

A night-time photograph of the Tower Bridge in London, illuminated with warm lights against a dark blue sky. The bridge's two towers and suspension cables are clearly visible, with the River Thames in the foreground. The overall scene is dark and atmospheric.

**NET CHECK**

member of NC GROUP

# UK MOBILE NETWORK BENCHMARK 2023

Comparison of Mobile Network Performances through Drive and Walk measurements

| 20<sup>th</sup> of April 2023 / 25<sup>th</sup> of May 2023

NET CHECK

# CONTENTS

**About**

**03**

**Equipment &  
Methodology**

**04**

**Ranking**

**06**

**Campaign  
Details**

**07**

# ABOUT NET CHECK



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

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**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 attaches great importance to using high quality and state-of-the-art measurement technology for all tests.**



## **DRIVE TESTING**

### **Measurement equipment for drive testing: SwissQual Benchmarker 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.



## **WALK TESTING**

### **Measurement equipment for walk testing: Freerider IV (Rohde & Schwarz)**

For testing network performance in pedestrian zones and tourist areas, a Rohde & Schwarz backpack solution was used, filled with smartphones and external batteries, carried along the walking routes by a measurement engineer.

For both walk and drive testing, current models of Android mobile phones of Samsung were used.

# 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:



The walk tests cover important areas of interest like malls, airports, and main train stations connected by public transport. The measurement engineers carry special backpacks containing the measurement equipment.



The 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.



Drive and walk tests are performed separately by different teams and can't be performed in parallel.



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 can reflect the KPI values from all the performed tests during the Benchmark campaign, or just from the tests performed within a certain city. Thus, the Ranking can be an overall Ranking or a per-city Ranking.



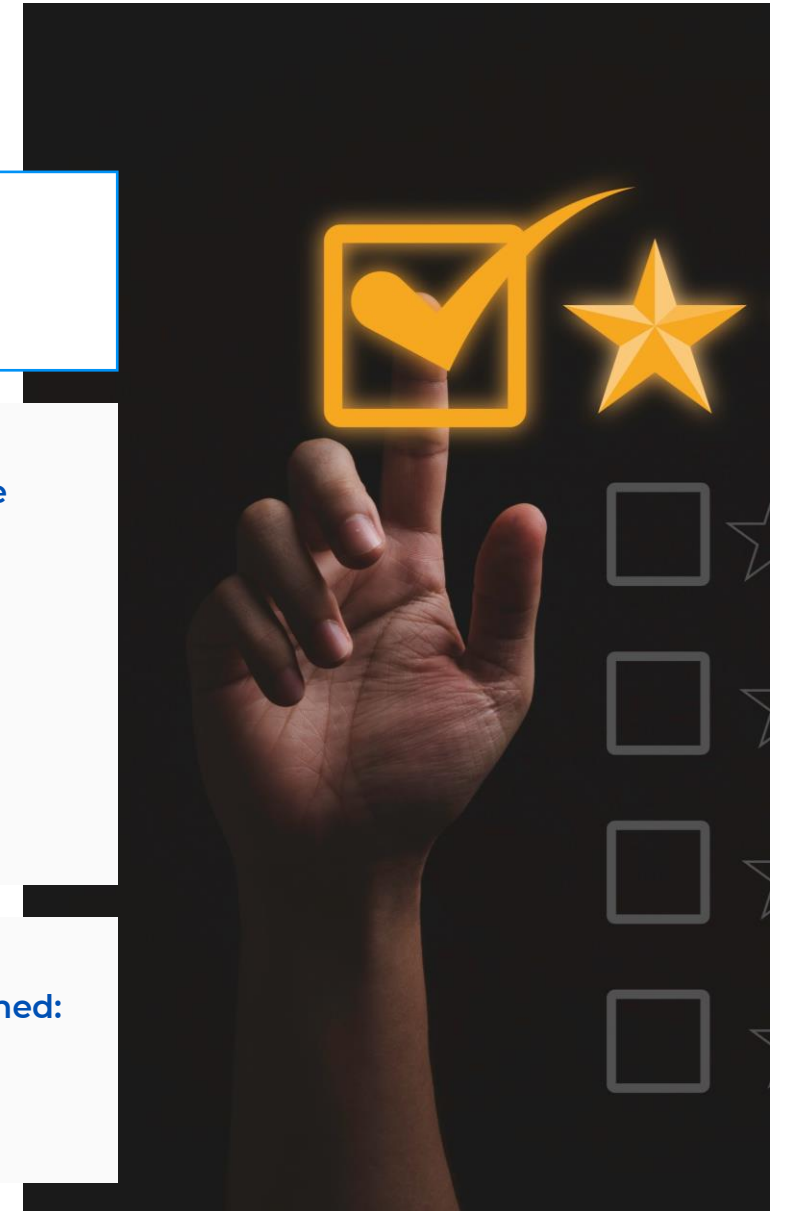
The purpose of any Benchmark is to evaluate customer experience. No two customers are alike, but in years of benchmarking two more or less distinct customer profiles have been identified:

- o a mobile network user giving value to all the available aspects of the modern mobile communications, one who will converse both in OTT applications and classical phone calls, browse the Internet, upload and download files, engage in on-line meetings and e-gaming and desire to experience the highest quality in all of the above
- o A mobile network user that appreciates more the availability and the reliability of the communication rather than the variety of options and peak performance in each and all, one who sees more value in "getting the message across" than in how many millions of colors can the message font have



In order to evaluate the network performances from the standing points of both the customer personae two different sets of ranking KPIs and ranking KPI weights are defined:

- o The Best Network Ranking
- o The Most Reliable Network Ranking



# CAMPAIGN & MEASUREMENT KPI DESCRIPTION

Ranking Identifiers	
CLASSIC CALLS	
Call Setup Success Ratio (%)*	Percentage of successfully established calls
Dropped Call Ratio (%)*	Percentage of dropped calls
Avg Call Setup Time	Average time to establish a call
Call Setup Time >= 15s Ratio	Percentage of successfully established calls, where call establishment takes more than 15 seconds
POLQA <= 1.6 RATIO*	Percentage of speech samples where the voice signal quality (MOS) is lower than 1.6
POLQA AVG (MOS)	The average value of the voice signal quality (MOS)
Disturbed Call Ratio	Call flow where for three or more consecutive samples (out of a total of ten) for speech quality measurement, the quality is less than 1.6
Impaired Call Ratio	Call flow where for five samples (out of a total of ten) for measuring speech quality, the quality is less than 1.6
WHATSAPP CALLS	
Call Setup Success Ratio (%)*	Percentage of successfully established calls
Dropped Call Ratio (%)*	Percentage of dropped calls
POLQA <= 1.6 RATIO*	Percentage of speech samples where the voice signal quality (MOS) is lower than 1.6
POLQA AVG (MOS)	The average value of the voice signal quality (MOS)
Disturbed Call Ratio	Call flow where for three or more consecutive samples (out of a total of ten) for speech quality measurement, the quality is less than 1.6
Impaired Call Ratio	Call flow where for five samples (out of a total of ten) for measuring speech quality, the quality is less than 1.6
MULTIRAB DATA	
MultiRAB Data Success Ratio	The percentage of successfully completed data transfers during the duration of the voice service

Ranking Identifiers	
DOWNLOAD (File Size 10MB)	
HTTP Transfer FDFS DL Success Ratio (%)*	Percentage of successfully completed data download transfer tests
UPLOAD (File Size 5MB)	
HTTP Transfer FDFS UL Success Ratio (%)*	Percentage of successfully completed data upload transfer tests
DOWNLOAD (Test Duration 10 seconds)	
HTTP Transfer FDTT DL MDR P10*	10% of total measured tests slower than (MB)
HTTP Transfer FDTT DL MDR AVG	Average file download speed (MB)
HTTP Transfer FDTT DL MDR P90	90% of total measured tests slower than (MB)
UPLOAD (Test Duration 10 seconds)	
UDP FDTT UL MDR P10*	10% of total measured tests slower than (MB)
UDP FDTT UL FDTT DL MDR AVG	Average file upload speed (MB)
UDP FDTT UL FDTT DL MDR P90	90% of total measured tests slower than (MB)
BROWSING (Web Browsing)	
HTTP Browsing Time To 1MB	The time required to open a 1MB page
HTTP Browsing Success Ratio (%)*	Percentage of successfully completed web browsing tests
VIDEO STREAM (YouTube Live Stream 4k)	
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 ten seconds or more
Video Stream Irritating Experience Ratio	Percentage of tests with significantly reduced quality of video transmission

\* KPI used for the Most Reliable Network Ranking

# CAMPAIGN & MEASUREMENT SCOPE

## DRIVE TESTS



Start: 20.04.2023.  
End: 25.05.2023.

11 Big Cities

14 Medium Cities  
20 Small Cities

Connecting Roads

5.000 km  
of Drive Tests

## WALK TESTS



Start: 20.04.2023.  
End: 15.05.2023.

11 Big Cities

9 Train Routes

1.160 km  
of Walk/ Train Tests



# CAMPAIGN & MEASUREMENT SET UP

For data services, a total of around 107,000 data samples per operator were collected. For voice services, around 8,600 test calls were made resulting in a total of around 85,000 speech samples

