

NET CHECK

UK CITY BENCHMARK 2025

Mobile Network Performances in Big Cities: Liverpool, Manchester, Glasgow

3rd September 2025 - 11th October 2025

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ABOUT NET CHECK

NET CHECK was founded in 1999 to improve the quality of communication networks.

Since then, NET CHECK has become one of the leading partners of network operators and infrastructure providers in the operation and optimisation of mobile and fixed communication networks of all technologies.



NET CHECK's core competencies include international network benchmarking (comparative measurements), network planning and fault analyses, covering drive test services, optimisation, site audit, network planning, rollouts, upgrades, swaps, root cause analysis, and advanced custom reporting



NET CHECK is part of the NC Group, headquartered in Berlin (Germany), and independent of any industry stakeholders. It is a trusted partner of scientific and government institutions due to its high level of expertise, data quality and security.



To ensure the sustainability and reproducibility of reliable results in repeating campaigns, NET CHECK has implemented an ISO-certified management system and approved its testing and post-processing procedures according to telecommunication industry standards.

The criteria according to which the network operators are assessed and the benchmarking created are determined exclusively by NET CHECK's experts. They follow the NET CHECK benchmarking methodology and are the same for all countries and test areas. The network operators have no influence on the routing of the tests within the test area. They also have no influence on the timing of the tests within the test period.

MEASUREMENT EQUIPMENT

NET CHECK places a strong emphasis on utilizing high quality, cutting-edge measurement technology for all tests.



DRIVE TESTING

Measurement equipment for drive testing: SwissQual Benchmark II (Rohde & Schwarz)

The measuring equipment was placed in the roof boxes of two passenger cars collecting data on the performance of voice and data services during the tests. They are cooled down to avoid overheating due to sun and extensive use.

This approach allows performance measurement for all the operators simultaneously and on the same locations.



BENCHMARKING METHODOLOGY

The NET CHECK testing methodology strives to provide an accurate, unbiased, and balanced assessment of network performance. It is based on ETSI (European Telecommunications Standards Institute) and has been successfully implemented in various countries and by different network operators.

To ensure that sample collection provides a representative view of the network performance across different-sized communities the following approach is used:



For nationwide rankings, drive tests cover big, medium and small cities, motorways, main roads and rural roads. The measuring equipment is placed in the roof boxes and collects data on the performance of voice and data services.



Measuring various KPIs (Key Performance Indicators) for voice and data services, NET CHECK's goal is to present real customer experience, as users perceive it when using a mobile communications network. Operators can earn a maximum of **1000 points**, with **350 points** for voice services and **650 points** for data services.



The network operator receives ranking points based on the measured KPI value. Each KPI can contribute a predefined number of ranking points.

THE RANKING



The ranking may reflect KPI values from all tests performed throughout the benchmark campaign, or just from tests conducted in a specific city. Thus, the ranking can be an overall ranking or a per-city ranking.



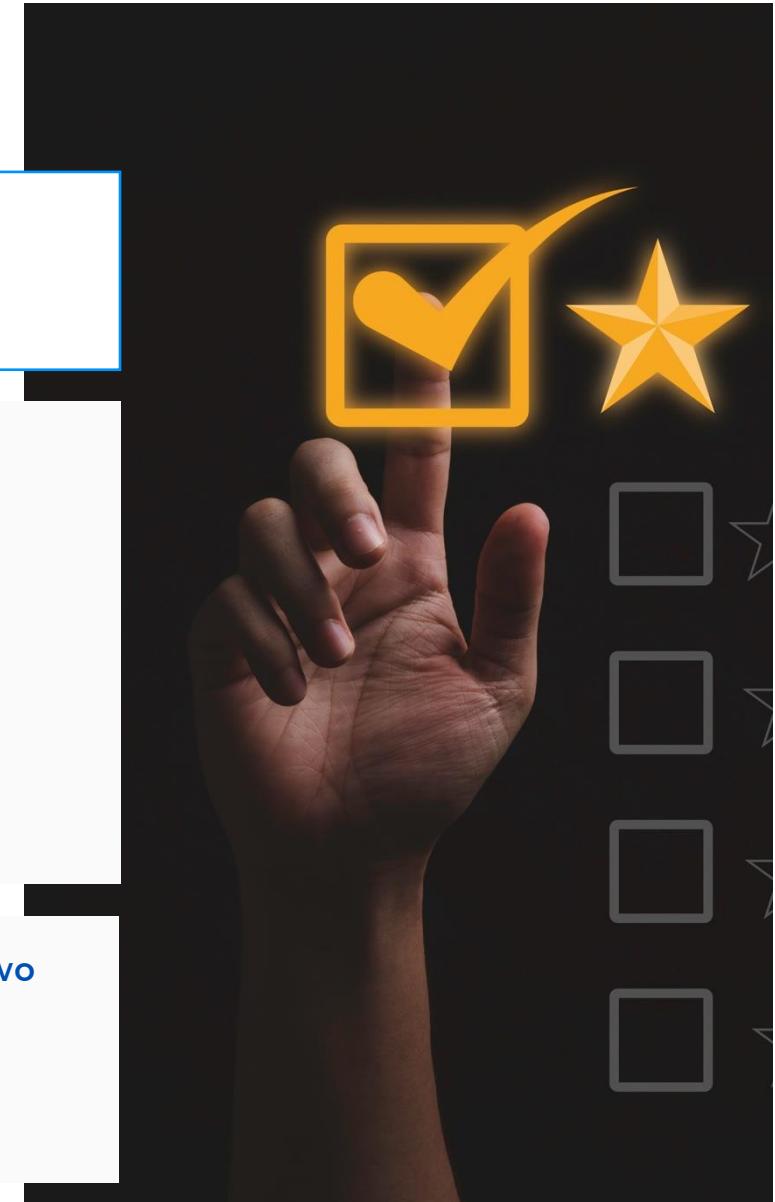
The purpose of any benchmark is to evaluate customer experience. While no two customers are alike, years of benchmarking have been revealed two broadly distinct customer profiles:

- **Profile 1:** A mobile network user who values all available aspects of modern mobile communication. This user relies on both OTT applications traditional voice calls, browses the internet, uploads and downloads files, engages in online meetings and e-gaming, and expects highest quality across all use cases.
- **Profile 2:** A mobile network user who appreciates the availability and the reliability of the communication more than the variety of options and peak performances.



