glide
- Call Flow
- CityFibre
- Community Fibre
- Gigaclear
- Hutchinson 3G UK Limited ("Three")
- Hyperoptic
- IFNL
- ITS
- KCOM
- Openreach
- Sky
- Spectrum Internet
- TalkTalk
- Truespeed
- Virgin Media
- Vodafone
- VX Fibre
- Wessex Internet
- Wight Fibre

[15] Sections 134A and 134B of the Act, as amended by Section 1 of the Digital Economy Act 2010, can be found here: https://www.legislation.gov.uk/ukpga/2010/24/section/1

Mobile network operators

A3.4 The following mobile network operators supplied data for use in this report:

- Everything Everywhere (“EE”)
- Hutchinson 3G UK (“Three”)
- Telefónica UK (“O2”)
- Vodafone.