## VOICE SERVICES

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

- o 2 standard calls
- o 3 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

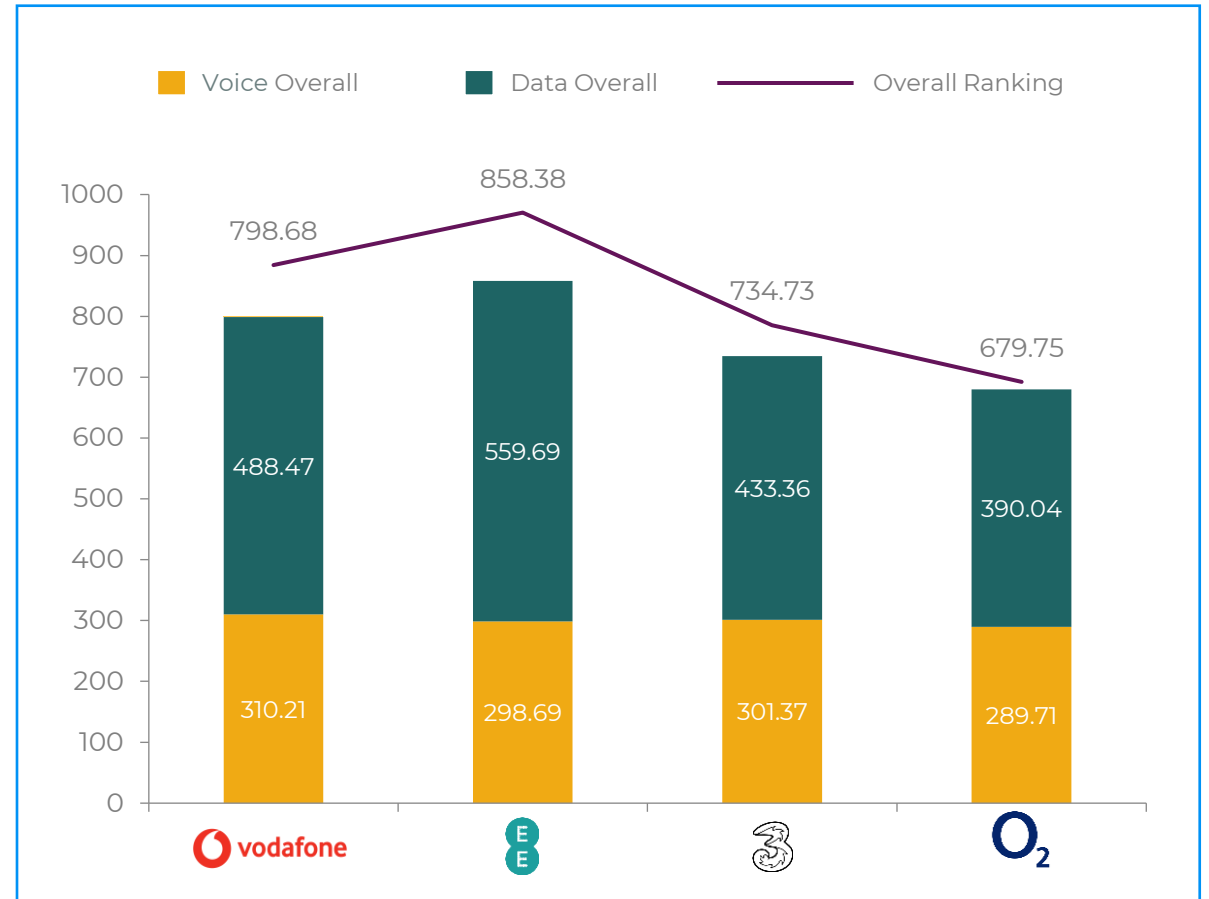
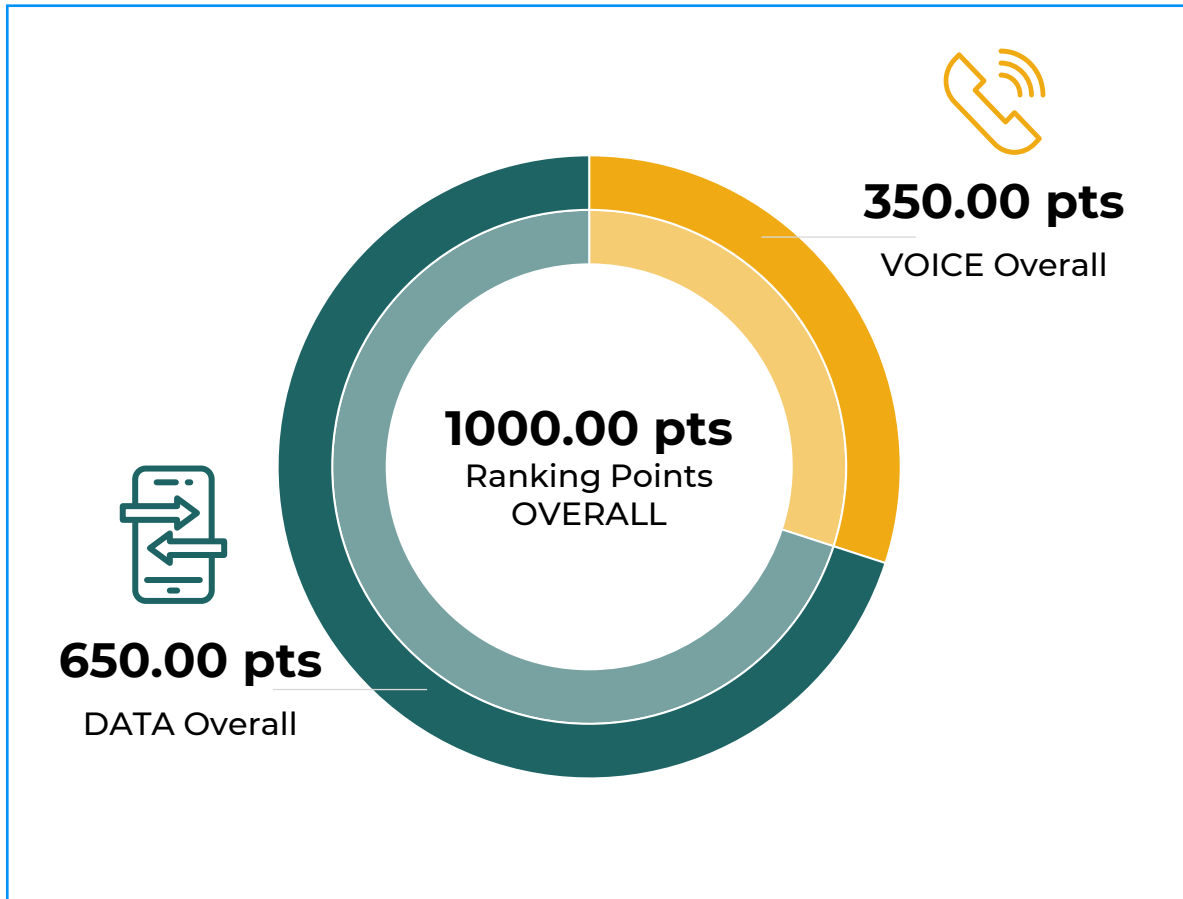
## DATA SERVICES

<b>MEASUREMENT DEVICE</b>	Samsung S21+	Samsung S22+
<b>MEASUREMENT OBJECTIVE</b>	Cities and Connecting Roads	Cities and Connecting Roads
<b>MEASUREMENT SAMPLE</b>	8,600 calls per operator	107,000 tests per operator
<b>TEST CASE SCENARIO</b>	Max Call Setup Time: 30 (s) Call duration: 120 (s) Call window: 160 (s) Call mode: VoLTE preferred Speech quality: POLQA WB Reference File: English Scenario: 2 x VoLTE preferred + 3 x MultiRAB + 1x WhatsApp call	YouTube 4K (livestream) Web Browsing, static and dynamic (Kepler as static, and dynamic based on Alexa ranking) Download and Upload tests: <ul style="list-style-type: none"> <li>· HTTP time based: FDTT DL 10 (s)/ UL UDP FDTT 10 (s)</li> <li>· HTTP file based: FDFS DL/ UL (10MB/5MB)</li> </ul> Online gaming and online meeting simulations
	<b>8,600</b> test calls	<b>107,000</b> data samples