To evaluate network performance from the perspectives of both customer personas, two rankings with different sets of ranking KPIs and corresponding weights are defined:

- 'The Best Network' ranking
- 'The Most Reliable Network' ranking



KPI DESCRIPTION

Voice KPIs

CLASSIC CALLS

Call Success Ratio [%]*	Percentage of successful calls
Average Call Setup Time	Average time to establish a call
Call Setup Time > 15s Ratio	Percentage of successfully established calls where call establishment lasts more than 15s
POLQA <= 1.6 Ratio*	Percentage of speech samples with voice signal quality (MOS) of 1.6 or lower
POLQA AVG (MOS)	The average value of the voice signal quality (MOS)
Disturbed and Impaired Call Ratio	Percentage of all successfully connected voice calls where 3 or more consecutive speech samples, or 5 or more speech samples in arbitrary order are evaluated with POLQA ≤ 1.6 MOS, or are perceived as completely silent speech samples

WHATSAPP CALLS

Call Success Ratio *	Percentage of successful calls
POLQA <= 1.6 Ratio*	Percentage of speech samples with voice signal quality (MOS) of 1.6 or lower
POLQA AVG (MOS)	The average value of the voice signal quality (MOS)
Disturbed and Impaired Call Ratio	Percentage of all successfully connected voice calls where 3 or more consecutive speech samples, or 5 or more speech samples in arbitrary order are evaluated with POLQA ≤ 1.6 MOS, or are perceived as completely silent speech samples

MULTIRAB DATA

MultiRAB Data Success Ratio	Percentage of successfully completed data transfers during the duration of the voice service
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* KPI used for 'The Most Reliable Network' ranking

Data KPIs

DOWNLOAD (File Size 10MB)

FDFS DL Success Ratio *	Percentage of successfully completed data download transfer tests
FDFS DL Transfer Time	Average duration of the 10MB file download

UPLOAD (File Size 5MB)

FDFS UL Success Ratio *	Percentage of successfully completed data upload transfer tests
FDFS UL Transfer Time	Average duration of the 5MB file upload

DOWNLOAD (Test Duration 7 seconds)

FDTT DL Throughput > 2Mbps Ratio*	Percentage of tests with average file download speed greater than 2Mbps
FDTT DL Throughput > 5Mbps Ratio	Percentage of tests with average file download speed greater than 5Mbps
FDTT DL Throughput > 20Mbps Ratio	Percentage of tests with average file download speed greater than 20Mbps
FDTT DL Throughput > 100Mbps Ratio	Percentage of tests with average file download speed greater than 100Mbps
FDTT DL MDR P90	90% of total measured tests slower than

UPLOAD (Test Duration 7 seconds)

FDTT UL Throughput > 1Mbps Ratio *	Percentage of tests with average file upload speed greater than 1Mbps
FDTT UL Throughput > 3Mbps Ratio	Percentage of tests with average file upload speed greater than 3Mbps
FDTT UL Throughput > 10Mbps Ratio	Percentage of tests with average file upload speed greater than 10Mbps
FDTT UL Throughput > 20Mbps Ratio	Percentage of tests with average file upload speed greater than 20Mbps
FDTT UL MDR P90	90% of total measured tests slower than

BROWSING (Web Browsing)

Browsing Time To 1MB	The time required to open a 1MB page
Browsing Success Ratio *	Percentage of successfully completed web browsing tests

VIDEO STREAM (YouTube Live Stream HD)

Video Stream Success Ratio *	Percentage of successfully completed video streaming tests
Video Stream TTFP >= 10 s Ratio	Percentage of tests where the video started after 10s or more
Video Stream Irritating Experience Ratio	Percentage of tests with significantly reduced quality of video transmission

INTERACTIVITY (eGaming and Online meeting simulations)

Interactivity Packet Error Ratio	Ratio of erroneous Interactivity test packets
Interactivity Median RTT	Median Round Trip Time of Interactivity test packets

MEASUREMENT SET UP

BIG CITIES

For data services, a total of around 6,700 data samples per operator were collected across 3 selected big cities. For voice services, around 600 test calls were made resulting in a total of around 8,300 speech samples, per operator

VOICE SERVICES

Voice services are tested through sequences consisting of a series of five mobile-to-mobile voice calls:

- o 2 standard calls
- o 2 calls during which a data download session is executed simulating internet usage during a call
- o 1 WhatsApp call

Then the sequence repeats.

DATA SERVICES

Data services are tested through sequences consisting of:

- o Web browsing on frequently visited web-pages
- o Playing a YouTube video
- o Network capacity tests: downloading and uploading files of given sizes or during a given time
- o Interactivity tests: simulating online gaming and online meetings

The sequence repeats during the entire measurement.

