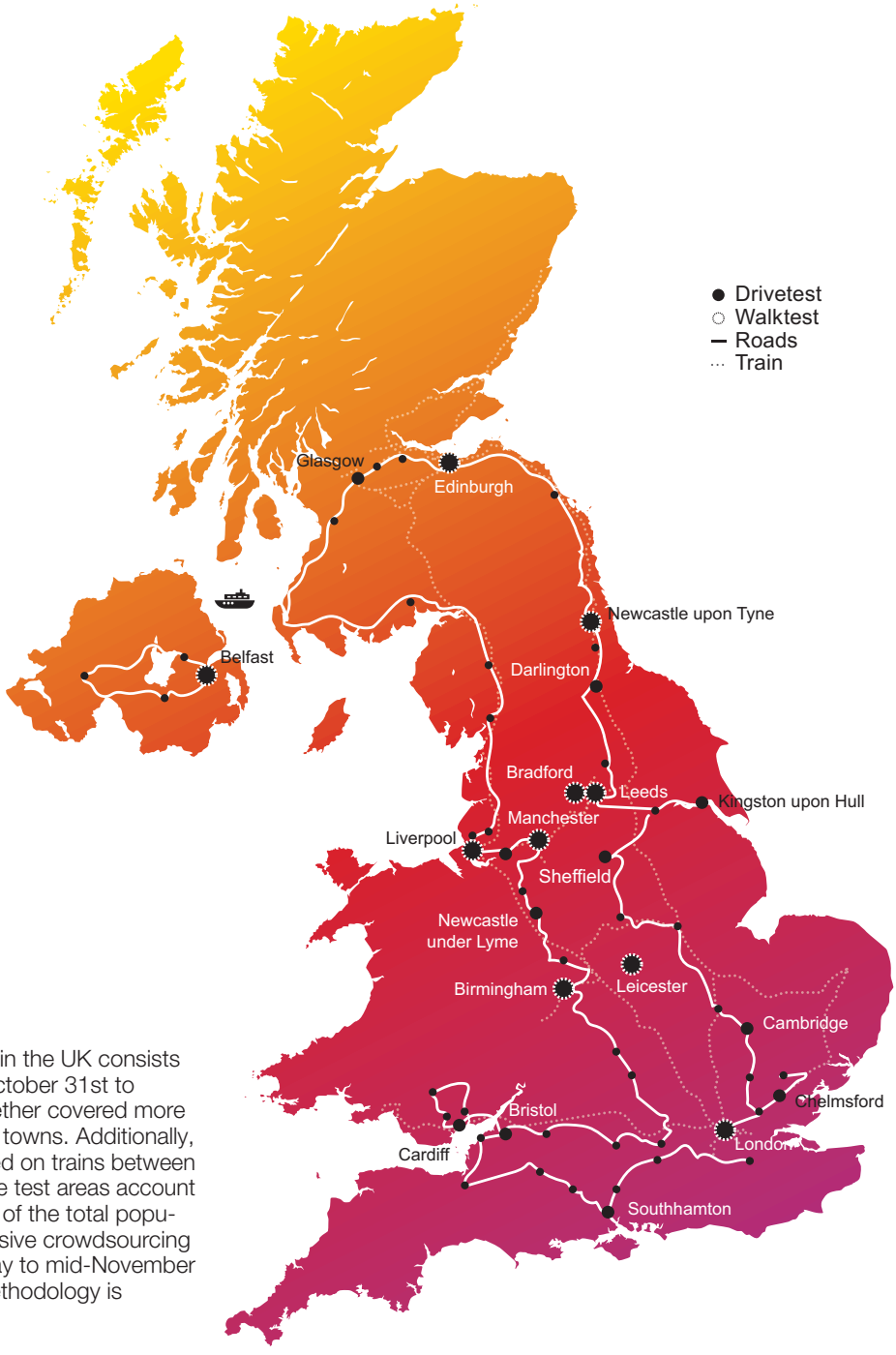
connect

The 2024 Mobile Network Test in the United Kingdom

umlaut
Part of Accenture

For the nineth time, we – umlaut, part of Accenture, and connect – have conducted our comprehensive benchmark of the UK's mobile networks. As in the previous year, its results show a very good winner, two contenders ranking in the good midfield, and one runner-up with the grade satisfactory.

The carefully designed methodology of our 2024 benchmark in the United Kingdom represents a holistic approach to network benchmarking. It combines drive tests and walk tests for executing detailed voice and data measurements under controlled circumstances combined with a sophisticated crowdsourcing methodology. The drive tests and walk tests allow for the maximum capabilities of the networks to be evaluated. Crowdsourcing provides profound insights into the overall coverage of voice, data and 5G services as well as realworld User Download Speeds and Latencies. We have thoroughly weighed these components in order to give a realistic and conclusive assessment of the rated networks' true potential and performance.



Scope

The 2024 umlaut connect Mobile Network Test in the UK consists of drive tests and walk tests conducted from October 31st to November 17th, 2023. Four drive test cars together covered more than 10,400 kilometres, visiting 19 cities and 38 towns. Additionally, two walk test teams visited ten cities and travelled on trains between them as well as to more remote destinations. The test areas account for 17.7 million people, or approx. 26.5 percent of the total population of the UK. In addition, the results of extensive crowdsourcing analyses, considering 24 weeks from end of May to mid-November 2023 are included in the score. Our detailed methodology is described on pages 12/13.

DRIVE TEST AND WALK TEST FACTS

17.7 million people covered	**10,430** km drive test	**207,063** data samples	**32,535** voice samples

CROWDSOURCING FACTS

10,441 million samples	**24** weeks (end of May to mid-November 2023)	**99.5%** of built-up area covered	**99.9%** of population covered

The UK Mobile Operators

Following Virgin Media and O2's merger in June 2021, the joint operator started moving all former Virgin Media mobile customers to O2 in early 2023. Thus counting 33.8 million mobile subscribers, VMO2 is the largest mobile network operator in the UK.
Formerly a subsidiary of British Telecom, O2 plc was purchased by the Spanish telecommunications company Telefónica in 2006. In 2021, O2 entered a 50:50 joint venture with Liberty Global, combining Liberty's brand Virgin Media and O2. The joint company also owns half of the mobile virtual network operator Tesco Mobile which operates on the VMO2 network in the UK.
The operator claims to cover approx. 99 percent of the UK population with 4G. Like the other UK operators, VMO2 is supporting Voice over LTE (VoLTE) in most of its 4G network. VMO2 is also continuously rolling out 5G, using its 3500 and 700 MHz spectrum for 5GNR. In late 2023, the company claimed to be live with 5G in more than 600 towns and cities in the UK.

With approximately 25 million customers, EE (formerly Everything Everywhere) is the second largest mobile network operator in the UK. Since 2016, EE has been part of the British Telecom Group. EE started offering its 4G service in 2012. Regarding 4G/LTE coverage, EE reports geographic coverage instead of population coverage. They quote Ofcom reporting an 85 per cent 4G geographic coverage which equates to more than 99 percent of the population. EE operates a growing number of "4G+" cells that support up to 5CA (five carrier frequencies) with up to 1 Gbps under the name "4GEE". Voice over LTE (VoLTE) is available in most of its 4G network.
BT with its brand EE claims to offer 5G in all major cities across the UK and to have the fastest 5G network in the country as well as offering the fastest overall speeds (4G and 5G combined). EE announced to cover the "entire" UK with 5G by 2028.

