

umlaut

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connect



# THE 2022 MOBILE NETWORK TEST IN SPAIN



For the seventh time, we – the benchmarking expert umlaut and connect magazine – have conducted our tough benchmark of the mobile networks in Spain. Once again, we have refined our methodology in the process.

All Spanish operators have worked hard to expand their 5G coverage and to strengthen their 4G offerings. So we wanted to find out which of the contenders offers the highest performance and best user experience of mobile voice and data services.

# RESULTS IN A NUTSHELL

Orange and Vodafone rank on a par and thus both win the umlaut connect Mobile Benchmark in Spain together. Orange scores highest in the Voice category, while Vodafone leads in the Data assessment. Movistar also achieves the grade very good and scores highest in the Crowdsourcing assessment. Yoigo ranks fourth with the grade good.

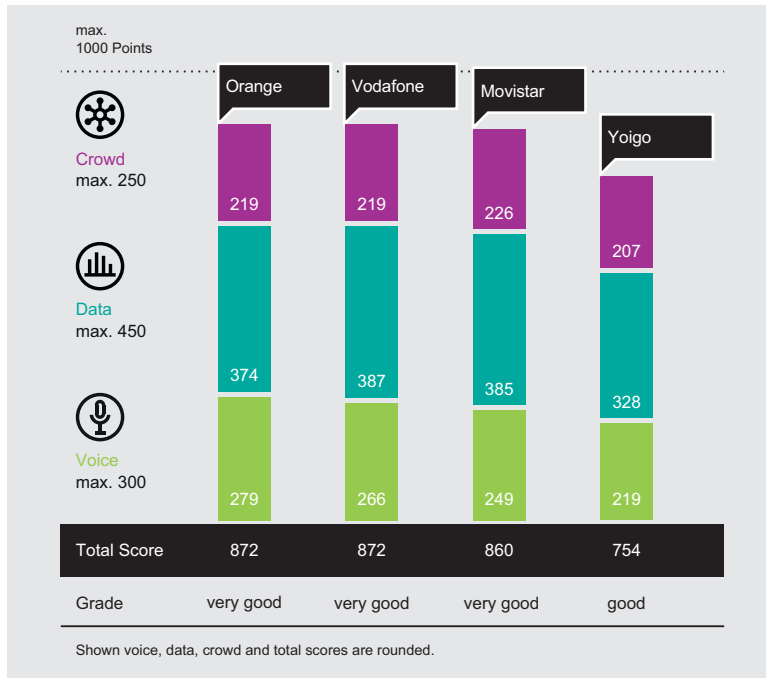
The network benchmarks conducted by umlaut, part of Accenture, and connect are widely accepted as the de-facto industry standard and for being highly objective. The carefully designed methodology of our benchmark in Spain represents a holistic approach to network benchmarking. It combines drive tests and walk tests for executing detailed voice and data measurements under controlled circumstances with a sophisticated crowdsourcing methodology. This provides profound insights into the overall coverage of broadband services as well as real-world 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.

## ORANGE AND VODAFONE SCORE ON A PAR AND THUS SHARE THIS YEAR'S WIN. MOVISTAR FOLLOWS WITH AN ALSO VERY GOOD RESULT, YOIGO RANKS FOURTH

While Vodafone wins the umlaut connect Mobile Benchmark in Spain for the seventh time in a row, Orange achieved a significant improvement over its results from our previous benchmark, improving by 27 points, thus fighting its way to the very top and joining the winning rank for the first time. Orange scores highest in the Voice category, while Vodafone leads in the Data category. Both are on a par in the Crowdsourcing results. Orange shows the highest 5G deployments according to the results gathered in our drive and walk tests. Movistar ranks third, scoring only slightly behind Vodafone and ahead of Orange in the Data category. The Telefónica brand shows particularly convincing results in terms of data performance in smaller Spanish towns and in the connecting roads. Also, Movistar achieves the highest score in our Crowdsourcing category. Its 5G deployment is still heavily based on DSS, but shows a good availability with this technology in our tests.

Yoigo ranks fourth with an overall good result and convincing KPIs in most of the test categories. Compared to our previous benchmark, this operator managed to improve its overall score by 19 points. To a large extent due to its roaming agreement with Orange, it also shows a good 5G coverage in our drive tests and walk tests.

Orange and Vodafone are both named "Best in test" with equal overall scores and the grades "very good". Movistar ranks third, also achieving the grade "very good". Yoigo comes in fourth with the grade "good".