	VOICE SERVICES	DATA SERVICES
MEASUREMENT DEVICE	Samsung S25+	Samsung S25+
MEASUREMENT OBJECTIVE	Big Cities	Big Cities
MEASUREMENT SAMPLE	600 calls per operator	6,700 tests per operator
TEST CASE SCENARIO	Max Call Setup Time: 30 (s) Call duration: 120 (s) Call window: 155 (s) Call mode: VoLTE preferred Speech quality: POLQA WB Reference File: English Scenario: <ul style="list-style-type: none"> • 2 x VoLTE preferred • 2 x MultiRAB • 1 x WhatsApp call 	YouTube HD (livestream) Web Browsing: Kepler as static, Amazon, BBC, Google, Wikipedia Instagram, Reddit, TikTok and eBay as dynamic web pages Download and Upload tests: <ul style="list-style-type: none"> • time based (FDTT): DL HTTP 7s / UL UDP 7 (s) • file based (FDFS), HTTP and HTTPS: DL (10MB) / UL (5MB) Online gaming and online meeting simulations
600 test calls	6,700 data samples	

MEASUREMENT SCOPE AND ACHIEVEMENTS

BIG CITIES

DRIVE TESTS



Start: 03.09.2025
End: 11.10.2025

Big Cities:

- Liverpool
- Manchester
- Glasgow

545 km
of Drive Tests

- Liverpool: 186 km
- Manchester: 160 km
- Glasgow: 199 km

KEY RESULTS



Liverpool

In both 'The Best Network' and 'The Most Reliable Network' ranking, Vodafone secures the highest score. In 'The Best Network' ranking, O2 places second, Three ranks third, while EE falls behind due to a lower voice score.

In 'The Most Reliable Network' ranking, O2 comes in second, EE third, while Three is in fourth place.

Manchester

In 'The Best Network' ranking, EE holds the top position, with Vodafone following closely behind, O2 in third, and Three in fourth place.

In 'The Most Reliable Network' ranking, Vodafone achieves the highest score, with EE in second, O2 in third, and Three in fourth place.

Glasgow

In 'The Best Network' ranking, EE achieves the highest score, followed by Vodafone in second place, while O2 ranks third and Three fourth.

In 'The Most Reliable Network' ranking, Vodafone takes the top position, with EE close behind in second place, O2 in third, and Three trailing the other three operators.

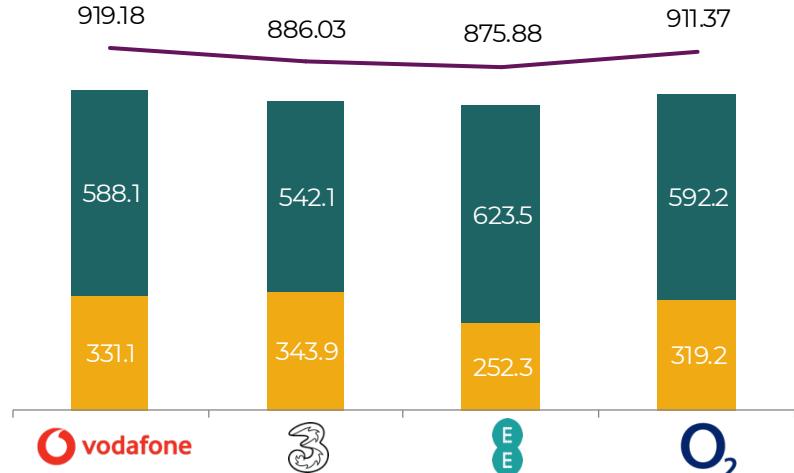
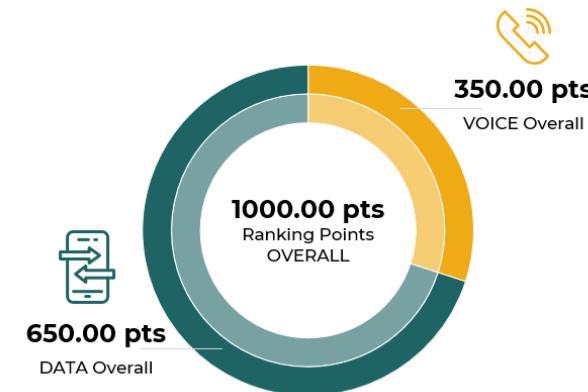
CITY RANKING

RANKING RESULTS: LIVERPOOL

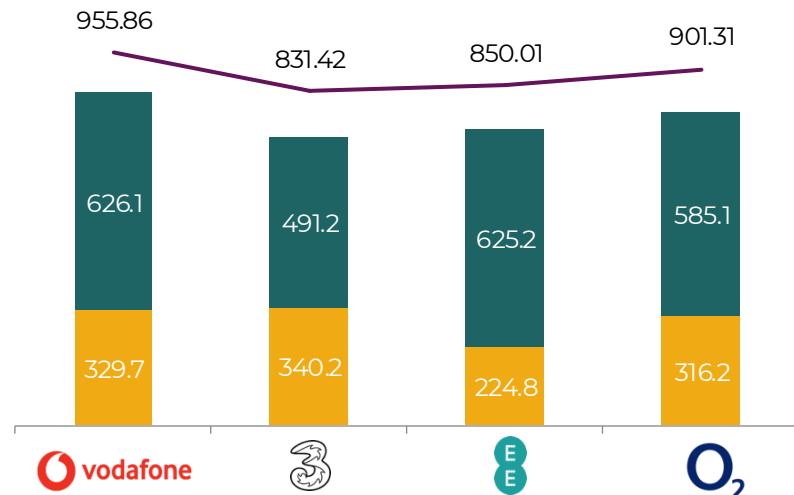
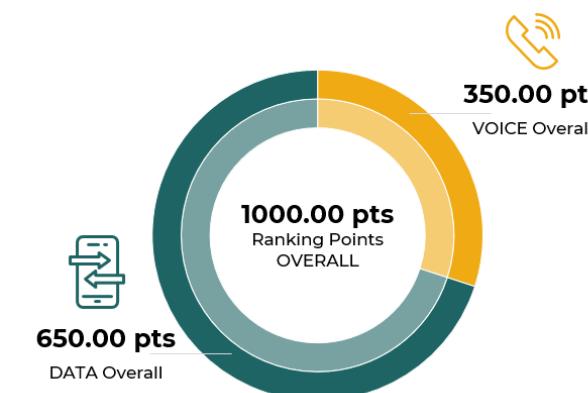
MEASUREMENT ROUTE