Vodafone UK is part of the international Vodafone Group which is also headquartered in the UK. The Vodafone Group owns and operates networks in 17 countries, having stakes in a further five countries through joint ventures and associates, and partnering with mobile networks in 48 further countries.
Vodafone UK launched 4G/LTE in 2013. Reporting 18.2 million mobile subscribers in autumn 2023, Vodafone is the third largest mobile network in the UK.
In June 2012, Vodafone and O2 signed a deal to "pool" their network technologies, creating a single national grid of 18,500 transmitter sites. Both operators however announced they would continue to use their own independent spectrum. Vodafone claims to cover more than 99 percent of the UK population with 4G/LTE offering up to 1 Gbps – as well as Voice over LTE (VoLTE). In 2023, Vodafone UK started to offer "5G Ultra" – 5G with over 1 Gbps – and claims to reach more than 1 million UK customers with this offer. As it is based on the aggregation of specific 5G carrier frequencies, "5G Ultra" can only be used with selected smartphones, mainly newer Samsung models.

Three UK is a subsidiary of CK Hutchison and launched its mobile service in the UK in 2003. As a relatively young operator Three started as a 3G-only network supplemented by 2G via national roaming. In December 2013, Three began to roll out its 4G/LTE service and expanded it rapidly all over the UK. With about 10.5 million customers, Three is the smallest mobile network operator in the UK.
In June 2023, Three and Vodafone announced a merger in order "to create one of Europe's leading 5G networks". As this meger was neither economically nor technically realized at the time of testing, in this year's Mobile Network Test we still treat them as two independent providers.
At the current state, Three UK claims to cover more than 99 percent of the UK's population with 3G or 4G. Voice over LTE (VoLTE) is available in most of its network.
The operator also claims to offer more spectrum for its 5G service than any other UK network operator and thus also claims to offer the UK's fastest 5G network.

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Results at a Glance

As in the previous years, the BT brand is the winner, achieving the grade “very good“ and scoring 73 points ahead of the second-ranking Vodafone. EE‘s lead is manifested in all three test categories, Voice, Data and Crowdsourcing. Compared to our previous Mobile Network Test in the UK in 2022, EE managed to improve its score by 4 points. The operator is also making good progress in terms of its 5G rollout.

Vodafone reaches a good second place and achieves the biggest score improvement over its previous year‘s results with a plus of 34 points. This makes Vodafone the most improved network in the UK this year and closes about 30 percent of the gap to EE. Vodafone showed the best voice performance in London and together with EE on the UK‘s roads. It is also local champion in Belfast and Leeds and shows good progress in its 5G rollout.

Three achieves a good third rank, also reaching the grade “good“. In comparison to its results from the previous year, Three was able to improve its score by 14 points. In the Voice assessment, Three ranks closely together with Vodafone and is particularly strong in the bigger cities. In Cardiff, Manchester and Liverpool, Three achieves the second place behind EE. It also provides quite high data throughputs in its 5G network.

The newly combined brands, still making up the UK‘s largest operator, rank fourth with the overall grade “satisfactory“. This rank is confirmed in all three test categories, Voice, Data and Crowdsourcing. VMO2 scores well in the big city walktests. It achieves a good overall result in London and outranks Three in the local assessments in Belfast, Edinburgh and Leeds. Compared to the previous year, VMO2 improved by 24 points.

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BEST IN TEST

EE

12/2023

MOBILE NETWORK TEST UNITED KINGDOM

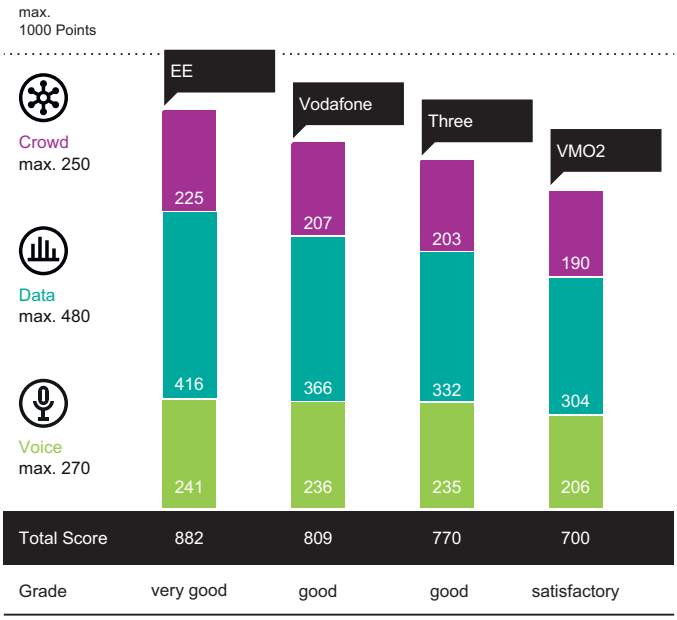
www.connect-testlab.com

“Congratulations to British Telecom for its brand EE winning our Mobile Network Test in the UK with the highest scores in all test disciplines. Vodafone achieves the highest score improvement compared to the previous year. Together with Three, Vodafone shows very good results in the Voice category. Three and VMO2 also manage to improve their scores considerably in comparison to our previous test in the UK.“

Hakan Ekmen, Global Networks Lead, Comms Industry and simultaneously CEO umlaut

Overall Results		EE	Vodafone	Three	VMO2
Voice	max. 270.00 P.	241	236	235	206
Cities (Drivetest)	121.50	90%	91%	92%	80%
Cities (Walktest)	40.50	97%	96%	97%	90%
Towns (Drivetest)	54.00	92%	83%	84%	76%
Roads (Drivetest)	33.75	89%	89%	83%	68%
Railways (Walktest)	20.25	64%	60%	57%	39%
Data	max. 480.00 P.	416	366	332	304
Cities (Drivetest)	216.00	91%	82%	76%	73%
Cities (Walktest)	72.00	89%	81%	59%	70%
Towns (Drivetest)	96.00	83%	70%	69%	48%
Roads (Drivetest)	60.00	86%	75%	68%	66%
Railways (Walktest)	36.00	70%	49%	48%	31%
Crowd	max. 250.00 P.	225	207	203	190
Crowd	250.00	90%	83%	81%	76%
Connect Rating	max. 1000 P.	882	809	770	700

Percentages and points rounded to integer numbers.
For the calculation of points and totals, the accurate, unrounded values were used.



Shown voice, data, crowd and total scores are rounded.

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Voice

THREE LEADS IN BIG CITIES VOICE DRIVETESTS, VODAFONE AND EE FOLLOWING AT CLOSE DISTANCE

In the voice tests, conducted by umlaut's test cars while driving in the UK's big cities, Three takes the overall lead by a narrow margin. Vodafone and EE follow at close distance. EE and Vodafone achieve the shortest call setup times, followed by Three at a narrow margin. All four operators provide excellent MultiRAB connectivity in the big city drivetests.

CITIES DRIVETEST

THREE

EE AND THREE AHEAD IN BIG CITIES VOICE WALKTESTS, VODAFONE FOLLOWS AT A NARROW GAP

In the walktests, conducted in Belfast, Birmingham, Bradford, Edinburgh, Leeds, Leicester, Liverpool, London, Manchester and Newcastle upon Tyne, EE and Three achieve the highest score, with Vodafone following at a narrow gap. Call setup times and MultiRAB connectivity are on the same high level as in the drivetest or even better. The performance of VMO2 comes closer to the rest of the field.

CITIES WALKTEST

EE AND THREE

EE AHEAD IN SMALLER TOWN VOICE DRIVETESTS

In the voice tests conducted by umlaut's test cars while visiting 38 smaller towns of the UK (see route map on page 1), EE takes the lead and shows the highest call reliability. Three follows at some distance on second place and Vodafone at a close gap on third rank. The KPIs such as success ratios, call setup times and MultiRAB connectivity are only slightly behind the results achieved in the big cities.

TOWNS DRIVETEST

EE

EE AND VODAFONE AHEAD IN VOICE TESTS ON ROADS

When it comes to the results of the voice tests performed while driving on British roads, EE and Vodafone are on a par regarding the achieved score. EE shows a slightly shorter average call setup time, speech quality and MultiRAB connectivity, while Vodafone takes the lead in terms of success ratios. Three follows at some distance, while VMO2 falls behind somewhat more noticeably here.