Overall Results		Orange	Vodafone	Movistar	Yoigo
<b>Voice</b>	max. 300.00 P.	279	266	249	219
Cities (Drivetest)	135.00	94%	90%	86%	75%
Cities (Walktest)	45.00	99%	96%	87%	88%
Towns (Drivetest)	60.00	95%	87%	85%	68%
Roads (Drivetest)	60.00	85%	81%	72%	62%
<b>Data</b>	max. 450.00 P.	374	387	385	328
Cities (Drivetest)	203.00	87%	87%	87%	76%
Cities (Walktest)	67.00	93%	90%	85%	83%
Towns (Drivetest)	90.00	72%	83%	83%	62%
Roads (Drivetest)	90.00	78%	83%	85%	69%
<b>Crowd</b>	max. 250.00 P.	219	219	226	207
Crowd	250.00	88%	88%	90%	83%
<b>Connect Rating</b>	max. 1000 P.	872	872	860	754

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

# SPAIN'S OPERATORS

*As the Spanish mobile network operators constantly compete for subscribers, we have seen changes in the market shares and their ranking. In addition, their competition in the 5G rollout continues to pick up speed.*



Movistar is the brand name the Spanish telecommunications company Telefónica uses for the mobile network in its home market. Telefónica S.A. is one of the largest telco companies in the world. The company operates networks in 14 countries and is present in 24. It counted a total of 113,800 employees and achieved worldwide revenues of over €39 billion in its fiscal year 2021. While the company introduced the Movistar brand in Latin American countries in 2005, it has been active in Spain since the launch of GSM services back in 1995. Today, Movistar is the largest mobile operator in Spain with approx. 18.5 million subscribers. It offers GSM service at 900 and 1800 MHz, UMTS/3G at 900 and 2100 MHz and LTE at 800, 1800 and 2600 MHz. Movistar is supporting 4G+ carrier aggregation with maximum speeds reaching up to 1 Gbps. The operator claims to provide 4G coverage of more than 96 per cent of the Spanish population. After having launched 5G in 2020, Movistar now operates 5G on 700 MHz and 3.5 GHz. It has announced to offer 5G in more than 700 cities and towns, planning to expand this number to 1400 by the end of 2022 and to 2400 municipalities by 2023.



vodafone

Vodafone España has been present on the Spanish mobile communications market since the year 2000. Then, the British Vodafone Group acquired Airtel Móviles which had operated in Spain since 1994. With approx. 13.5 million subscribers, Vodafone has now become the second largest mobile operator in Spain. In its fiscal year 2021, Vodafone Spain achieved revenues of €3.8 billion which contributes about 10 per cent to the whole Vodafone Group's financial results. Vodafone's mobile network in Spain offers GSM service at 900 and 1800 MHz, UMTS/3G at 900 and 2100 MHz and LTE at 800, 1800, 2100 and 2600 MHz. The Vodafone 4G network in Spain supports LTE 4 carrier aggregation (4CA or "4G+") with maximum speeds of 1 Gbps. Vodafone España claims to offer the best LTE coverage in Spain, reaching approx. 98 per cent of the Spanish population. The operator was the first to launch 5G in Spain. It uses spectrum at 700 MHz and 3.5 GHz for 5G and now reports to offer this new mobile network technology in approx. 1000 cities and towns, reaching 45 per cent of the Spanish population.



Orange España is the brand name of France Telecom's mobile network in Spain. It has been operating under this name since 2006. Previously, the network was known as "Amena" – this brand name lives on in Orange Spain's portfolio as a low-cost offer that is only available via the internet. Also, its network serves a number of mobile virtual network operators such as MasMovil, Carrefour Móvil and others. With approx. 11.5 million mobile customers, Orange is now the third largest Spanish mobile operator. In the fiscal year 2021, Orange Spain reported a revenue of €4.7 billion which contributed approx. 11 per cent to the Orange Group's total revenue. Orange Spain has deployed 2G networks at 900 and 1800 MHz, 3G networks at 900 and 2100 MHz and 4G at 800, 1800 and 2600 MHz. The operator claims that its 4G network reaches more than 97 per cent of the Spanish population. Orange offers 5G on 700 MHz and 3.5 GHz and reports to have rolled it out in approx. 1100 cities and towns, reaching about 59 per cent of the Spanish population. The operator plans to extend this number to 1500 municipalities by the end of 2022.



Yoigo was the latest mobile operator to enter the Spanish market. Founded in 2000 under the name Xfera, the company started its actual operation in 2006, offering only a UMTS/3G network at 2100 MHz. At this time, the Swedish telecommunications company TeliaSonera acquired the majority of shares and rebranded the network as "Yoigo". In June 2016, the former MVNO Más Móvil bought the company. For its fiscal year 2020, Más Móvil reported revenues of €1.9 billion. Its latest customer numbers are 8.7 million mobile subscribers. Yoigo had a national roaming agreement with Movistar until the end of 2016. Since January 2017, Yoigo customers freely roam in the 2G, 3G and 4G networks of Orange at locations without Yoigo coverage. Yoigo operates 3G at 2100 MHz as well as 4G at 1800 MHz and 2100 MHz. Thanks to its roaming agreements, the operator claims an LTE coverage of approx. 98 per cent of the population. Yoigo has no spectrum on 700 MHz but claims to reach 54 per cent of the population with 5G on 3.5 GHz thanks to a combination of own infrastructure and an agreement with Orange.