'BEST NETWORK' RANKING



'MOST RELIABLE NETWORK' RANKING



■ Voice Overall

■ Data Overall

■ Overall Ranking

KPI RESULTS: LIVERPOOL

VOICE

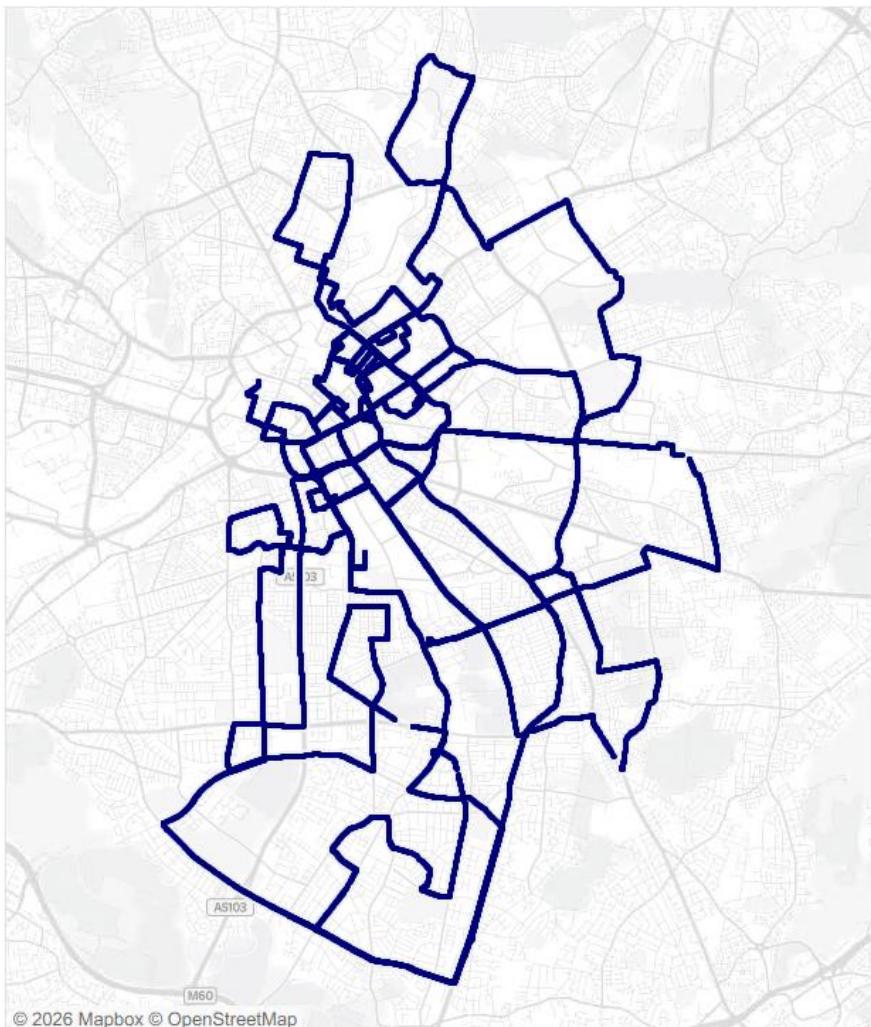
NAME	vodafone	3	E	O ₂
CLASSIC CALLS				
Call Success Ratio (%)	100.00%	100.00%	91.03%	99.35%
Average Call Setup Time (s)	2.44 [s]	1.75 [s]	1.52 [s]	1.71 [s]
Call Setup Time > 15s Ratio (%)	0.00%	0.00%	0.00%	0.00%
POLQA <=1.6 Ratio (%)	0.41%	0.09%	0.40%	0.42%
POLQA AVG (MOS)	4.65 [MOS]	4.67 [MOS]	4.70 [MOS]	4.66 [MOS]
Disturbed And Impaired Call Ratio (%)	0.65%	0.00%	0.00%	0.65%
WHATAPP CALLS				
Call Success Ratio (%)	100.00%	100.00%	100.00%	100.00%
POLQA <=1.6 Ratio (%)	1.07%	1.39%	0.17%	1.92%
POLQA AVG (MOS)	3.92 [MOS]	4.14 [MOS]	4.22 [MOS]	4.08 [MOS]
Disturbed And Impaired Call Ratio (%)	0.00%	0.00%	0.00%	2.44%
Multi RAB DATA				
MultiRAB Data Success Ratio (%)	100.00%	100.00%	100.00%	100.00%