# OVERALL NETWORK RANKING

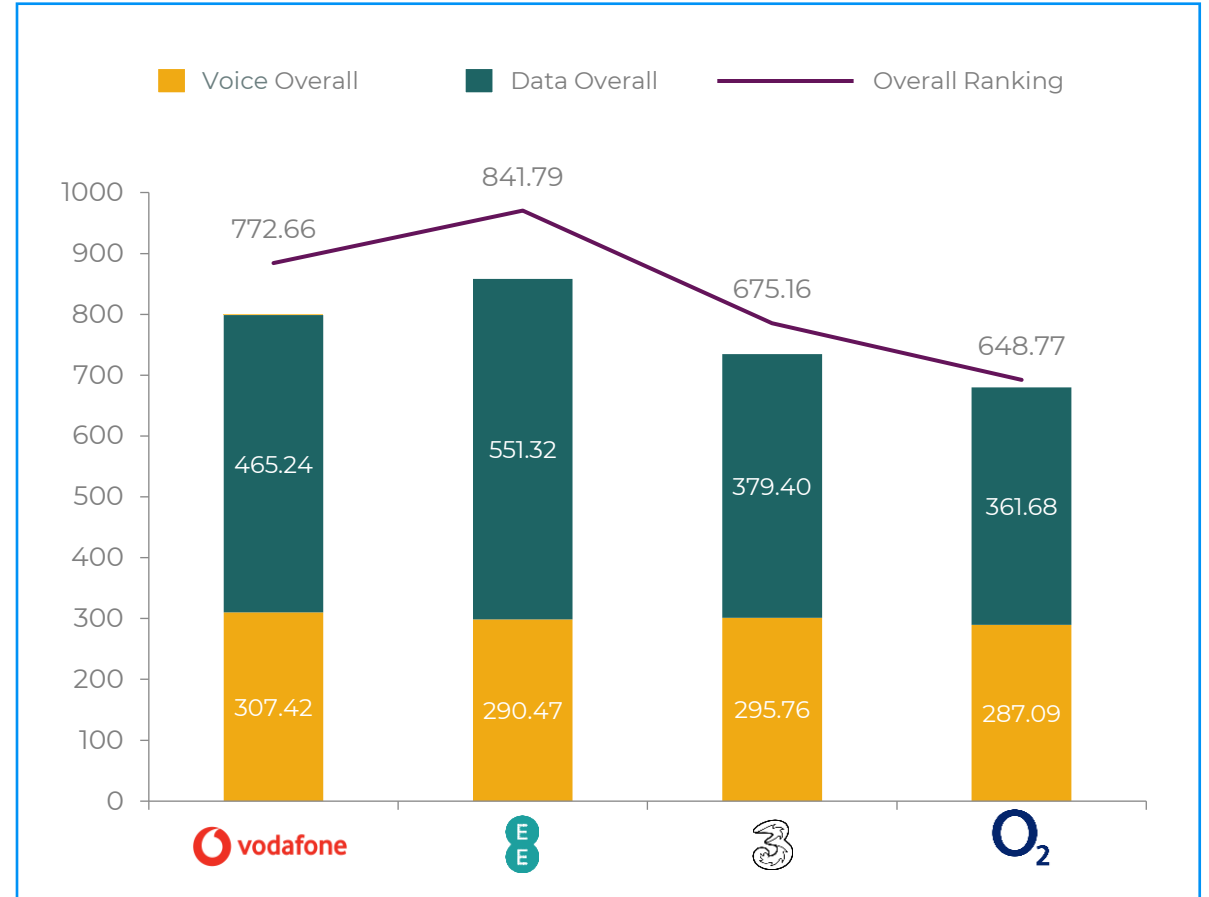
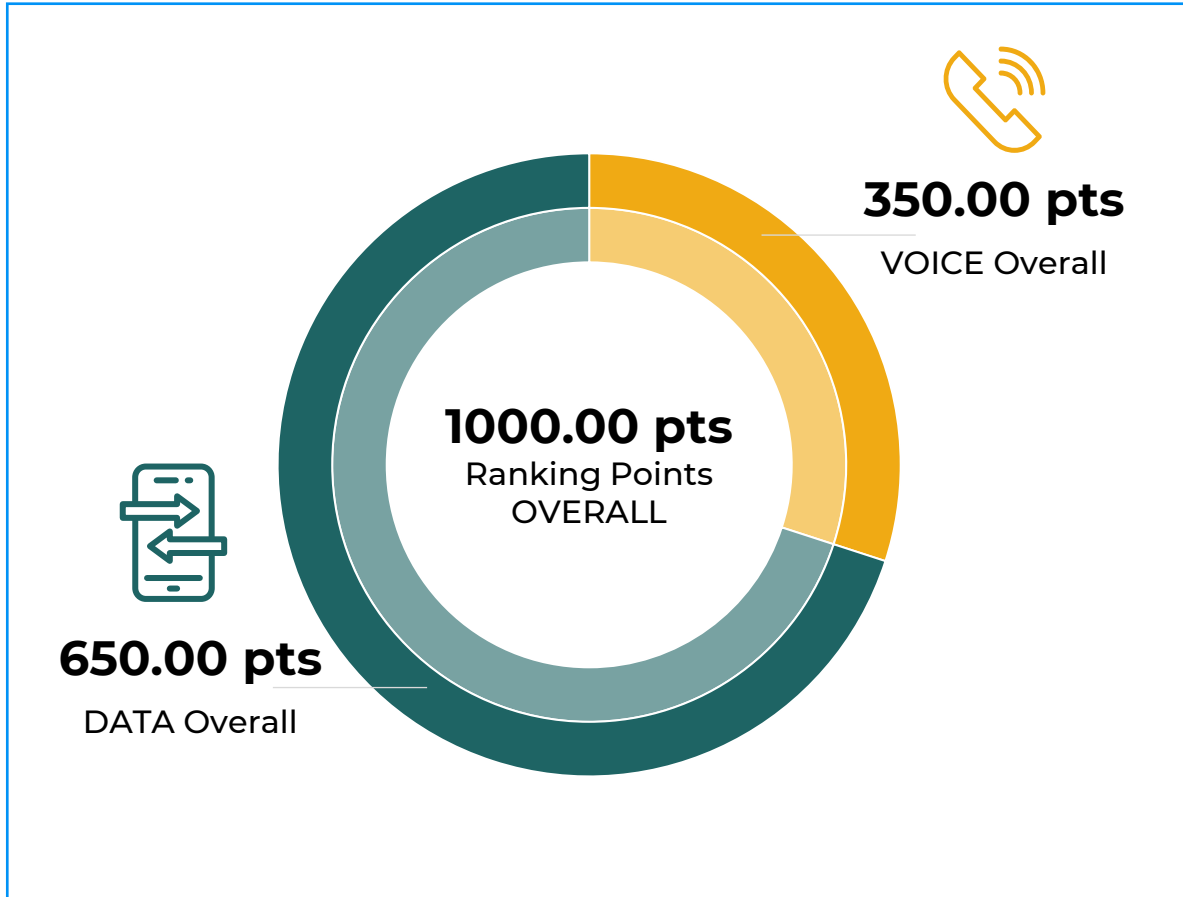
# RANKING RESULTS: BEST NETWORK

The highest overall score in voice tests was achieved by Vodafone and the highest overall score in data tests was achieved by EE. Three was third in data, but second in voice. In total, EE won the biggest number of points, followed by Vodafone, then Three and then O2.



# RANKING RESULTS: MOST RELIABLE NETWORK

The overall Most Reliable Network Ranking has the same packing order: highest score in voice tests for Vodafone, highest score in data tests for EE. Three is second in voice and third in data. In total, EE has the biggest number of points, then Vodafone, Three and O2.