*The network benchmarks conducted by umlaut and connect are widely accepted as a completely objective authority. In 2022, we present the umlaut connect Mobile Benchmark in Spain for the seventh time, further enhancing its methodology.*

# A CLOSE LOOK AT THE SPANISH NETWORKS



Congratulations to Orange and Vodafone for both winning the umlaut connect Mobile Benchmark in Spain. We would also like to recognize Movistar with very good performance and Yoigo for improving their mobile network compared to the previous test.“

Hakan Ekmen, CEO umlaut

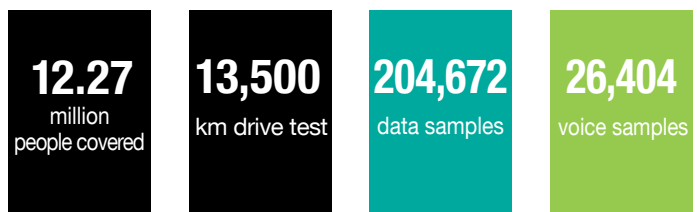
umlaut, headquartered in Aachen, Germany, is a world leader in mobile network testing. The company was formerly known as P3, changed its name in autumn 2019, and has become a part of Accenture in 2021. umlaut has over 4,300 employees, distributed in over 50 locations all around the world, with a turnover of more than 400 million Euros.

umlaut is partnering with the international telecommunications magazine connect, which has 29 years of editorial expertise and is one of the leading test authorities in Europe for telecommunication products and services. Together, we – umlaut and connect – have been conducting the most important network benchmark test in Germany for almost 20 years, ex-

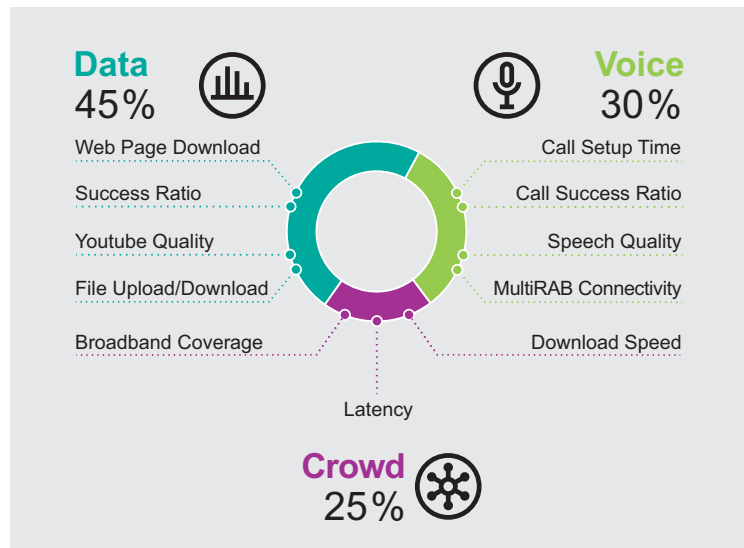
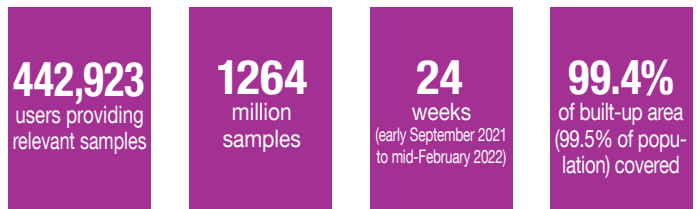
tending it to other European countries since 2009. As the de-facto industry standard, our benchmarking methodology focuses on customer-perceived network quality.

The 2022 umlaut connect Mobile Benchmark in Spain consists of drive tests and walk tests conducted from February 1st to 24th, 2022. Two drive test cars together covered about 13,500 kilometres, visiting 18 cities and 26 towns. Additionally, a walk test team visited seven cities. The test areas account for 12.27 million people, or approx. 25.9 per cent of the total Spanish population. In addition, the results of extensive crowdsourcing analyses, considering 24 weeks from early September 2021 to mid-February 2022 are included in the score.

## DRIVE TEST AND WALK TEST FACTS



## CROWDSOURCING FACTS



# VOICE

Although messaging, e-mails and social media communications have gained in importance, voice telephony is still important. When taking or placing a phone call, customers expect reliable connections. How do the Spanish mobile networks fulfil these expectations?

By now, all four mobile operators in Spain are supporting Voice over LTE (VoLTE). VoLTE transmits voice calls as data packets over a 4G connection and thus is a clear improvement over the „circuit-switched“ connections in 3G or 2G networks. But with 5G a new challenge arises: For 5G-based telephony, “Voice over 5G“ or “Voice over New Radio“ would be required – but this technology has not yet found its way into the current network implementations. So as before from 4G to 3G, a new kind of fallback is needed – this time from 5G to 4G/VoLTE.

For the voice rating, each of the two drive test cars and the walk test team carried one Samsung Galaxy S21+ per operator. The phones in the cars called a counterpart in one of the other cars. The phones carried by the walk test team in the cities called a stationary counterpart. The connected testing equipment registered the success ratios, call setup times and speech quality of the test calls. In order to simulate normal smartphone usage, additional data transfers took place in the background of the calls. Also, the so-called MultRAB (Multi Radio Access Bearer) Connectivity denominates whether data connectivity was available during the test calls. The voice scores account for 30 per cent of the total result.