DATA

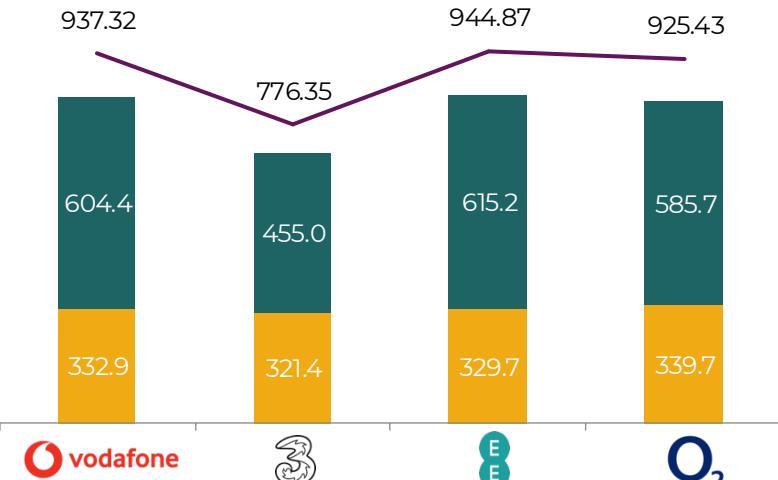
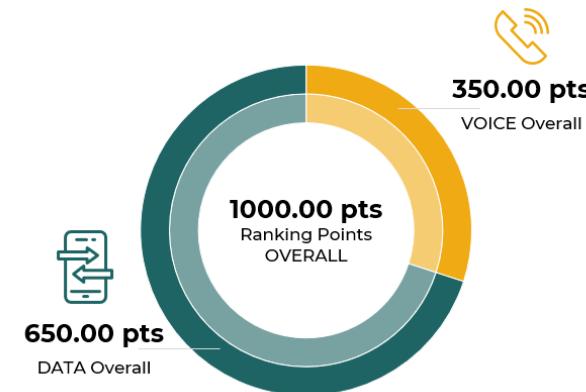
NAME	vodafone	3	E	O ₂
DOWNLOAD (File Size 10MB)				
FDFS DL Success Ratio (%)	100.00%	54.50%	100.00%	99.47%
FDFS DL Transfer Time (s)	2.15 [s]	2.89 [s]	1.17 [s]	1.74 [s]
UPLOAD (File Size 5MB)				
FDFS UL Success Ratio (%)	100.00%	97.88%	99.48%	99.47%
FDFS UL Transfer Time (s)	4.35 [s]	2.74 [s]	1.88 [s]	3.56 [s]
DOWNLOAD (Test Duration 7 seconds)				
FDTT DL Throughput > 2Mbps Ratio (%)	98.94%	98.45%	99.00%	98.97%
FDTT DL Throughput > 5Mbps Ratio (%)	96.83%	96.37%	98.50%	97.44%
FDTT DL Throughput > 20Mbps Ratio (%)	86.24%	81.87%	94.00%	92.82%
FDTT DL Throughput > 100Mbps Ratio (%)	54.50%	62.18%	81.00%	70.77%
FDTT DL MDR P90 (Mbit/s)	273.07 [Mbit/s]	743.18 [Mbit/s]	634.24 [Mbit/s]	342.90 [Mbit/s]
UPLOAD (Test Duration 7 seconds)				
FDTT UL Throughput > 1Mbps Ratio (%)	100.00%	98.92%	100.00%	98.94%
FDTT UL Throughput > 3Mbps Ratio (%)	96.76%	96.76%	98.96%	97.87%
FDTT UL Throughput > 10Mbps Ratio (%)	87.03%	84.32%	91.19%	85.11%
FDTT UL Throughput > 20Mbps Ratio (%)	64.86%	72.97%	80.83%	66.49%
FDTT UL MDR P90 (Mbit/s)	60.72 [Mbit/s]	128.16 [Mbit/s]	82.51 [Mbit/s]	77.72 [Mbit/s]
BROWSING (Web Browsing)				
Browsing Time to 1MB (ms)	1103.17 [ms]	1049.41 [ms]	817.16 [ms]	897.49 [ms]
Browsing Success Ratio (%)	99.89%	99.79%	100.00%	99.27%
VIDEO STREAM (YouTube Live Stream HD)				
Video Stream Success Ratio (%)	100.00%	100.00%	100.00%	99.48%
Video Stream TTFP >= 10 s Ratio (%)	0.53%	1.06%	0.00%	0.00%
Video Stream Irritating Experience Ratio (%)	0.00%	0.00%	0.00%	0.00%
INTERACTIVITY				
Interactivity Packet Error Ratio (%)	11.14%	26.58%	2.01%	2.36%
Interactivity Median RTT (ms)	39.39 [ms]	28.99 [ms]	35.48 [ms]	34.73 [ms]