# RANKING RESULTS: VOICE DRIVE

## DRIVE CITY



NAME	vodafone	E	3	O <sub>2</sub>
<b>CLASSIC CALLS</b>		<b>KPI results</b>		
Call Setup Success Ratio (%)	99.46%	99.01%	99.10%	98.73%
Dropped Call Ratio (%)	0.26%	0.95%	0.29%	0.26%
AVG CST (s)	3.99 [s]	3.93 [s]	3.57 [s]	4.25 [s]
Bad CST Ratio (>= 15 s) (%)	0.14%	0.19%	0.12%	0.19%
MOS <= 1.6 RATIO	0.43%	0.79%	0.41%	0.77%
POLQA AVG (MOS)	4.62 [MOS]	4.53 [MOS]	4.43 [MOS]	4.46 [MOS]
Disturbed And Impaired Call Ratio (%)	0.09%	0.07%	0.05%	0.09%
<b>WHATSAPP CALLS</b>				
Call Setup Success Ratio (%)	99.69%	99.27%	99.17%	99.68%
Dropped Call Ratio (%)	0.21%	0.42%	0.00%	0.11%
MOS <= 1.6 RATIO	1.18%	0.73%	1.36%	2.11%
POLQA AVG (MOS)	4.45 [MOS]	4.52 [MOS]	4.43 [MOS]	4.40 [MOS]
Disturbed And Impaired Call Ratio (%)	0.21%	0.10%	0.31%	0.74%
<b>Multi RAB DATA</b>				
MultiRAB Data Success Ratio (%)	99.26%	98.76%	99.63%	99.71%

## DRIVE CONNECTING ROADS



NAME	vodafone	E	3	O <sub>2</sub>
<b>CLASSIC CALLS</b>		<b>KPI results</b>		
Call Setup Success Ratio (%)	99.90%	99.14%	98.56%	98.75%
Dropped Call Ratio (%)	0.39%	1.44%	0.68%	0.87%
AVG CST (s)	4.08 [s]	4.07 [s]	3.88 [s]	4.56 [s]
Bad CST Ratio (>= 15 s) (%)	0.48%	0.00%	0.68%	0.68%
MOS <= 1.6 RATIO	1.19%	1.22%	1.33%	1.84%
POLQA AVG (MOS)	4.52 [MOS]	4.46 [MOS]	4.32 [MOS]	4.34 [MOS]
Disturbed And Impaired Call Ratio (%)	0.19%	0.10%	0.10%	0.86%
<b>WHATSAPP CALLS</b>				
Call Setup Success Ratio (%)	99.16%	98.33%	100.00%	98.74%
Dropped Call Ratio (%)	0.42%	1.27%	1.26%	0.43%
MOS <= 1.6 RATIO	1.19%	1.77%	2.15%	1.54%
POLQA AVG (MOS)	4.48 [MOS]	4.42 [MOS]	4.37 [MOS]	4.43 [MOS]
Disturbed And Impaired Call Ratio (%)	0.42%	0.42%	0.84%	0.00%
<b>Multi RAB DATA</b>				
MultiRAB Data Success Ratio (%)	99.15%	98.98%	99.83%	98.45%

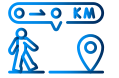
# RANKING RESULTS: VOICE WALK

## WALK CITY



NAME	vodafone	E	3	O <sub>2</sub>
<b>CLASSIC CALLS</b>		<b>KPI results</b>		
Call Setup Success Ratio (%)	99,34%	99,28%	98,29%	98,81%
Dropped Call Ratio (%)	0,33%	0,40%	0,60%	0,53%
AVG CST (s)	3,95 [s]	3,84 [s]	3,43 [s]	4,31 [s]
Bad CST Ratio (>= 15 s) (%)	0,20%	0,00%	0,27%	0,20%
MOS <= 1.6 RATIO	0,33%	0,45%	0,79%	2,22%
POLQA AVG (MOS)	4,64 [MOS]	4,57 [MOS]	4,41 [MOS]	4,35 [MOS]
Disturbed And Impaired Call Ratio (%)	0,13%	0,13%	0,33%	1,12%
<b>WHATSAPP CALLS</b>				
Call Setup Success Ratio (%)	98,85%	97,73%	98,85%	98,57%
Dropped Call Ratio (%)	0,00%	0,29%	0,00%	0,29%
MOS <= 1.6 RATIO	1,40%	0,47%	1,77%	3,30%
POLQA AVG (MOS)	4,40 [MOS]	4,51 [MOS]	4,42 [MOS]	4,30 [MOS]
Disturbed And Impaired Call Ratio (%)	0,57%	0,00%	2,59%	2,00%
<b>Multi RAB DATA</b>				
MultiRAB Data Success Ratio (%)	98,95%	99,30%	98,71%	98,12%

## WALK TRAIN ROUTE



NAME	vodafone	E	3	O <sub>2</sub>
<b>CLASSIC CALLS</b>		<b>KPI results</b>		
Call Setup Success Ratio (%)	89,16%	91,13%	90,12%	87,10%
Dropped Call Ratio (%)	7,66%	10,62%	7,76%	7,87%
AVG CST (s)	5,22 [s]	4,60 [s]	4,17 [s]	5,53 [s]
Bad CST Ratio (>= 15 s) (%)	1,80%	1,33%	1,37%	1,85%
MOS <= 1.6 RATIO	5,21%	4,49%	6,22%	8,36%
POLQA AVG (MOS)	4,16 [MOS]	4,23 [MOS]	3,98 [MOS]	3,90 [MOS]
Disturbed And Impaired Call Ratio (%)	0,80%	1,61%	2,06%	3,23%
<b>WHATSAPP CALLS</b>				
Call Setup Success Ratio (%)	92,59%	91,23%	88,68%	90,91%
Dropped Call Ratio (%)	8,00%	3,85%	4,26%	8,00%
MOS <= 1.6 RATIO	5,74%	5,73%	5,12%	9,79%
POLQA AVG (MOS)	4,25 [MOS]	4,07 [MOS]	4,19 [MOS]	3,93 [MOS]
Disturbed And Impaired Call Ratio (%)	0,00%	1,75%	1,89%	9,09%
<b>Multi RAB DATA</b>				
MultiRAB Data Success Ratio (%)	90,91%	97,04%	98,41%	94,81%