ORANGE IS AHEAD IN THE VOICE TESTS, WITH VODAFONE AND MOVISTAR EACH FOLLOWING WITH A GAP. YOIGO RANKS LAST, WITH ROOM FOR IMPROVEMENTS PARTICULARLY IN TOWNS AND ON THE ROADS.

## CITIES DRIVE TEST

ORANGE

**ORANGE LEADS IN THE DRIVE TESTS IN CITIES, FOLLOWED BY VODAFONE AND MOVISTAR. YOIGO FALLS A LITTLE BEHIND.**

In the larger cities, Orange achieves the highest score by offering the best call reliability and also the shortest call setup times. In terms of call setup times, Vodafone follows on the second rank, in terms of success ratios, Movistar ranks second. Yoigo falls somewhat behind in this aggregation for larger cities.

## CITIES WALK TEST

ORANGE

**ORANGE ALSO AHEAD IN CITY WALK TESTS, CLOSELY FOLLOWED BY VODAFONE. YOIGO OUTRANKS MOVISTAR IN THIS AGGREGATION.**

In the walk tests conducted in Spain's larger cities, Orange takes the lead due to impressive call success ratio of 100 per cent. Vodafone follows at a close gap with an also high success ratio, short call setup times and equally high speech quality. In this category, Yoigo scores a little stronger than Movistar due to shorter call setup times and almost equal success ratios.

## Voice

300 of 1000 Points

- Orange
- Vodafone
- Movistar
- Yoigo



**TOWNS  
DRIVE TEST**

ORANGE

**ORANGE TAKES THE LEAD IN THE VOICE DRIVE TESTS IN TOWNS. VODAFONE AND MOVISTAR RANK CLOSELY TOGETHER.**

In the drive tests conducted in smaller towns, the lead of Orange ahead of the other contenders becomes more distinct – based on the best results for success ratios, call setup times and speech quality. Vodafone on the second rank and Movistar on the third rank close together. Here, Movistar achieves a slightly higher average success ratio, while Vodafone shows shorter call setup times and a higher speech quality than Movistar. Yoigo falls behind at a more distinct gap, due to a lower average success ratio and a distinctly lower speech quality. The latter can be explained with Yoigo not supporting the EVS codec (Enhanced Voice Services).

**ROADS  
DRIVE TEST**

ORANGE

**ORANGE LEADS IN VOICE DRIVE TESTS CONDUCTED ON SPANISH ROADS. VODAFONE FOLLOWS AT NARROW GAP AND MOVISTAR AT MORE DISTANCE**

While the scores of all four Spanish operators somewhat decrease when travelling on the connecting roads between the cities and towns, Orange still takes the lead. It is ahead due to the shortest call setup times and the highest speech quality seen in this category. Vodafone follows closely with the best results for success ratios. The gap to Movistar is a little more distinct, but – as in all aggregations – this contender shows the best MultiRAB connectivity. Yoigo ranks last, showing still acceptable call setup times, but increasing room for improvement in terms of success ratios. As in all aggregations, Yoigo’s lack of support for the EVS codec also leads to lower results in terms of speech quality.



**VOICE RESULTS AT A GLANCE**

In all four aggregations, Orange takes the lead in the Voice assessment. While the advance is smaller in the larger cities, it becomes more distinct in smaller towns. Vodafone also shows convincing results in the cities. In the city drivetests, Movistar is closely behind Vodafone, while in the city walk tests, Yoigo ranks third, ahead of Movistar. Movistar shows the longest call setup times on the Spanish market in all aggregations. On the roads, Orange is still ahead, but all four operators show room for improvement, with Yoigo falling behind particularly in the success ratios.

Operator	Orange	Vodafone	Movistar	Yoigo
<b>Cities (Drivetest)</b>				
Success Ratio (%)	99.3	98.9	99.2	97.6
Call Setup Time P90 (s)	1.5	2.3	3.0	2.4
Speech Quality P10 (MOS-LQO)	4.2	4.1	3.5	2.8
Multirab Connectivity (%)	99.7	99.8	100.0	99.3
<b>Towns (Drivetest)</b>				
Success Ratio (%)	99.4	98.6	98.9	97.2
Call Setup Time P90 (s)	1.6	2.6	3.0	2.8
Speech Quality P10 (MOS-LQO)	4.1	4.0	3.5	2.6
Multirab Connectivity (%)	99.9	99.7	100.0	98.9
<b>Roads (Drivetest)</b>				
Success Ratio (%)	96.6	97.0	96.1	93.9
Call Setup Time P90 (s)	1.9	2.9	3.6	3.2
Speech Quality P10 (MOS-LQO)	3.7	3.4	3.0	2.5
Multirab Connectivity (%)	99.3	99.5	99.8	98.5
<b>Cities (Walktest)</b>				
Success Ratio (%)	100.0	99.6	99.3	99.2
Call Setup Time P90 (s)	1.5	1.9	2.9	2.1
Speech Quality P10 (MOS-LQO)	4.4	4.4	3.4	3.1
Multirab Connectivity (%)	99.8	99.9	100.0	99.7



# DATA

*With the volume of transmitted data permanently growing, data connectivity constantly becomes more important. Which operator in Spain manages best to meet the increasing demand?*

All four Spanish networks claim to cover a large part of the population with their 4G/LTE services. This includes Yoigo, which claims to reach 98 per cent LTE coverage of the population thanks to its roaming agreement with Orange. Now the race continues regarding 5G – and again, there is a notable competition among all four network operators to lead the field regarding this new mobile network technology.