ROADS DRIVETEST

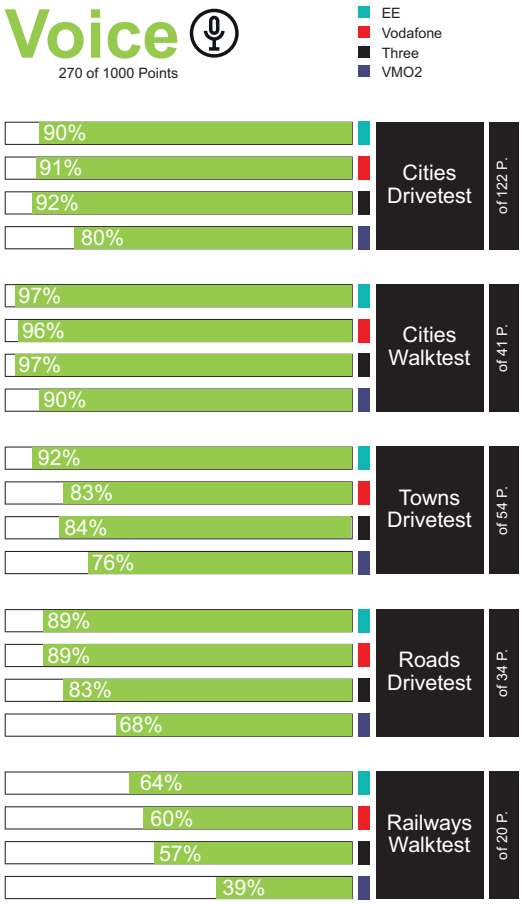
EE AND VODAFONE

EE SCORES AHEAD OF VODAFONE AND THREE IN VOICE TESTS PERFORMED ON RAILWAYS

In the voice tests performed by the test teams while travelling in trains through the UK, all operators fall clearly behind their scores in the other scenarios. Here, EE takes the lead, ahead of Vodafone and Three, with all three operators scoring relatively close together. The distance of VMO2 is more distinct in the railway scenario compared to the other ones.

RAILWAYS WALKTEST

EE



Operator	EE	Vodafone	Three	VMO2
Cities (Drivetest)				
Success Ratio (%)	98.5	98.7	99.0	97.8
Call Setup Time P90 (s)	1.5	1.6	1.8	3.5
Speech Quality P10 (MOS-LQO)	4.3	4.3	4.3	3.9
Multirab Connectivity (%)	100.0	99.9	100.0	99.9
Cities (Walktest)				
Success Ratio (%)	99.5	99.6	99.7	98.9
Call Setup Time P90 (s)	1.4	1.5	1.5	2.0
Speech Quality P10 (MOS-LQO)	4.6	4.7	4.5	4.1
Multirab Connectivity (%)	100.0	99.2	100.0	100.0
Towns (Drivetest)				
Success Ratio (%)	99.1	97.5	97.8	97.4
Call Setup Time P90 (s)	1.6	1.8	2.1	3.8
Speech Quality P10 (MOS-LQO)	4.3	4.3	4.1	3.8
Multirab Connectivity (%)	99.9	99.9	99.9	99.5
Roads (Drivetest)				
Success Ratio (%)	97.7	98.1	96.8	94.3
Call Setup Time P90 (s)	1.8	2.2	2.2	4.1
Speech Quality P10 (MOS-LQO)	4.1	4.0	3.7	3.6
Multirab Connectivity (%)	100.0	99.9	99.6	99.6
Railways (Walktest)				
Success Ratio (%)	91.0	90.6	89.6	86.2
Call Setup Time P90 (s)	1.8	2.6	1.8	3.8
Speech Quality P10 (MOS-LQO)	4.1	3.8	3.7	3.5
Multirab Connectivity (%)	99.2	98.3	99.5	99.3

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Data

EE AHEAD IN BIG CITIES DATA DRIVETESTS

In the data drivetests conducted in big UK cities, EE clearly takes the lead. Vodafone follows at some distance on the second rank, and Three follows at third place. VMO2 ranks fourth, but is not too far behind the third-ranking Three in the drivetests. In a more detailed analysis, EE benefits from using LTE-5CA (carrier aggregation), which this operator utilizes above 40 percent in the cities together with 5GNR-2CA.

CITIES DRIVETEST

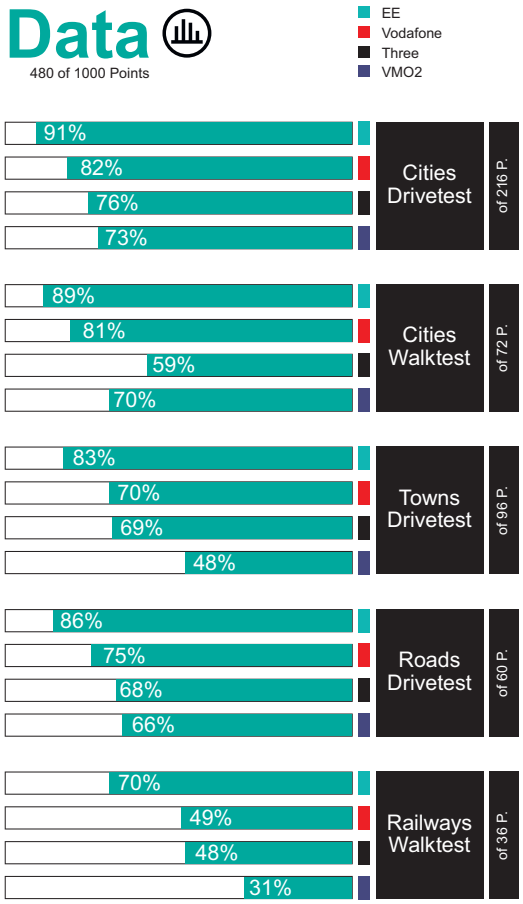
EE

EE ALSO LEADS IN BIG CITIES DATA WALKTESTS

In the data walktests conducted in the UK's bigger cities, EE also leads the field, Vodafone ranks second. VMO2 ranks third in this scenario, scoring on about the same level as in the data drivetests. In this scenario, Three falls distinctly behind, with lower success ratios in the web page, file upload and Youtube tests and also lower P10 (90% faster than) data rates in the file download and upload tests. VMO2 provides good speech quality in the voice OTT tests ("conversational app"), and is even leading in this KPI in the big cities walk tests.

CITIES WALKTEST

EE



Data Cities (Drivetest)	EE	Vodafone	Three	VMO2
Web-Page Download				
Success Ratio/Avg. Session Time (%/s)	99.6/1.5	98.8/1.6	98.0/1.6	97.8/1.7
File Download (10 MB)				
Success Ratio/Avg. Session Time (%/s)	100.0/2.1	99.6/2.9	99.7/4.5	98.6/4.4
90%/10% faster than (Mbps)	18.6/243.5	13.0/190.5	8.0/282.7	7.6/159.7
File Upload (5 MB)				
Success Ratio/Avg. Session Time (%/s)	100.0/3.5	99.1/4.8	99.3/5.8	99.4/6.8
90%/10% faster than (Mbps)	5.9/50.0	4.0/51.5	2.9/61.9	2.7/36.7
File Download (7 Seconds)				
Success Ratio (%)	99.7	99.2	99.0	98.3
10% faster than (Mbps)	541.2	352.6	564.6	246.4
Speed > 20Mbps / 100Mbps (%)	91.1/63.9	89.4/55.9	81.2/49.1	80.7/42.5
File Upload (7 Seconds)				
Success Ratio (%)	99.9	98.7	98.3	98.1
10% faster than (Mbps)	64.8	70.2	86.2	44.1
Speed > 2Mbps / 5Mbps (%)	98.0/93.3	97.6/89.6	95.0/84.6	95.7/85.6
Youtube				
Success Ratio/Start Time (%/s)	99.3/2.1	97.6/2.2	96.1/2.2	96.3/2.5
Average Video Resolution (p)	1078	1075	1075	1073
Youtube live				
Success Ratio/Start Time (%/s)	99.3/2.4	97.1/2.6	94.8/2.7	94.1/2.9
Average Video Resolution (p)	1079	1074	1071	1070
Conversational-App				
Success Ratio (%)	99.6	99.2	99.5	99.1
Speech Quality P10 (MOS-LQO)	3.5	2.8	2.9	3.0
Interactivity e-Gaming				
Success Ratio/Interactivity e-Gaming (%)	94.5/73.8	90.0/67.1	88.5/69.5	89.4/69.9