# RANKING RESULTS: DATA DRIVE

## DRIVE CITY



NAME	vodafone	E	3	O <sub>2</sub>
<b>DOWNLOAD (File Size 10MB)</b>				
FDFS DL Success Ratio (%)	98,95%	99,25%	97,36%	96,09%
<b>UPLOAD (File Size 5MB)</b>				
FDFS UL Success Ratio (%)	98,49%	98,58%	97,35%	95,24%
<b>DOWNLOAD (Test Duration 10 seconds)</b>				
FDTT DL 10 PCTL Data Rate (Mbit/s)	12,20 [Mbit/s]	21,74 [Mbit/s]	7,90 [Mbit/s]	5,10 [Mbit/s]
FDTT DL Average Data Rate (Mbit/s)	134,13 [Mbit/s]	188,36 [Mbit/s]	235,08 [Mbit/s]	81,12 [Mbit/s]
FDTT DL 90 PCTL Data Rate (Mbit/s)	302,86 [Mbit/s]	443,01 [Mbit/s]	593,91 [Mbit/s]	203,82 [Mbit/s]
<b>UPLOAD (Test Duration 10 seconds)</b>				
FDTT UL 10 PCTL Data Rate (Mbit/s)	6,09 [Mbit/s]	6,83 [Mbit/s]	3,99 [Mbit/s]	2,73 [Mbit/s]
FDTT UL Average Data Rate (Mbit/s)	32,43 [Mbit/s]	34,89 [Mbit/s]	36,67 [Mbit/s]	17,42 [Mbit/s]
FDTT UL 90 PCTL Data Rate (Mbit/s)	68,23 [Mbit/s]	68,16 [Mbit/s]	92,36 [Mbit/s]	37,09 [Mbit/s]
<b>BROWSING (Web Browsing)</b>				
HTTP Browsing 1MB Reached Time Average (ms)	1516,86 [ms]	1732,33 [ms]	1760,69 [ms]	1791,48 [ms]
HTTP Browsing Success Ratio (%)	99,15%	99,18%	98,40%	97,59%
<b>VIDEO STREAM (YouTube live stream 4k)</b>				
Video Stream Success Ratio (%)	99,45%	99,24%	97,95%	97,47%
TTFP >= 10 s Ratio (%)	0,24%	0,12%	0,65%	0,80%
Video Stream Irritating Experience Ratio (%)	0,68%	0,47%	1,73%	1,84%
<b>INTERACTIVITY KPIs</b>				
Interactivity Packet Error Ratio (%)	5,17%	4,74%	8,83%	8,97%
Interactivity Median RTT (ms)	42,38 [ms]	36,89 [ms]	37,30 [ms]	41,26 [ms]

## DRIVE CONNECTING ROADS



NAME	vodafone	E	3	O <sub>2</sub>
<b>DOWNLOAD (File Size 10MB)</b>				
FDFS DL Success Ratio (%)	97,87%	99,08%	96,83%	93,41%
<b>UPLOAD (File Size 5MB)</b>				
FDFS UL Success Ratio (%)	97,52%	98,16%	95,67%	95,59%
<b>DOWNLOAD (Test Duration 10 seconds)</b>				
FDTT DL 10 PCTL Data Rate (Mbit/s)	6,26 [Mbit/s]	13,74 [Mbit/s]	5,08 [Mbit/s]	2,65 [Mbit/s]
FDTT DL Average Data Rate (Mbit/s)	74,62 [Mbit/s]	98,32 [Mbit/s]	148,58 [Mbit/s]	41,77 [Mbit/s]
FDTT DL 90 PCTL Data Rate (Mbit/s)	201,98 [Mbit/s]	235,08 [Mbit/s]	463,21 [Mbit/s]	110,64 [Mbit/s]
<b>UPLOAD (Test Duration 10 seconds)</b>				
FDTT UL 10 PCTL Data Rate (Mbit/s)	3,79 [Mbit/s]	5,33 [Mbit/s]	2,38 [Mbit/s]	2,31 [Mbit/s]
FDTT UL Average Data Rate (Mbit/s)	22,86 [Mbit/s]	31,84 [Mbit/s]	28,72 [Mbit/s]	14,64 [Mbit/s]
FDTT UL 90 PCTL Data Rate (Mbit/s)	48,62 [Mbit/s]	63,28 [Mbit/s]	74,54 [Mbit/s]	29,06 [Mbit/s]
<b>BROWSING (Web Browsing)</b>				
HTTP Browsing 1MB Reached Time Average (ms)	1728,37 [ms]	1732,76 [ms]	1959,83 [ms]	1959,07 [ms]
HTTP Browsing Success Ratio (%)	98,65%	99,18%	97,88%	96,87%
<b>VIDEO STREAM (YouTube live stream 4k)</b>				
Video Stream Success Ratio (%)	99,24%	99,25%	97,13%	97,30%
TTFP >= 10 s Ratio (%)	0,51%	0,25%	0,90%	1,20%
Video Stream Irritating Experience Ratio (%)	1,36%	0,42%	2,96%	1,85%
<b>INTERACTIVITY KPIs</b>				
Interactivity Packet Error Ratio (%)	6,72%	5,86%	11,69%	10,23%
Interactivity Median RTT (ms)	46,62 [ms]	40,65 [ms]	45,36 [ms]	43,40 [ms]