RANKING RESULTS: MANCHESTER

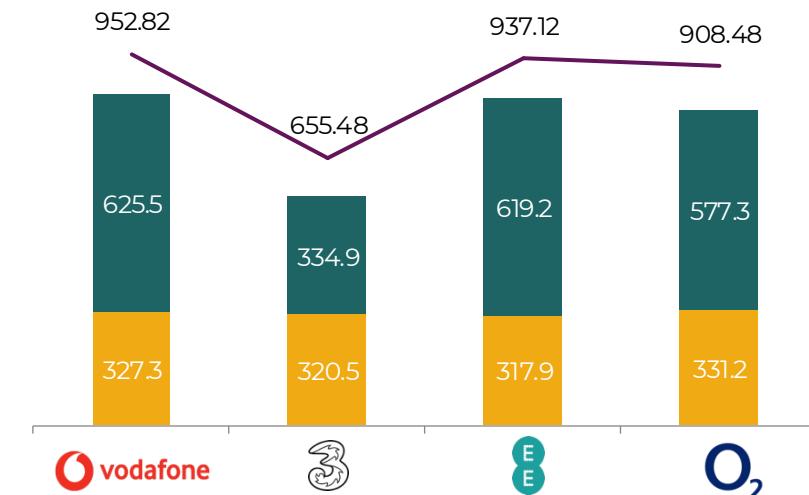
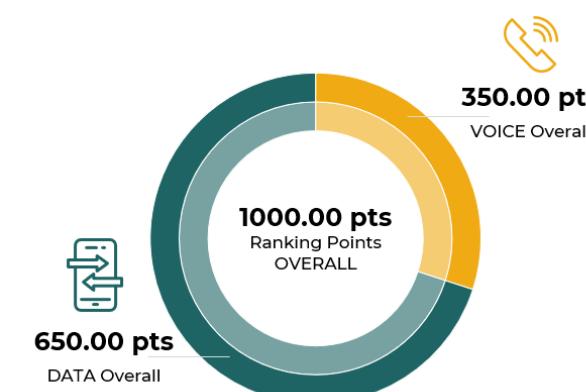
MEASUREMENT ROUTE



'BEST NETWORK' RANKING



'MOST RELIABLE NETWORK' RANKING



Voice Overall

Data Overall

Overall Ranking

KPI RESULTS: MANCHESTER

VOICE

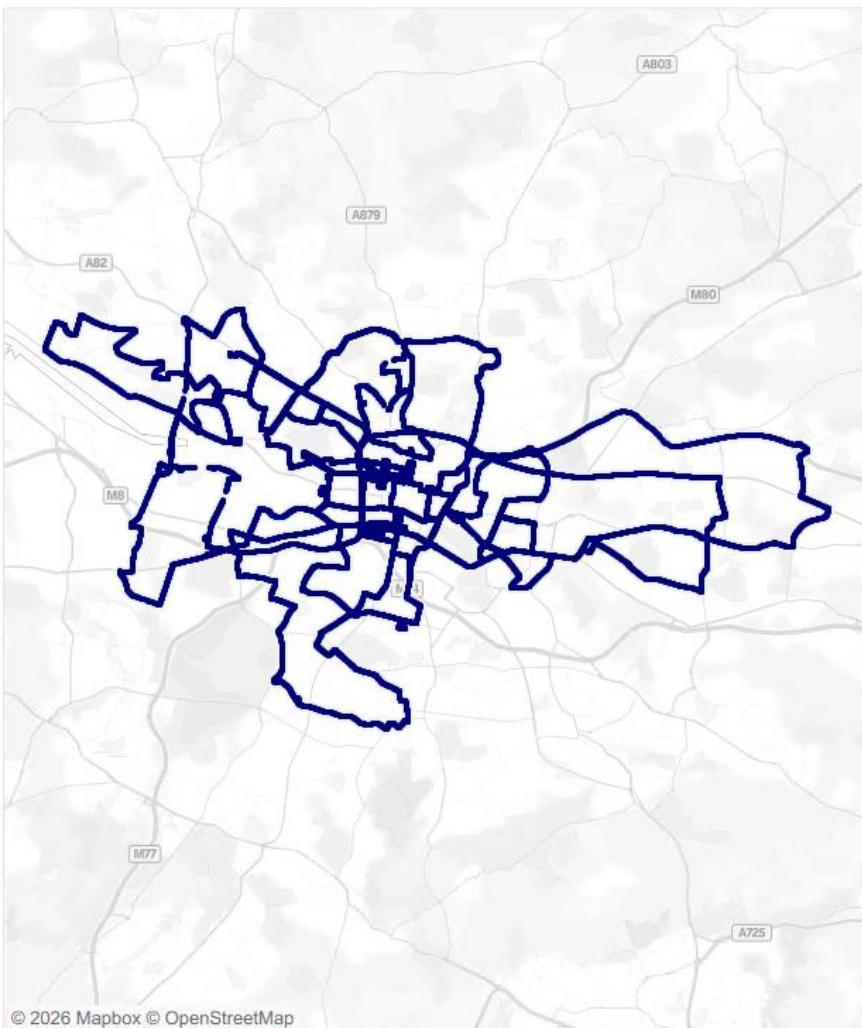
NAME	vodafone	3	E	O ₂
CLASSIC CALLS				
KPI results				
Call Success Ratio (%)	100.00%	99.35%	99.35%	100.00%
Average Call Setup Time (s)	2.33 [s]	1.70 [s]	1.60 [s]	1.67 [s]
Call Setup Time > 15s Ratio (%)	0.00%	0.00%	0.00%	0.00%
POLQA <=1.6 Ratio (%)	0.47%	0.38%	0.52%	0.37%
POLQA AVG (MOS)	4.68 [MOS]	4.66 [MOS]	4.64 [MOS]	4.67 [MOS]
Disturbed And Impaired Call Ratio (%)	0.00%	0.66%	0.00%	0.00%
WHATAPP CALLS				
Call Success Ratio (%)	100.00%	100.00%	100.00%	100.00%
POLQA <=1.6 Ratio (%)	1.25%	0.87%	0.54%	1.05%
POLQA AVG (MOS)	4.00 [MOS]	4.12 [MOS]	4.15 [MOS]	4.08 [MOS]
Disturbed And Impaired Call Ratio (%)	2.50%	2.44%	0.00%	0.00%
Multi RAB DATA				
MultiRAB Data Success Ratio (%)	100.00%	100.00%	100.00%	100.00%