The commercial deployment of 5G in Spain has come so far that we assume this standard as a given in the data tests of this year’s umlaut connect Mobile Benchmark in Spain. So, the Samsung S21+ smartphones carried by our two drive test cars and also by our walk test team were configured to prefer 5G – whenever this technology is available, it should also be used for our data measurements.

In areas of the country where 5G is not yet available, this device can also make full use of the 4 carrier aggregation (4CA), offered by Movistar, Orange and Vodafone. It is the technical basis for the so-called “4G+” services which theoretically support data rates up to 1 Gbps.

umlaut’s testing rewards fast throughputs as well as the networks’ availability and stability. In order to assess typical performance as well as peak speeds, we consider two values: the minimum data rate that is available in 90 per cent of the cases, and additionally the peak data rate that is surpassed in 10 per cent of the cases. Web page and file downloads or file uploads reward fast speeds, while the determination of success ratios and assessing YouTube payouts concentrate on reliability aspects.

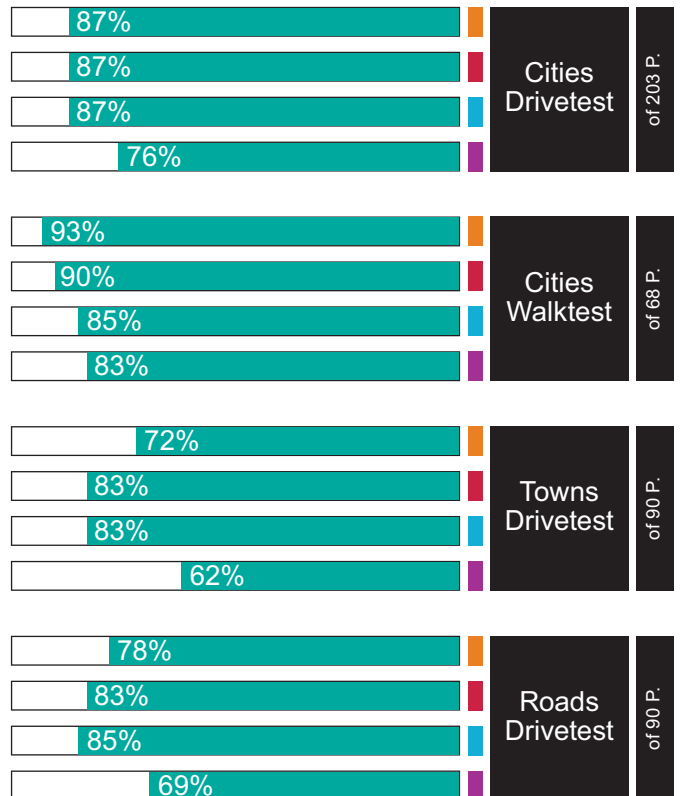


VODAFONE IS AHEAD IN THE DATA CATEGORY, CLOSELY FOLLOWED BY MOVISTAR. ORANGE RANKS THIRD AT A SLIGHTLY WIDER GAP. YOIGO COMES IN FOURTH AT A MORE DISTINCT DISTANCE.

## Data

450 of 1000 Points

- Orange
- Vodafone
- Movistar
- Yoigo



**CITIES DRIVE TEST**

ORANGE & VODAFONE & MOVISTAR

**ORANGE, VODAFONE AND MOVISTAR SCORE ON A PAR IN DATA DRIVE TESTS CONDUCTED IN THE BIG CITIES, YOIGO FALLS A LITTLE FURTHER BEHIND**

In the drive tests conducted in 18 larger Spanish cities, Orange, Vodafone and Movistar each reach 87 per cent of the achievable points. In terms of Web Browsing, Movistar and Vodafone are on a par. In the File Download tests, Orange is slightly ahead, while Vodafone takes the lead in the File Uploads. In the YouTube tests, Movistar leads at a more distinct margin. Yoigo keeps up quite well in most of the categories, but shows some distinct opportunity for improvement in the YouTube assessment.

**CITIES WALK TEST**

ORANGE

**ORANGE AHEAD OF VODAFONE IN BIG CITY DATA WALK TESTS, MOVISTAR ON THIRD RANK AND YOIGO FOLLOWING AT A CLOSE GAP ON THE FOURTH.**

In the overall results of the walk tests conducted in Barcelona, Bilbao, Madrid, Malaga, Sevilla, Valencia and Zaragoza, Orange takes the overall lead. In some of the tests such as Web Browsing or File Downloads and Uploads, Yoigo even competes with Vodafone for the second rank, while Movistar falls slightly behind. In the YouTube tests, however, Vodafone scores best, followed by almost equally strong results of Orange and Movistar, while Yoigo falls a little further behind.