Data Cities (Walktest)	EE	Vodafone	Three	VMO2
Web-Page Download				
Success Ratio/Avg. Session Time (%/s)	99.6/1.6	98.9/1.7	95.1/1.9	97.0/1.7
File Download (10 MB)				
Success Ratio/Avg. Session Time (%/s)	99.8/3.0	99.3/3.3	99.3/6.6	98.8/4.4
90%/10% faster than (Mbps)	15.7/201.4	13.0/180.5	4.9/206.9	8.9/146.1
File Upload (5 MB)				
Success Ratio/Avg. Session Time (%/s)	98.8/3.3	98.6/4.7	97.0/6.2	97.5/7.1
90%/10% faster than (Mbps)	6.9/50.2	3.7/52.3	2.9/53.0	2.4/28.8
File Download (7 Seconds)				
Success Ratio (%)	100.0	99.8	98.3	98.3
10% faster than (Mbps)	442.9	312.9	368.3	194.5
Speed > 20Mbps / 100Mbps (%)	83.2/55.7	87.9/52.5	70.8/36.9	83.9/43.8
File Upload (7 Seconds)				
Success Ratio (%)	99.1	98.8	95.8	98.0
10% faster than (Mbps)	64.4	75.4	73.3	37.1
Speed > 2Mbps / 5Mbps (%)	99.3/96.2	97.4/91.1	93.5/83.9	94.5/81.7
Youtube				
Success Ratio/Start Time (%/s)	100.0/2.2	97.2/2.3	89.4/2.5	95.5/2.4
Average Video Resolution (p)	1078	1074	1071	1077
Youtube live				
Success Ratio/Start Time (%/s)	98.4/2.6	96.2/2.7	92.4/3.1	94.0/2.8
Average Video Resolution (p)	1078	1071	1064	1070
Conversational-App				
Success Ratio (%)	99.6	99.0	99.3	98.6
Speech Quality P10 (MOS-LQO)	3.5	3.4	3.2	3.6
Interactivity e-Gaming				
Success Ratio/Interactivity e-Gaming (%)	96.9/71.8	89.1/67.8	78.4/65.2	87.6/70.1

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Data

EE ALSO LEADS IN DATA DRIVETESTS IN TOWNS

As in the big cities, EE also leads in the data drivetests performed in 38 smaller towns of the UK. Vodafone and Three follow on second place with almost equal scores. VMO2 falls behind at a pronounced gap. This ranking can be seen in many of the KPIs such as the success ratios of web page and file downloads or Youtube accesses. In some of the download KPIs, Three shows somewhat faster results than Vodafone.

TOWNS DRIVETEST

EE

EE AHEAD IN DATA DRIVETESTS ON THE UK'S ROADS

The data measurements performed by umlaut's test cars on the UK's roads are of particular interest for motorists. In this category, EE once again leads the field. Vodafone follows on a clear second rank, while Three and VMO2 score relatively close together. In the web page and file download tests, the success ratios are generally okay for all four operators, but they are dropping at Three and VMO2 in some of the upload and the Youtube tests.

ROADS DRIVETEST

EE

Photo: Steve Heap, shutterstock

Data Towns (Drivetest)	EE	Vodafone	Three	VMO2
Web-Page Download				
Success Ratio/Avg. Session Time (%/s)	99.6/1.6	97.8/1.9	97.0/1.7	93.6/2.2
File Download (10 MB)				
Success Ratio/Avg. Session Time (%/s)	100.0/3.2	98.8/6.8	98.8/5.7	96.5/11.0
90%/10% faster than (Mbps)	12.9/149.1	4.6/122.4	6.5/241.7	2.8/62.8
File Upload (5 MB)				
Success Ratio/Avg. Session Time (%/s)	99.6/5.2	99.0/5.9	98.7/7.9	97.8/8.0
90%/10% faster than (Mbps)	3.4/44.3	3.2/37.7	2.2/38.6	2.3/28.2
File Download (7 Seconds)				
Success Ratio (%)	99.3	97.4	99.0	93.6
10% faster than (Mbps)	239.0	197.5	479.2	82.9
Speed > 20Mbps / 100Mbps (%)	84.3/30.6	60.6/17.2	74.1/29.0	43.8/7.8
File Upload (7 Seconds)				
Success Ratio (%)	98.7	98.4	97.5	97.8
10% faster than (Mbps)	58.9	53.1	45.6	35.4
Speed > 2Mbps / 5Mbps (%)	96.2/86.3	96.7/85.0	91.9/77.2	94.1/78.0
Youtube				
Success Ratio/Start Time (%/s)	99.0/2.2	97.4/2.5	96.6/2.3	88.3/3.0
Average Video Resolution (p)	1077	1068	1075	1058
Youtube live				
Success Ratio/Start Time (%/s)	97.8/2.6	94.4/3.1	95.3/2.9	86.9/3.7
Average Video Resolution (p)	1079	1064	1071	1047
Conversational-App				
Success Ratio (%)	98.9	98.6	99.3	97.8
Speech Quality P10 (MOS-LQO)	3.3	3.4	2.9	3.1
Interactivity e-Gaming				
Success Ratio/Interactivity e-Gaming (%)	92.4/67.6	91.0/60.6	86.9/60.1	87.1/62.0

Data Roads (Drivetest)	EE	Vodafone	Three	VMO2
Web-Page Download				
Success Ratio/Avg. Session Time (%/s)	98.9/1.7	97.5/1.9	97.6/2.0	96.8/2.0
File Download (10 MB)				
Success Ratio/Avg. Session Time (%/s)	99.4/3.9	99.6/8.3	100.0/7.6	99.0/8.3
90%/10% faster than (Mbps)	11.9/104.6	3.9/107.3	4.2/92.0	4.5/63.9
File Upload (5 MB)				
Success Ratio/Avg. Session Time (%/s)	99.2/5.1	99.6/7.4	98.6/9.8	98.2/8.2
90%/10% faster than (Mbps)	3.9/46.3	2.2/30.8	1.6/30.9	2.0/25.3
File Download (7 Seconds)				
Success Ratio (%)	99.8	97.2	97.6	96.6
10% faster than (Mbps)	135.6	131.7	120.9	72.6
Speed > 20Mbps / 100Mbps (%)	79.3/18.5	55.4/12.1	66.4/13.0	50.1/5.7
File Upload (7 Seconds)				
Success Ratio (%)	98.3	98.8	95.1	95.8
10% faster than (Mbps)	59.8	36.0	37.7	27.3
Speed > 2Mbps / 5Mbps (%)	96.4/86.9	92.1/81.5	89.1/69.5	91.8/77.2
Youtube				
Success Ratio/Start Time (%/s)	97.7/2.2	96.0/2.6	93.5/2.7	93.5/2.8
Average Video Resolution (p)	1076	1069	1070	1064
Youtube live				
Success Ratio/Start Time (%/s)	97.5/2.6	95.0/3.1	90.9/3.4	90.2/3.4
Average Video Resolution (p)	1076	1059	1061	1062
Conversational-App				
Success Ratio (%)	99.0	98.8	98.0	97.9
Speech Quality P10 (MOS-LQO)	3.0	3.0	2.6	3.0
Interactivity e-Gaming				
Success Ratio/Interactivity e-Gaming (%)	91.5/65.7	91.8/59.5	79.7/55.6	87.0/62.0

Data

EE AHEAD IN RAILWAYS DATA TESTS ON OVERALL LOW LEVEL, THREE ON SECOND RANK

RAILWAYS WALKTEST

EE

In the walktests that were specifically conducted on British trains, all operators show some room for improvements. But EE is still ahead in this assessment, at a pronounced gap to Vodafone and Three who score in the mid-field, but almost at a par in this scenario. VMO2 comes in fourth, once again with a clear distance to the other candidates. This ranking can be clearly seen in the success ratios and many of the other tested KPIs. In the determined download speeds, Three is in most KPIs somewhat ahead of Vodafone.