# RANKING RESULTS: DATA DRIVE

## WALK CITY



NAME	vodafone	E	3	O <sub>2</sub>
<b>DOWNLOAD (File Size 10MB)</b>				
FDFS DL Success Ratio (%)	92,11%	98,86%	84,68%	94,19%
<b>UPLOAD (File Size 5MB)</b>				
FDFS UL Success Ratio (%)	89,06%	98,98%	90,89%	90,71%
<b>DOWNLOAD (Test Duration 10 seconds)</b>				
FDTT DL 10 PCTL Data Rate (Mbit/s)	6,65 [Mbit/s]	16,10 [Mbit/s]	0,94 [Mbit/s]	3,95 [Mbit/s]
FDTT DL Average Data Rate (Mbit/s)	100,49 [Mbit/s]	174,98 [Mbit/s]	104,58 [Mbit/s]	72,75 [Mbit/s]
FDTT DL 90 PCTL Data Rate (Mbit/s)	238,08 [Mbit/s]	411,13 [Mbit/s]	325,76 [Mbit/s]	182,54 [Mbit/s]
<b>UPLOAD (Test Duration 10 seconds)</b>				
FDTT UL 10 PCTL Data Rate (Mbit/s)	2,49 [Mbit/s]	6,75 [Mbit/s]	2,10 [Mbit/s]	1,51 [Mbit/s]
FDTT UL Average Data Rate (Mbit/s)	24,67 [Mbit/s]	34,06 [Mbit/s]	20,33 [Mbit/s]	11,91 [Mbit/s]
FDTT UL 90 PCTL Data Rate (Mbit/s)	53,28 [Mbit/s]	65,98 [Mbit/s]	50,67 [Mbit/s]	25,67 [Mbit/s]
<b>BROWSING (Web Browsing)</b>				
HTTP Browsing 1MB Reached Time Average (ms)	1810,64 [ms]	1767,54 [ms]	2434,89 [ms]	1991,15 [ms]
HTTP Browsing Success Ratio (%)	92,74%	99,39%	93,51%	96,30%
<b>VIDEO STREAM (YouTube live stream 4k)</b>				
Video Stream Success Ratio (%)	92,23%	99,09%	91,38%	95,32%
TTFP >= 10 s Ratio (%)	0,97%	0,17%	1,43%	1,36%
Video Stream Irritating Experience Ratio (%)	1,36%	0,57%	3,00%	2,00%
<b>INTERACTIVITY KPIs</b>				
Interactivity Packet Error Ratio (%)	13,94%	4,36%	11,43%	13,56%
Interactivity Median RTT (ms)	46,17 [ms]	36,64 [ms]	45,29 [ms]	44,31 [ms]

## WALK TRAIN ROUTE



NAME	vodafone	E	3	O <sub>2</sub>
<b>DOWNLOAD (File Size 10MB)</b>				
FDFS DL Success Ratio (%)	86,06%	89,88%	83,77%	78,54%
<b>UPLOAD (File Size 5MB)</b>				
FDFS UL Success Ratio (%)	78,26%	87,94%	82,22%	74,32%
<b>DOWNLOAD (Test Duration 10 seconds)</b>				
FDTT DL 10 PCTL Data Rate (Mbit/s)	2,08 [Mbit/s]	4,51 [Mbit/s]	0,82 [Mbit/s]	1,14 [Mbit/s]
FDTT DL Average Data Rate (Mbit/s)	53,18 [Mbit/s]	90,71 [Mbit/s]	81,44 [Mbit/s]	34,42 [Mbit/s]
FDTT DL 90 PCTL Data Rate (Mbit/s)	155,87 [Mbit/s]	285,62 [Mbit/s]	231,11 [Mbit/s]	110,27 [Mbit/s]
<b>UPLOAD (Test Duration 10 seconds)</b>				
FDTT UL 10 PCTL Data Rate (Mbit/s)	0,88 [Mbit/s]	1,37 [Mbit/s]	0,58 [Mbit/s]	0,50 [Mbit/s]
FDTT UL Average Data Rate (Mbit/s)	11,81 [Mbit/s]	19,60 [Mbit/s]	12,26 [Mbit/s]	6,90 [Mbit/s]
FDTT UL 90 PCTL Data Rate (Mbit/s)	26,30 [Mbit/s]	50,36 [Mbit/s]	29,32 [Mbit/s]	16,87 [Mbit/s]
<b>BROWSING (Web Browsing)</b>				
HTTP Browsing 1MB Reached Time Average (ms)	2555,02 [ms]	2377,91 [ms]	3066,37 [ms]	3028,02 [ms]
HTTP Browsing Success Ratio (%)	87,87%	93,36%	84,91%	82,65%
<b>VIDEO STREAM (YouTube live stream 4k)</b>				
Video Stream Success Ratio (%)	83,27%	94,30%	78,57%	74,68%
TTFP >= 10 s Ratio (%)	1,87%	1,61%	2,14%	2,87%
Video Stream Irritating Experience Ratio (%)	7,01%	6,05%	11,23%	10,34%
<b>INTERACTIVITY KPIs</b>				
Interactivity Packet Error Ratio (%)	17,84%	16,04%	23,93%	31,20%
Interactivity Median RTT (ms)	48,58 [ms]	42,19 [ms]	52,23 [ms]	45,32 [ms]