Data Cities (Drivetest)	Orange	Vodafone	Movistar	Yoigo
<b>Web-Page Download</b>				
Success Ratio (%)	98.6	99.3	99.4	98.2
Overall Session Time (s)	1.6	1.6	1.7	1.6
<b>File Download (10 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	99.2/3.0	99.9/3.5	99.7/3.2	99.0/2.7
90%/10% faster than (Mbps)	12.7/242.8	11.4/179.0	13.5/129.9	13.2/228.6
<b>File Upload (5 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	99.6/2.8	100.0/3.0	99.9/3.1	99.3/3.2
90%/10% faster than (Mbps)	7.6/56.4	7.9/48.8	7.0/42.2	6.9/55.6
<b>File Download (7 Seconds)</b>				
Success Ratio (%)	99.5	99.1	99.6	98.8
10% faster than (Mbps)	462.9	400.1	194.4	455.1
Speed > 5Mbps / 20Mbps (%)	98.4/90.7	96.8/84.2	98.3/85.4	96.3/90.2
<b>File Upload (7 Seconds)</b>				
Success Ratio (%)	99.0	99.7	98.9	98.8
10% faster than (Mbps)	83.9	72.7	59.0	87.0
Speed > 2Mbps / 5Mbps (%)	98.7/96.1	98.6/95.2	98.5/95.0	97.6/92.4
<b>Youtube</b>				
Success Ratio/Start Time (%/s)	98.3/2.4	98.3/2.4	99.4/2.4	94.1/2.4
Average Video Resolution (p)	970	972	973	969
<b>Youtube live</b>				
Success Ratio/Start Time (%/s)	97.7/1.7	97.6/1.7	98.5/1.8	92.4/1.7
Average Video Resolution (p)	1080	1080	1080	1080
<b>Youtube 4K Smartphone</b>				
Success Ratio/Start Time (%/s)	98.7/2.5	98.9/2.6	99.3/2.5	87.7/2.8
Average Video Resolution (p)	1675	1645	1595	1071

Data Cities (Walktest)	Orange	Vodafone	Movistar	Yoigo
<b>Web-Page Download</b>				
Success Ratio (%)	99.6	99.0	98.0	99.6
Overall Session Time (s)	1.4	1.5	1.6	1.6
<b>File Download (10 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	99.8/1.9	99.6/2.2	99.6/2.9	99.6/2.0
90%/10% faster than (Mbps)	27.7/261.4	22.2/209.4	17.8/144.7	20.7/227.5
<b>File Upload (5 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	100.0/1.8	99.8/2.4	99.3/3.1	99.8/2.1
90%/10% faster than (Mbps)	16.7/62.0	10.1/59.9	8.8/49.1	12.4/51.7
<b>File Download (7 Seconds)</b>				
Success Ratio (%)	99.6	98.9	99.3	99.6
10% faster than (Mbps)	518.0	565.1	234.1	484.9
Speed > 5Mbps / 20Mbps (%)	99.8/96.9	98.7/93.9	98.6/89.3	99.4/93.4
<b>File Upload (7 Seconds)</b>				
Success Ratio (%)	99.8	99.5	99.3	99.0
10% faster than (Mbps)	96.5	102.0	71.3	86.0
Speed > 2Mbps / 5Mbps (%)	99.8/97.6	98.9/96.1	99.4/97.8	99.2/97.9
<b>Youtube</b>				
Success Ratio/Start Time (%/s)	99.6/2.3	99.3/2.4	98.9/2.4	94.6/2.4
Average Video Resolution (p)	977	970	973	973
<b>Youtube live</b>				
Success Ratio/Start Time (%/s)	98.5/1.5	98.1/1.7	96.4/1.7	94.5/1.7
Average Video Resolution (p)	1080	1080	1080	1080
<b>Youtube 4K Smartphone</b>				
Success Ratio/Start Time (%/s)	94.3/2.9	99.3/2.8	98.5/2.4	87.2/2.5
Average Video Resolution (p)	1739	1686	1617	1089





**TOWNS  
DRIVE TEST**

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**VODAFONE &  
MOVISTAR**

**VODAFONE AND MOVISTAR SCORE ON A PAR IN DATA DRIVE TESTS IN SMALLER TOWNS, WITH ORANGE FOLLOWING CLOSELY AND YOIGO AT A WIDER GAP**

In the data drive tests that our measurement cars performed in 26 smaller Spanish towns, Vodafone and Movistar take the lead, showing good results in all tested categories and scoring overall on a par. Orange shows some room for improvement particularly in the Web Browsing and File Download tests, while Yoigo ranks last in all considered applications.