Data Railways (Walktest)	EE	Vodafone	Three	VMO2
Web-Page Download				
Success Ratio/Avg. Session Time (%/s)	95.8/2.0	90.1/2.2	91.2/2.2	84.5/2.5
File Download (10 MB)				
Success Ratio/Avg. Session Time (%/s)	98.9/5.2	95.4/10.2	97.9/8.3	90.8/14.5
90%/10% faster than (Mbps)	7.4/164.6	2.7/142.1	3.7/224.3	2.2/94.2
File Upload (5 MB)				
Success Ratio/Avg. Session Time (%/s)	98.8/8.2	93.6/11.6	92.3/14.8	89.0/14.1
90%/10% faster than (Mbps)	2.1/38.7	1.2/31.5	1.1/29.1	1.0/20.4
File Download (7 Seconds)				
Success Ratio (%)	98.0	96.0	96.6	89.3
10% faster than (Mbps)	326.9	215.3	328.2	114.3
Speed > 20Mbps / 100Mbps (%)	75.3/28.2	55.3/25.7	63.9/29.7	42.3/13.1
File Upload (7 Seconds)				
Success Ratio (%)	94.4	92.7	90.6	85.8
10% faster than (Mbps)	45.2	46.2	40.7	24.9
Speed > 2Mbps / 5Mbps (%)	90.7/76.1	87.5/73.0	81.7/60.7	83.1/61.9
Youtube				
Success Ratio/Start Time (%/s)	92.8/2.6	87.2/2.8	83.2/2.7	76.7/3.3
Average Video Resolution (p)	1071	1058	1066	1059
Youtube live				
Success Ratio/Start Time (%/s)	92.8/3.0	85.2/3.5	79.4/3.3	72.1/3.6
Average Video Resolution (p)	1070	1044	1055	1040
Conversational-App				
Success Ratio (%)	95.9	94.5	95.8	93.9
Speech Quality P10 (MOS-LQO)	2.8	2.7	2.6	2.7
Interactivity e-Gaming				
Success Ratio/Interactivity e-Gaming (%)	80.4/63.0	75.8/58.2	61.3/54.0	68.3/59.3

EE AND THREE COMPETE FOR HIGHEST 5G DATA RATES

5G

5G is the standard setting in our measurements. But to shed light on the progress of the 5G rollout, we look at the results of the KPI "Data rates of the 7 second Download tests". This gives a good indication of the data rates which are delivered by this technology. But as this assessment does not consider other aspects such as 5G coverage or the latencies of 5G-only connections, we do not identify a separate 5G winner.

That said, in this assessment, EE shows the highest average 5G data rates in the cities and on trains, while Three takes the lead in the P90 values (10 percent faster than) in the drivetests in cities, towns and on the roads. Three is also ahead in the average data rates in towns and on the roads. In the cities, all operators show a strong 5G penetration, mostly with more than 75 percent of the areas covered by this technology. EE, Vodafone and VMO2 to some extent use Dynamic Spectrum Sharing (DSS), but the share of samples is not very significant. For Three, the tests did not register this connection type. Compared to the previous year, most of the "plain 5G" shares and data rates have increased for all operators, so the 5G rollout in the UK is generally well on track.

Photo: Trabantos, shutterstock

Data rates 7s Download	EE			Vodafone			Three			VMO2		
Samples with 5G	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)
Cities – Drivetest	78.5%	274.2	594.4	63.2%	203.4	389.4	78.2%	253.1	637.1	76.4%	131.4	269.5
Cities – Walktest	78.1%	220.2	473.8	63.1%	180.9	358.7	78.7%	147.3	388.0	89.1%	108.4	200.0
Towns – Drivetest	33.9%	138.8	421.8	13.7%	254.9	440.4	46.5%	276.3	659.9	27.5%	73.8	187.3
Roads – Drivetest	34.1%	76.0	160.1	9.9%	209.1	362.1	34.8%	119.8	298.2	19.5%	70.7	134.9
Trains – Walktest	46.8%	169.9	495.8	35.7%	162.8	328.8	57.8%	147.3	375.2	45.3%	69.1	149.2
Samples with 5G-DSS	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)	Share	Average (Mbps)	10% faster than (Mbps)
Cities – Drivetest	1.6%	91.2	224.3	11.9%	143.4	314.1	–	–	–	1.4%	50.4	95.1
Cities – Walktest	0.7%	83.8	126.2	9.5%	109.9	234.8	–	–	–	0.2%	41.7	41.7
Towns – Drivetest	5.4%	56.0	134.3	3.0%	138.6	299.1	–	–	–	3.0%	17.6	36.8
Roads – Drivetest	2.2%	30.7	52.8	6.6%	85.9	236.8	–	–	–	1.5%	15.2	29.0
Trains – Walktest	4.0%	36.7	67.1	4.8%	89.8	233.4	–	–	–	2.2%	41.8	97.0

Crowd

EE LEADS IN TERMS OF BROADBAND COVERAGE, THREE FOLLOWS ON SECOND RANK

In the Coverage Quality assessment (see KPI definitions on pages 12/13), EE is ahead, followed by Three and then Vodafone. In Coverage Reach, a leading EE is followed by VMO2 and then Vodafone. In the investigation of Time of Broadband, EE leads again, followed by Three and then Vodafone. Overall, VMO2 has the biggest opportunity for improvement.

BROADBAND COVERAGE

EE

EE LEADS IN PASSIVE DOWNLOAD ANALYSIS

In the passively observed download data rates, EE is ahead again, although in the Basic Internet class (minimum of 2 Mbps) Vodafone reaches a slightly higher share. In the HD Video class (at least 5 Mbps), the ranking corresponds to the overall result. In the demanding UHD Video class (at least 20 Mbps), EE leads, but Three is ahead of Vodafone and then VMO2.

DOWNLOADS PASSIVE

EE

EE ALSO AHEAD IN ACTIVE DOWNLOAD ANALYSIS

The actively performed download tests are conducted to better approximate the maximum performance of an internet connection. In this metric, EE again takes the lead, with Three following due to higher average and P90 (10 percent faster than) results compared to Vodafone. In the P10 value (90 percent faster than), VMO2 is on a par with Three, but behind Vodafone.

DOWNLOADS ACTIVE

EE

Operators	EE	Vodafone	Three	VMO2
Broadband Coverage				
Coverage Quality (%)	98.3	93.2	94.6	89.1
Coverage Reach (%)	96.3	94.4	93.2	96.1
Time on Broadband (%)	98.3	94.2	95.7	91.5
Download Speed (Passive)				
Basic Internet Class(%)	95.2	95.3	94.6	93.3
HD Video Class / UHD Video Class (%)	85.9/29.3	83.3/23.6	81.4/24.9	79.3/23.3
Latency				
Gaming Class / OTT Voice Class (%)	80.4/94.8	68.4/95.3	58.3/93.4	58.9/93.3
Voice				
HD Voice (%)	98.3	89.5	94.3	86.4
Download Speed (Active)				
Avg. Throughput (Mbit/s)	54.7	37.1	43.5	27.3
90% / 10% faster than (Mbit/s)	3.9/127.9	2.9/89.5	2.6/95.2	2.6/63.6
Upload Speed (Active)				
Avg. Throughput (Mbit/s)	17.0	12.9	11.6	9.5
90% / 10% faster than (Mbit/s)	1.8/39.5	1.8/28.9	1.6/26.8	1.5/21.5
Stability				
Transaction Success (%)	93.1	90.7	89.7	87.8

EE AHEAD IN ACTIVE UPLOAD TESTS

The results of the active Download category are also mostly confirmed by the accompanying upload tests. EE again achieves the highest sub-score in this category. The average and P90 (10 percent faster than) throughputs follow the overall ranking. In the P10 KPI (90 percent of the measured values faster than), EE and Vodafone are on a par, followed by Three and VMO2.