DATA

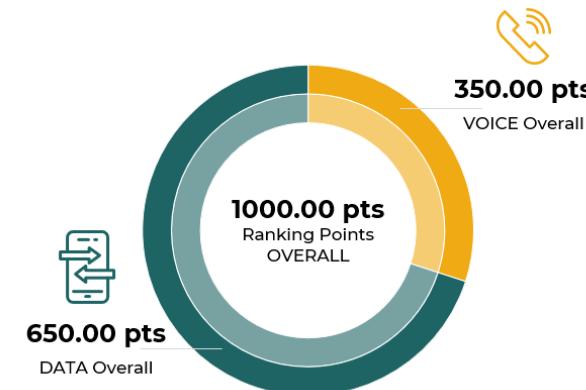
NAME	vodafone	3	E	O ₂
DOWNLOAD (File Size 10MB)				
FDFS DL Success Ratio (%)	100.00%	55.74%	100.00%	98.40%
FDFS DL Transfer Time (s)	1.82 [s]	3.53 [s]	0.94 [s]	1.83 [s]
UPLOAD (File Size 5MB)				
FDFS UL Success Ratio (%)	99.47%	99.45%	99.48%	99.47%
FDFS UL Transfer Time (s)	3.56 [s]	2.73 [s]	2.00 [s]	3.03 [s]
DOWNLOAD (Test Duration 7 seconds)				
FDTT DL Throughput > 2Mbps Ratio (%)	100.00%	95.03%	99.49%	98.42%
FDTT DL Throughput > 5Mbps Ratio (%)	99.48%	90.61%	97.95%	95.26%
FDTT DL Throughput > 20Mbps Ratio (%)	86.91%	73.48%	93.85%	86.32%
FDTT DL Throughput > 100Mbps Ratio (%)	57.07%	55.80%	80.00%	72.11%
FDTT DL MDR P90 (Mbit/s)	304.09 [Mbit/s]	68299 [Mbit/s]	567.63 [Mbit/s]	478.71 [Mbit/s]
UPLOAD (Test Duration 7 seconds)				
FDTT UL Throughput > 1Mbps Ratio (%)	98.92%	99.44%	100.00%	100.00%
FDTT UL Throughput > 3Mbps Ratio (%)	95.68%	97.77%	100.00%	98.38%
FDTT UL Throughput > 10Mbps Ratio (%)	88.11%	87.15%	94.79%	88.11%
FDTT UL Throughput > 20Mbps Ratio (%)	76.22%	70.39%	81.77%	72.43%
FDTT UL MDR P90 (Mbit/s)	86.46 [Mbit/s]	113.63 [Mbit/s]	81.59 [Mbit/s]	73.73 [Mbit/s]
BROWSING (Web Browsing)				
Browsing Time to 1MB (ms)	926.09 [ms]	1195.10 [ms]	774.74 [ms]	862.03 [ms]
Browsing Success Ratio (%)	100.00%	98.70%	99.59%	99.68%
VIDEO STREAM (YouTube Live Stream HD)				
Video Stream Success Ratio (%)	99.47%	97.81%	99.48%	99.47%
Video Stream TTFP >= 10 s Ratio (%)	0.00%	0.56%	0.52%	0.53%
Video Stream Irritating Experience Ratio (%)	0.00%	0.56%	0.52%	0.00%
INTERACTIVITY				
Interactivity Packet Error Ratio (%)	4.48%	25.87%	1.02%	2.46%
Interactivity Median RTT (ms)	31.94 [ms]	34.15 [ms]	30.83 [ms]	32.38 [ms]

RANKING RESULTS: GLASGOW

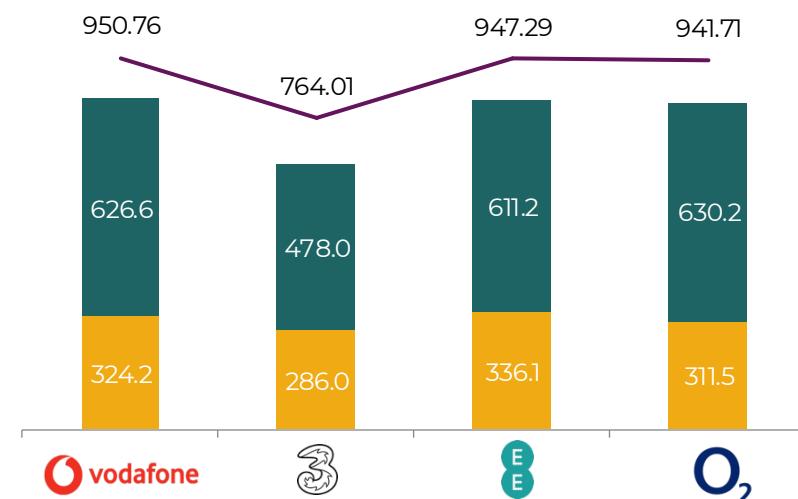
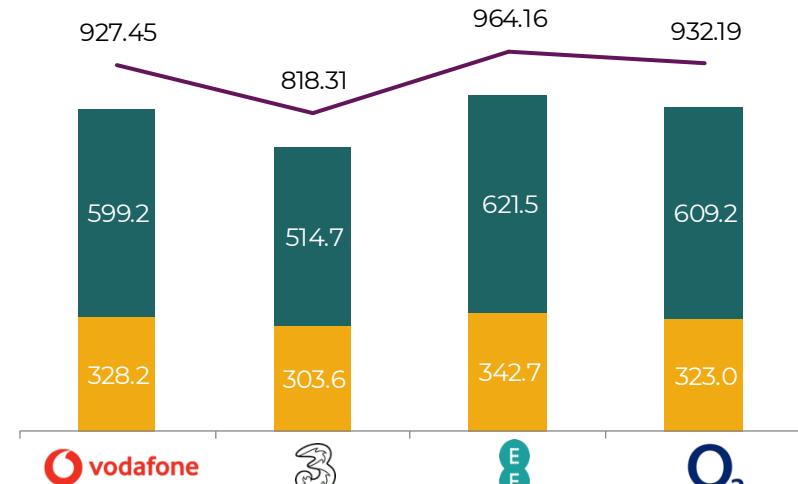
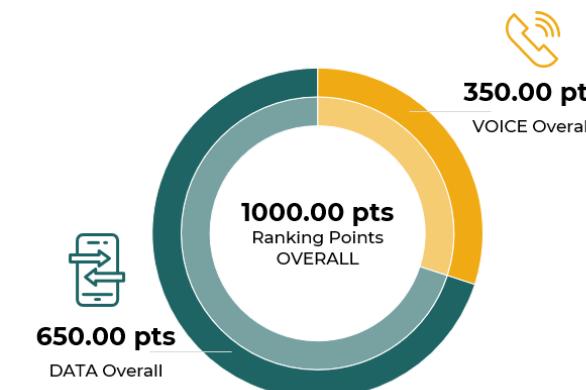
MEASUREMENT ROUTE