**ROADS  
DRIVE TEST**

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**MOVISTAR**

**MOVISTAR AHEAD ON CONNECTING ROADS, CLOSELY FOLLOWED BY VODAFONE AND THEN ORANGE**

On the connecting roads covered by our test cars, Movistar shows the strongest results. Vodafone follows closely, and Orange a little further behind. While all three operators score well in terms of Web Browsing, Orange shows some room for improvement in the File Download and Upload tests as well as in the YouTube assessment. Yoigo ranks fourth in all tested applications, but overall scores a little stronger on the roads than in the smaller towns.

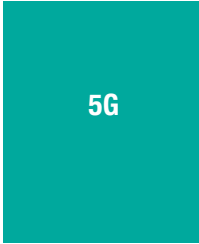
Data Towns (Drivetest)	Orange	Vodafone	Movistar	Yoigo
<b>Web-Page Download</b>				
Success Ratio (%)	96.9	99.1	99.0	97.2
Overall Session Time (s)	2.0	1.7	1.9	2.2
<b>File Download (10 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	97.6/7.2	99.8/4.7	99.6/3.9	98.0/15.1
90%/10% faster than (Mbps)	4.7/94.1	8.4/87.9	10.6/107.9	1.8/66.9
<b>File Upload (5 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	99.7/4.6	99.6/3.4	99.7/4.3	99.2/8.8
90%/10% faster than (Mbps)	4.5/41.1	6.2/38.9	5.5/37.2	2.2/22.7
<b>File Download (7 Seconds)</b>				
Success Ratio (%)	98.9	99.2	99.4	98.9
10% faster than (Mbps)	121.5	107.5	150.1	135.4
Speed > 5Mbps / 20Mbps (%)	93.5/70.9	95.1/76.2	97.4/82.1	91.1/49.6
<b>File Upload (7 Seconds)</b>				
Success Ratio (%)	98.1	99.1	98.9	96.9
10% faster than (Mbps)	56.2	51.8	49.1	25.2
Speed > 2Mbps / 5Mbps (%)	98.2/90.7	98.4/92.5	97.9/91.4	95.4/80.5
<b>Youtube</b>				
Success Ratio/Start Time (%/s)	97.9/2.7	98.8/2.5	99.5/2.6	95.2/2.8
Average Video Resolution (p)	951	970	973	952
<b>Youtube live</b>				
Success Ratio/Start Time (%/s)	95.1/2.1	98.0/1.7	97.4/2.0	93.4/2.2
Average Video Resolution (p)	1080	1080	1080	1080
<b>Youtube 4K Smartphone</b>				
Success Ratio/Start Time (%/s)	97.3/2.8	97.3/2.7	98.5/2.6	94.8/3.0
Average Video Resolution (p)	1435	1558	1550	1085

Data Roads (Drivetest)	Orange	Vodafone	Movistar	Yoigo
<b>Web-Page Download</b>				
Success Ratio (%)	97.2	98.6	98.7	96.4
Overall Session Time (s)	2.1	1.8	1.9	2.2
<b>File Download (10 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	98.8/7.8	99.4/5.4	99.5/4.6	98.3/9.1
90%/10% faster than (Mbps)	4.8/74.4	6.9/77.6	8.5/98.2	3.9/59.8
<b>File Upload (5 MB)</b>				
Success Ratio/Avg. Session Time (%/s)	99.0/6.8	99.3/5.4	99.4/5.6	98.4/7.4
90%/10% faster than (Mbps)	2.7/31.4	3.7/31.7	3.5/35.3	2.4/23.0
<b>File Download (7 Seconds)</b>				
Success Ratio (%)	98.3	98.8	99.0	97.6
10% faster than (Mbps)	93.0	93.7	128.0	73.2
Speed > 5Mbps / 20Mbps (%)	91.8/60.4	93.1/67.9	95.9/74.9	89.4/54.9
<b>File Upload (7 Seconds)</b>				
Success Ratio (%)	97.2	98.0	98.1	94.9
10% faster than (Mbps)	40.5	40.0	44.9	26.9
Speed > 2Mbps / 5Mbps (%)	94.3/81.7	95.4/86.5	93.9/84.1	92.1/76.1
<b>Youtube</b>				
Success Ratio/Start Time (%/s)	96.2/2.8	96.9/2.6	98.4/2.6	92.4/2.8
Average Video Resolution (p)	958	968	967	952
<b>Youtube live</b>				
Success Ratio/Start Time (%/s)	95.7/2.1	95.6/1.9	96.6/1.9	89.1/2.2
Average Video Resolution (p)	1080	1079	1080	1080
<b>Youtube 4K Smartphone</b>				
Success Ratio/Start Time (%/s)	95.3/2.9	97.2/2.8	98.8/2.6	91.8/2.6
Average Video Resolution (p)	1349	1467	1478	1066



### CLEAR ADVANCEMENTS IN 5G DEPLOYMENT IN SPAIN

In comparison to our previous umlaut connect Mobile Benchmark in Spain, when the deployment of 5G had only just started, all four operators have come quite far. We see a strong 5G penetration particularly in the cities, where Orange – and due to their roaming agreement also Yoigo – reach a share of our drive test and walk test samples with 5G close to or even above 80 per cent. Our observations show that Movistar still relies more strongly on 5G DSS (Dynamic Spectrum Sharing), which distributes the available spectrum between 4G and 5G depending on current demand. Orange along with Yoigo uses this technique more on connecting roads and in smaller towns. In the larger cities, we see a bigger share of samples with 5G NR (New Radio) – the variant of 5G that no longer shares its radio interface with 4G. In the latest spectrum auction for the Spanish market, Orange and Telefónica/Movistar were able to obtain additional 5G spectrum in the 3.5 GHz. As a result, Orange now holds 110 MHz of spectrum in the 3.5 GHz band, Movistar 100 MHz, Vodafone 90 MHz and Yoigo 80 MHz. In the 700 MHz band, Orange, Vodafone and Movistar each hold 20 MHz, while Yoigo has no share in this part of the 5G-relevant spectrum.