UPLOADS ACTIVE

EE

EE LEADS IN HD VOICE AVAILABILITY, THREE RANKS SECOND BEST IN THIS CATEGORY

In the analysis of the availability of HD voice connections (i.e. Voice over LTE), EE takes the first place. In this assessment, Three ranks second best, ahead of Vodafone and then VMO2.

VOICE

EE

EE PROVIDES SHORTEST LATENCIES, FOLLOWED BY VODAFONE. VMO2 SCORES SLIGHTLY HIGHER THAN THREE

EE also shows the best results in the latency category, both for the more relaxed OTT Voice class (roundtrip times up to 100 milliseconds) Vodafone achieves a higher share than EE. In the more demanding Gaming class (up to 50 ms), EE leads and Vodafone follows, but VMO2 scores slightly higher than Three.

LATENCY

EE

EE AHEAD IN CROWDSOURCED ASSESSMENT OF TRANSACTION STABILITY

In the Stability category, which looks at the success rates of regular transaction tests, the overall ranking is once more confirmed: EE takes the lead, while Vodafone, Three and VMO2 follow in this order, with distinct, but overall small gaps between their results.

STABILITY

EE

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The 2024 Mobile Network Test in the United Kingdom

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Reliability

Reliability is not an additional category of our tests, but rather a diffent angle of looking at the results: For each KPI, our scoring distinguishes between "Qualifiers" (the expected basic performance) and "Differentiators" (the additional performance that exceeds the expected basics). The view at Reliability limits itself to most of the Qualifiers and the basic KPIs of the crowdsourcing – thus conveying an impression of the standard performance a user can reasonably expect from a mobile network. The reference values in this representation are therefore only the subset of score points which we assigned to the Qualifiers. The resulting scores state the reliabiltiy with which an operator offers its network services. This approach concentrates on the compulsory basics instead of the highest peaks of a network's performance.

Operator		EE	Vodafone	Three	VMO2
Voice	max. 148.5 points	125	122	123	107
Drivetest	115.1	87%	84%	85%	75%
Walktest	33.4	77%	76%	75%	63%
Data	max. 264.0 points	245	214	191	172
Drivetest	204.6	94%	84%	78%	68%
Walktest	59.4	87%	71%	52%	54%
Crowd	max. 116.9 points	107	104	103	98
Crowd	116.9	92%	89%	88%	84%
Total	max. 529.4 points	477	440	417	377

EE LEADS IN VOICE RELIABILITY, FOLLOWED BY THREE

In the overall assessment of the Reliability of voice connections, EE achieves the highest score, with Three ranking second and Vodafone following on third place at a narrow gap of just one score point. VMO2 comes in fourth. This overall ranking can also be seen in the drivetest results. In the walktest results, EE scores ahead of Vodafone, followed by Three and then VMO2.

VOICE

EE

EE LEADS IN DATA RELIABILITY

Looking at Reliability in the Data tests, EE also leads – based both on the results of the drivetest as well as on the results of the walktests. The gap to the runner-ups is distinct. The drivetest results show the overall ranking. In the walktests, EE also ranks first, and Vodafone second, but VMO2 scores slightly stronger than Three.

DATA

EE

EE ALSO AHEAD IN CROWDSOURCING, VODAFONE AND THREE ALMOST ON A PAR, VMO2 FOURTH

In the crowdsourced KPIs, EE once more takes the lead at a distinct gap over the other contenders. The rest of the field ranks close together. Vodafone ranks second and Three third, but both score very close together. VMO2 follows on fourth place at a little more distinct gap of five score points.

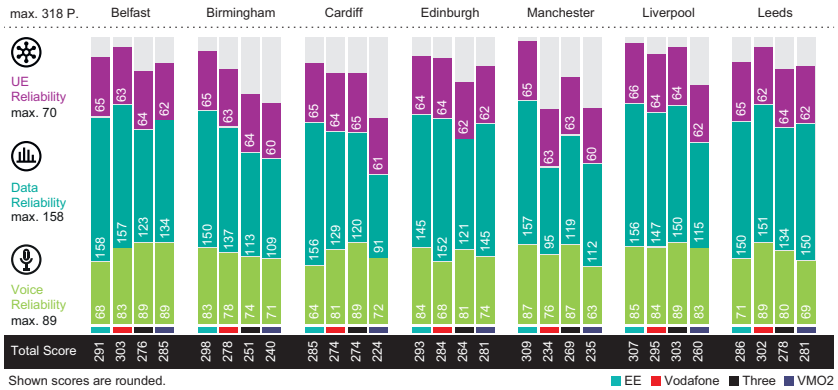
CROWD

EE

RELIABILITY IN CITY SCORES

EE ALSO LEADS IN THE RELIABILITY CITY SCORES IN BIRMINGHAM, CARDIFF, EDINBURGH, MANCHESTER AND LIVERPOOL. VODAFONE IS AHEAD IN BELFAST AND LEEDS.

In the the Reliability Assessment of the UK's largest cities (also see page 11), we see the same ranking as in the overall result in Birmingham. EE also leads in Cardiff, but here Vodafone and Three score on a par. In Edinburgh, EE is ahead, with Vodafone following at close distance and VMO2 ranking third ahead of Three. In Manchester and Liverpool, EE also leads, but is followed by Three. In Belfast and Leeds, Vodafone is ahead of EE with all four contenders scoring particulary strong. In Belfast, Edinburgh, Manchester and Leeds, VMO2 achieves the third rank ahead of Three.



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The 2024 Mobile Network Test in the United Kingdom

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City Score London

Traditionally, umlaut and connect take a closer look at London to see how the countries' mobile operators cover the UK's capital. This is not only of great interest for the approximately nine million inhabitants of this lively centre of business, politics and culture, but not least for the roughly 20 million visitors per year who frequent Londons' streets, squares and attractions. In this focused assessment, EE and Vodafone achieve the grade "very good", while Three and VMO2 achieve the grade "good".

Photo: Li Tsai, shutterstock

IN THE VOICE SCORE FOR LONDON, VODAFONE IS AHEAD, THREE RANKS SECOND AND EE THIRD

In a tight race for the highest score in the voice category in London, Vodafone takes the lead. Three ranks second at a gap of one score point out of a possible total of 162. EE follows at a close distance of two score points behind Three. VMO2 ranks fourth at a more distinct gap.

VOICE

VODAFONE

EE AHEAD IN DATA CATEGORY IN LONDON, VODAFONE COMES IN SECOND AND VMO2 THIRD AHEAD OF THREE

In the data category, the lead of EE is pronounced, and Vodafone follows on a strong second place. VMO2 manages to outperform Three in this category. However, the gap between ranks three and four is comparatively small with five out of a possible maximum of 288 points.

DATA

EE

EE LEADS IN CROWD ASSESSMENT IN LONDON, FOLLOWED BY VODAFONE, THREE AND THEN VMO2

In the Crowdsourcing concentrated on the London city area, EE is also ahead. The analyses show the same order as in the nationwide ranking: Vodafone follows on second place, with Three closely behind at a gap of three out of a possible total of 150 points. VMO2 ranks fourth at a slightly wider gap.