'BEST NETWORK' RANKING



'MOST RELIABLE NETWORK' RANKING



Voice Overall

Data Overall

Overall Ranking

KPI RESULTS: GLASGOW

VOICE

NAME	vodafone	3	E	O ₂
CLASSIC CALLS				
KPI results				
Call Success Ratio (%)	100.00%	98.21%	100.00%	98.80%
Average Call Setup Time (s)	2.61 [s]	1.79 [s]	1.52 [s]	1.83 [s]
Call Setup Time > 15s Ratio (%)	0.00%	0.00%	0.00%	0.00%
POLQA <=1.6 Ratio (%)	0.72%	0.78%	0.34%	0.48%
POLQA AVG (MOS)	4.65 [MOS]	4.64 [MOS]	4.69 [MOS]	4.66 [MOS]
Disturbed And Impaired Call Ratio (%)	0.60%	0.00%	0.00%	0.00%
WHATAPP CALLS				
Call Success Ratio (%)	100.00%	100.00%	100.00%	100.00%
POLQA <=1.6 Ratio (%)	1.43%	4.05%	0.32%	0.16%
POLQA AVG (MOS)	3.95 [MOS]	3.99 [MOS]	4.21 [MOS]	4.17 [MOS]
Disturbed And Impaired Call Ratio (%)	0.00%	2.27%	0.00%	0.00%
Multi RAB DATA				
MultiRAB Data Success Ratio (%)	100.00%	100.00%	100.00%	100.00%

DATA

NAME	vodafone	3	E	O ₂
DOWNLOAD (File Size 10MB)				
FDFS DL Success Ratio (%)	100.00%	57.92%	99.53%	100.00%
FDFS DL Transfer Time (s)	2.73 [s]	2.62 [s]	0.70 [s]	1.79 [s]
UPLOAD (File Size 5MB)				
FDFS UL Success Ratio (%)	100.00%	100.00%	99.53%	100.00%
FDFS UL Transfer Time (s)	298 [s]	293 [s]	1.82 [s]	316 [s]
DOWNLOAD (Test Duration 7 seconds)				
FDTT DL Throughput > 2Mbps Ratio (%)	99.52%	98.05%	99.53%	99.53%
FDTT DL Throughput > 5Mbps Ratio (%)	97.61%	92.68%	99.53%	98.11%
FDTT DL Throughput > 20Mbps Ratio (%)	89.47%	86.34%	98.14%	91.04%
FDTT DL Throughput > 100Mbps Ratio (%)	56.94%	68.29%	90.70%	74.53%
FDTT DL MDR P90 (Mbit/s)	310.73 [Mbit/s]	635.27 [Mbit/s]	669.31 [Mbit/s]	381.29 [Mbit/s]
UPLOAD (Test Duration 7 seconds)				
FDTT UL Throughput > 1Mbps Ratio (%)	100.00%	100.00%	100.00%	100.00%
FDTT UL Throughput > 3Mbps Ratio (%)	99.51%	100.00%	100.00%	97.56%
FDTT UL Throughput > 10Mbps Ratio (%)	91.63%	93.50%	97.20%	87.80%
FDTT UL Throughput > 20Mbps Ratio (%)	78.82%	75.50%	89.72%	76.59%
FDTT UL MDR P90 (Mbit/s)	88.09 [Mbit/s]	136.30 [Mbit/s]	85.48 [Mbit/s]	79.70 [Mbit/s]
BROWSING (Web Browsing)				
Browsing Time to 1MB (ms)	1093.40 [ms]	1166.55 [ms]	722.49 [ms]	866.94 [ms]
Browsing Success Ratio (%)	99.71%	98.92%	99.81%	99.90%
VIDEO STREAM (YouTube Live Stream HD)				
Video Stream Success Ratio (%)	99.51%	99.51%	99.07%	99.52%
Video Stream TTFP >= 10 s Ratio (%)	0.00%	0.99%	0.00%	0.00%
Video Stream Irritating Experience Ratio (%)	0.00%	0.99%	0.00%	0.00%
INTERACTIVITY				
Interactivity Packet Error Ratio (%)	6.73%	20.36%	0.78%	1.86%
Interactivity Median RTT (ms)	39.17 [ms]	43.33 [ms]	35.82 [ms]	38.09 [ms]

UK CITY BENCHMARK 2025

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