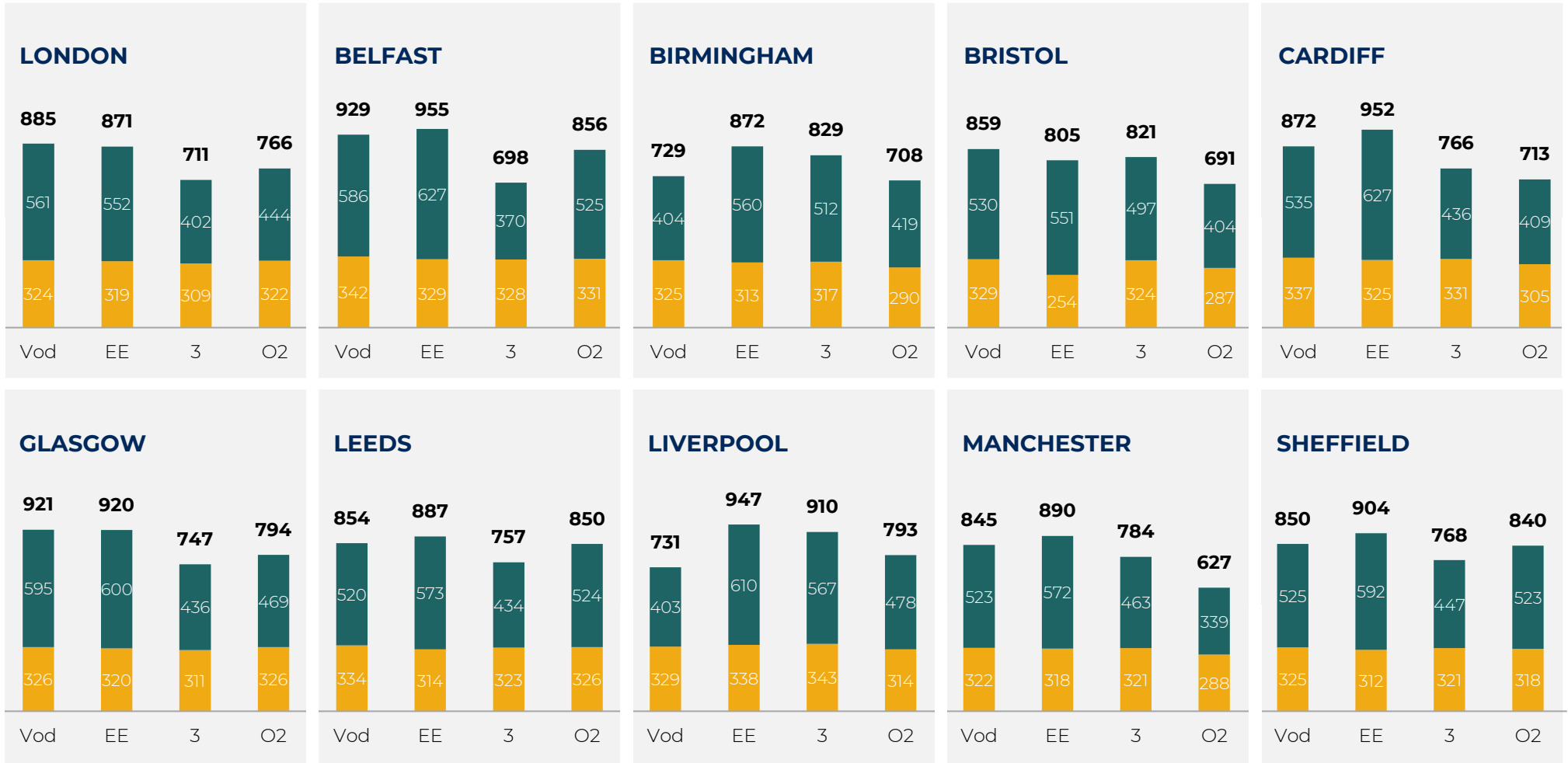
# CITY RANKING

# BEST NETWORK RANKING PER CITY

The Best Network Ranking per city for the largest cities in the UK

Both the Drive test and the Walk test results are combined

The ranking points are scaled to a maximum of 1,000 points, providing comparability with the overall Rankings.



Methodology 2023

Voice and Speech: 350

Data: 650

Voice & Speech

Data

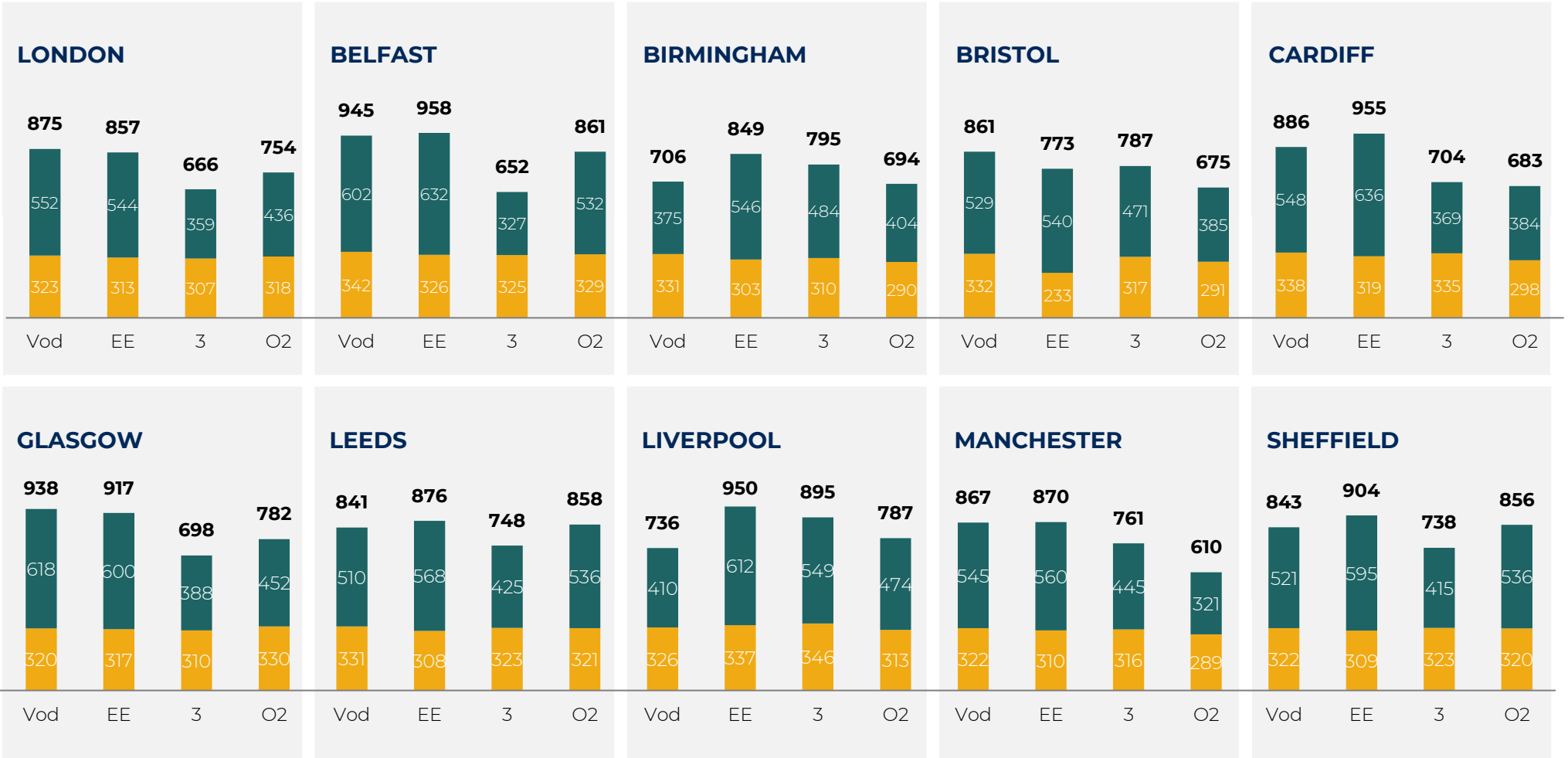
Ranking Points are scaled to max. 1000 points

# MOST RELIABLE NETWORK RANKING PER CITY

The Most Reliable Network Ranking per city for the largest cities in the UK

Both the Drive test and the Walk test results are combined

The ranking points are scaled to a maximum of 1,000 points, providing comparability with the overall Rankings.



Methodology 2023

Voice and Speech: 350

Data: 650

Voice & Speech Data

Ranking Points are scaled to max. 1000 points

# UK MOBILE NETWORK BENCHMARK 2023

## NET CHECK



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