CROWD

EE

EE AHEAD IN RELIABILITY ASSESSMENT FOR LONDON, VODAFONE AND THREE STONGER IN VOICE HERE TOO

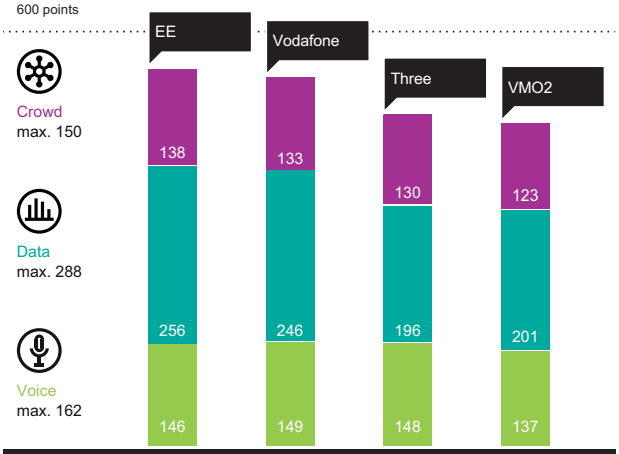
In the view at only basic requirements EE also leads the field. In the voice category, however, Vodafone and Three are two out of a possible maximum of 89 points ahead of EE. In the data category, EE's lead is distinct, in the crowdsourcing, EE, Vodafone and Three are only one out of 70 points apart of each other.

RELIABILITY

EE

City Score - London

max. 600 points

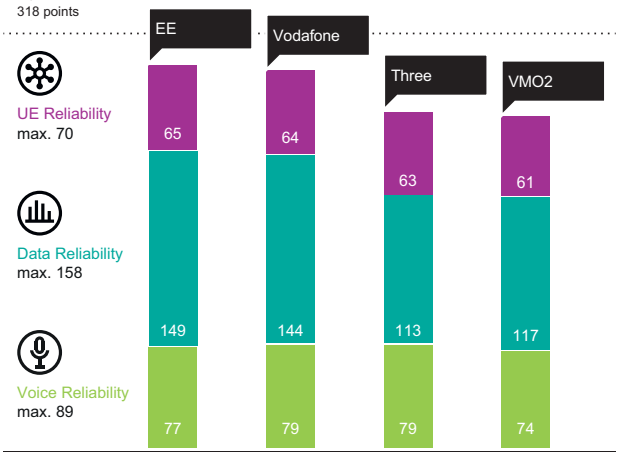


	EE	Vodafone	Three	VMO2
Total Score	540	528	474	461
Grade	very good	very good	good	good

Shown voice, data, crowd and total scores are rounded.

City Score Reliability - London

max. 318 points



	EE	Vodafone	Three	VMO2
Total Score	291	287	255	252

Shown voice, data, crowd and total scores are rounded.

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The 2024 Mobile Network Test in the United Kingdom

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The UK‘s Largest Cities

In addition to London, umlaut and connect also analyse the local performances in the seven other largest cities of the UK. After all, for their inhabitants and visitors it is also interesting to see how the different operators perform in their areas. With a maximum score of 600 points in this assessment, the grade “very good“ starts at 510 points (and “good“ at 450 points; “outstanding“ would start at 570). Very good results are thus achieved by EE in all seven considered cities, by Vodafone in Belfast, Edinburgh, Liverpool and Leeds, by Three in Cardiff, Liverpool and Leeds, and by VMO2 in Leeds.

VODAFONE AHEAD IN BELFAST, EE FOLLOWS ON SECOND PLACE, VMO2 RANKS THIRD AHEAD OF THREE

In the capital of Northern Ireland, Vodafone takes the lead due to very strong voice results. EE follows on second rank, and VMO2 outranks Three due to a higher score in the data category. In the crowdsourcing, the nationwide ranking applies: EE is ahead, followed by Vodafone, Three and then VMO2.

BELFAST

VODAFONE

EE AHEAD IN BIRMINGHAM, FOLLOWED BY VODAFONE, THREE AND THEN VMO2

In the West Midlands city, the lead of EE is quite pronounced – the BT brand achieves the highest score in all three sub-categories. The nationwide ranking EE-Vodafone-Three-VMO2 can also be seen in the separate voice and data categories. In the crowdsourcing, Three takes the second place from Vodafone, both ranking behind EE and ahead of VMO2.

BIRMINGHAM

EE

EE AHEAD IN CARDIFF, THREE TAKES SECOND PLACE HERE, FOLLOWED BY VODAFONE

In the capital of Wales, EE takes the lead, but is followed by a strong Three, due to Three achieving the highest score in the voice category. In the data and crowdsourcing categories, EE is also ahead, but Three outranks Vodafone – by one point in the data assessment, but more distinctly in the crowdsourcing.

CARDIFF

EE

EE LEADS IN EDINBURGH, CLOSELY FOLLOWED BY VODAFONE. VMO2 RANKS THIRD HERE, AHEAD OF THREE

In the capital of Scotland, EE is also ahead overall, but Vodafone follows at comparably close distance and achieves the highest score in the data category as well as in the crowdsourcing. VMO2 follows on third place with a lead of a few points ahead of Three, scoring behind Three in voice, but ahead of Three in the data and crowd categories.

EDINBURGH

EE

EE IS LOCAL CHAMPION IN MANCHESTER, THREE TAKES SECOND PLACE AND VODAFONE THIRD, AHEAD OF VMO2

In northwest Englands industrial center, EE leads at a distinct gap ahead of second-placed Vodafone. EE achieves the highest scores in all three categories. Three follows closely in the voice assessment, outranks Vodafone in the data category, and scores on a par with Vodafone in the crowdsourcing. VMO2 also scores ahead of Vodafone in the data category.

MANCHESTER

EE

EE AHEAD IN LIVERPOOL, AHEAD OF THREE AND AN ALSO VERY STRONG VODAFONE. VMO2 RANKS FOURTH

In the northwest English city, the race takes place on a particularly high level and is tight. EE takes the overall lead, closely followed by Three at then Vodafone at a comparatively close distance. Three achieves the highest score in the voice category and scores ahead of Vodafone in data and crowdsourcing. In the voice category, EE and Vodafone are just one point apart.

LIVERPOOL

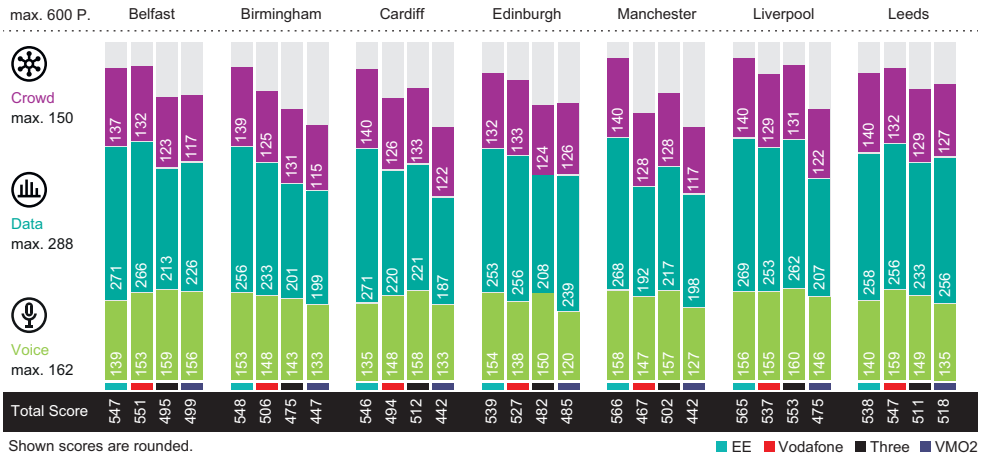
EE

VODAFONE IS LOCAL CHAMPION IN LEEDS, CLOSELY AHEAD OF EE. VMO2 RANKS THIRD AHEAD OF THREE.

In the Yorkshire city, Vodafone leads the field with the highest score in the voice category. In the voice assessment, Three takes second place. In data, EE is ahead, but VMO2 scores on a par with Vodafone, outranking Three and thus taking the third place overall. The crowdsourcing again shows the nationwide ranking.

LEEDS

VODAFONE



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The 2024 Mobile Network Test in the United Kingdom

umlaut Part of Accenture

Methodology

The umlaut connect Mobile Network Test is the result of extensive drivetests and walktests, combined with a sophisticated crowdsourcing analysis.

Logistics

connect's network test partner umlaut, Part of Accenture, sent four measurement vehicles through the country, each equipped with twelve smartphones. For each network operator, a Samsung Galaxy S23 took the voice measurements, and another S23 established the connections for the new test case "conversational app" (see section "Data connections" below). For the actual data test, we used a third Samsung Galaxy S23 per operator. For all measurements, the smartphones were set to "5G preferred" – so wherever supported by the network, the data tests took place via 5G.

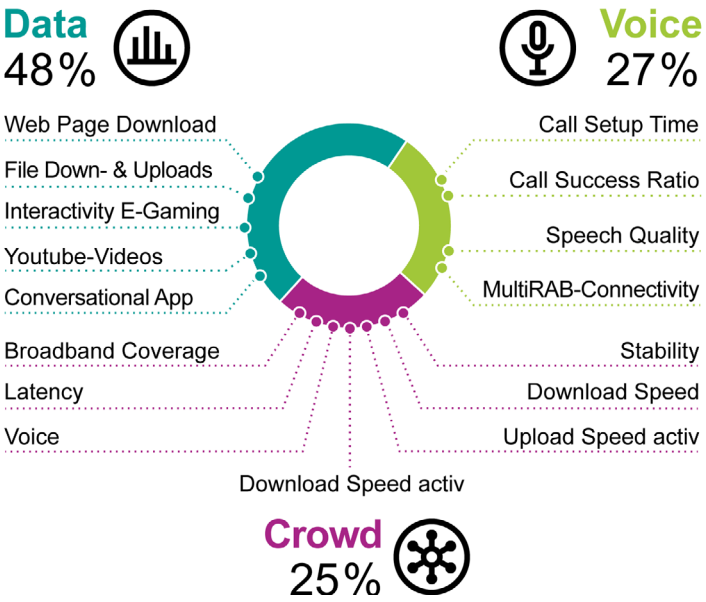
In addition to the drive tests, two walk test teams carried out measurements on foot in each country, in zones with heavy public traffic such as railway station concourses, airport terminals, cafés, public transport and museums. The walk test programme also included journeys on long-distance railway lines. For the walk tests, the same three smartphone types were used per network operator for the same measurements as in the drive tests. The walk test teams transported the smartphones in backpacks or trolleys equipped with powerful batteries. The firmware of the test smartphones corresponded to the original network operator version in each case.

The drive and walk tests took place between 8 am and 10 pm. For the drive tests, two vehicles were in the same city, but not in the same place, so that one car would not falsify the measurements of the other. On the connecting roads, two vehicles each drove the same routes, but one after the other with some time and distance between them. For the selection of the test routes, umlaut created four different suggestions for each country, from which connect blindly selected a route.

Voice connections

Voice connections account for 27 percent of the overall result. For this purpose, mobile telephone calls were established from vehicle to vehicle („mobile-to-mobile") and their success rates, call set-up time and voice quality were measured. The smartphones of the walk test teams made calls to a stationary (smartphone) remote station for the voice tests.

To ensure realistic conditions, data traffic was handled simultaneously in the background. We also recorded MultiRAB connectivity: the use of several "**r**adio **a**ccess **b**earers" provides data connections in the background of the voice calls. The transmission quality was evaluated with the POLQA wideband method suitable for HD voice. "VoLTE preferred" was configured on all phones – from 5G, the phones thus fall back to telephony via LTE.



Data connections

The data measurements account for 48 percent of the total result. Several popular live pages (dynamic) and the ETSI reference page known as the Kepler page (static) were retrieved to assess internet page calls. In addition, 10 MB and 5 MB files were downloaded and uploaded, respectively, in order to determine the performance for smaller data transfers. We also determined the data rate within a 7-second period when uploading and downloading large files. As Youtube dynamically adapts the resolution to the available bandwidth, the evaluation takes into account the average image resolution or number of lines of the videos as well as the success rate and the time until playback starts.

A typical over-the-top voice connection (OTT) is represented by the "conversational app" test case. To do this, we set up a voice channel via the SIP and STUN protocols using the OPUS codec and determined the success rate and voice quality. In addition, for our test point "Interactivity of eGaming" our measurements simulated a highly interactive UDP multiplayer session to determine the latency times of the connection and any possible packet losses. >>

Methodology

Crowdsourcing
Crowdsourcing results accounted for 25 per cent of the overall rating. They show which network performance actually arrives at the user – however, the end devices and tariffs used also have an impact on these results.

To obtain the data basis for these analyses, thousands of popular apps recorded the parameters described below in the background – provided the user agreed to the completely anonymous data collection. The measured values were recorded in 15-minute intervals and transmitted to the umlaut servers once a day. The reports contain only a few bytes, so they hardly burden the user's data volume.

Broadband Coverage
In order to determine the broadband *coverage reach*, umlaut laid a grid of 2 x 2 km tiles ("Evaluation Areas", in short EAs) over the test area. A minimum number of users and measured values had to be available for each EA. For the evaluation, umlaut awarded one point per EA if the network under consideration offered 3G coverage. Three points were awarded if 4G or 5G was available in the EA. The score achieved was divided by the achievable number of points (three points per EA in the "Union Footprint" – the area of the country measured by all testers with their smartphones).

We also looked at the *coverage quality*. For each operator, it indicates the average percentage of 4G or 5G coverage on an EA, averaged over all EAs in the common footprint, i.e. the area in which data is served by all operators.

The *time on broadband* in turn tells us how often a user had 4G or 5G reception in the period under consideration – regardless of the EAs in which the samples were recorded. For this purpose, umlaut sets the samples that show 4G/5G coverage in relation to the total number of all samples. Important: The percentage values determined for all three parameters reflect the respective degree of fulfilment – and not a percentage of 4G/5G mobile coverage in relation to area or population.

Data rates and Latencies
The *passive* determination of *download data rates* and *latencies* was carried out independently of the EAs and focused on the experience of each user. Samples that were captured via Wi-fi or when flight mode was activated, for example, were filtered out by umlaut before the analysis.

To take into account that many mobile phone tariffs throttle the data rate, umlaut defined three application-related speed classes: *Basic internet* requires a minimum of 2 Mbit/s, *HD video* requires 5 Mbit/s and *UHD video* requires 20 Mbit/s. For a sample to be valid, a minimum amount of data must have flowed in a 15-minute period.

Similarly, the latency of the data packets is assigned to an application-related class: Roundtrip times up to 100 ms are sufficient for *OTT voice services*, less than 50 ms qualify a sample for *gaming*.

This way, the evaluation also does justice to the fact that the passively observed data rates depend on the applications used in each case.

In order to better assess the maximum possible throughput, umlaut also conducted *active* measurements of *upload* and *download* data rates once a month. They determine the amount of data transferred in 3.5 seconds. For the determined values, we consider the average data rate, the P10 value (90% of the values higher than the specified threshold, a good approximation of the typical minimum speed) and the P90 (10% above this threshold), a view at the peak values.

Stability
Based on the determined data rates and additional browsing and connection tests, umlaut also examined when a broadband connection could be used at all. The averaged and weighted results define the percentage of *transaction success*.

HD Voice
The parameter *HD voice* shows the proportion of the user's voice connections that were established in HD quality – and thus via VoLTE (Voice over LTE). A prerequisite was that the smartphone supports this standard.

Reliability
umlaut divided all measured values into basic requirements ("Qualifier KPIs") and values related to peak performance ("Differentiator KPIs"). The presentation of *reliability* takes into account only the "Qualifier KPIs" from the voice and data category as well as the basic KPIs from crowdsourcing.