### DIFFERENT STRENGTHS DEPENDING ON THE GEOGRAPHICAL FOCUS

As a representative example, below we look at the results of samples with 5G in the 7 second Download tests. It shows that each Spanish operator achieves high success ratios, wherever 5G is already available in their networks. In terms of the observed data rates, Orange and Vodafone are having a neck-and-neck race in the larger cities, while Movistar shows some advancements in the smaller towns. When Vodafone is able to offer 5G on connecting roads, it provides the highest data rates seen in this assessment – but the share of 5G samples on the roads is actually higher in the network of Orange. Due its roaming agreement with Orange, also Yoigo shows a convincing share of 5G in the cities and towns as well as on the roads visited by our test teams.

Data rates 7s Download	Orange				Vodafone				Movistar				Yoigo			
	Share	Success Ratio	Average (Mbps)	10% faster than (Mbps)	Share	Success Ratio	Average (Mbps)	10% faster than (Mbps)	Share	Success Ratio	Average (Mbps)	10% faster than (Mbps)	Share	Success Ratio	Average (Mbps)	10% faster than (Mbps)
<b>Samples with 5G</b>																
Cities – Drivetest	74.4%	99.6%	281.3	511.4	47.1%	99.9%	262.0	519.8	12.8%	100.0%	235.7	396.6	67.1%	99.5%	119.0	385.1
Cities – Walktest	81.8%	100.0%	328.2	546.8	66.4%	99.5%	342.6	629.4	9.4%	96.3%	309.4	427.1	76.8%	99.5%	205.7	460.8
Towns – Drivetest	7.5%	100.0%	152.9	465.1	1.2%	100.0%	71.6	126.5	5.5%	100.0%	208.7	326.3	11.4%	97.7%	104.6	206.3
Roads – Drivetest	3.0%	100.0%	50.8	95.6	0.3%	100.0%	153.8	220.7	0.6%	100.0%	57.8	86.0	3.9%	100.0%	23.3	85.5
<b>Samples with 5G-DSS</b>																
Cities – Drivetest	11.9%	99.6%	58.6	122.1	–	–	–	–	25.6%	99.3%	69.8	143.9	10.8%	98.6%	25.1	78.7
Cities – Walktest	8.2%	97.7%	64.8	105.0	–	–	–	–	31.2%	100.0%	92.2	172.0	6.8%	100.0%	7.2	6.9
Towns – Drivetest	34.8%	98.1%	57.8	141.6	–	–	–	–	26.1%	100.0%	66.5	149.2	25.9%	99.5%	8.0	6.9
Roads – Drivetest	20.3%	96.7%	53.4	101.0	–	–	–	–	15.0%	100.0%	68.1	165.6	13.6%	95.8%	6.3	6.9



### DATA RESULTS AT A GLANCE

In terms of 5G, Orange (and Yoigo) are showing the highest 5G deployments. All four operators already use 5G NR particularly in the cities, with Movistar still showing a higher share of 5G DSS. Movistar shows the highest data reliability in the drive test scenarios, while Orange takes the lead in the walk test scenario. Vodafone ranks second in both scenarios with a very good reliability. Orange provides the best downlink performance in the cities, while Movistar is leading in the towns and on the roads. Vodafone shows the best uplink performance in the drive test scenarios, while they rank second behind Orange in the walktests conducted in the larger cities. Yoigo ranks fourth, showing room for improvement particularly in terms of data performance in towns.



# CROWD

422,923 users in Spain have contributed around 1.3 billion measurement samples between early September 2021 and mid-February 2022. We have conducted a thorough analysis of this extensive data set, using an even more refined methodology compared to previous years.

MOVISTAR TAKES THE LEAD IN THE CROWD CATEGORY. ORANGE AND VODAFONE FOLLOW ON A PAR. YOIGO RANKS FOURTH AT A MORE DISTINCT GAP.

While the drive tests and walk tests, which determine the network performance with traditional methods, are in place since more than two decades, crowdsourcing can add important dimensions such as time, geography or variety in devices and tariff plans – if done in the right way. A detailed description of our crowdsourcing methodology can be found on page 14. A total of 422,923 Spanish mobile phone users have provided relevant samples to our crowd data. The test area of our crowdsourcing represents 99.4 per cent of the built-up area of Spain and 99.5 per cent of the country’s population.

**COVERAGE**

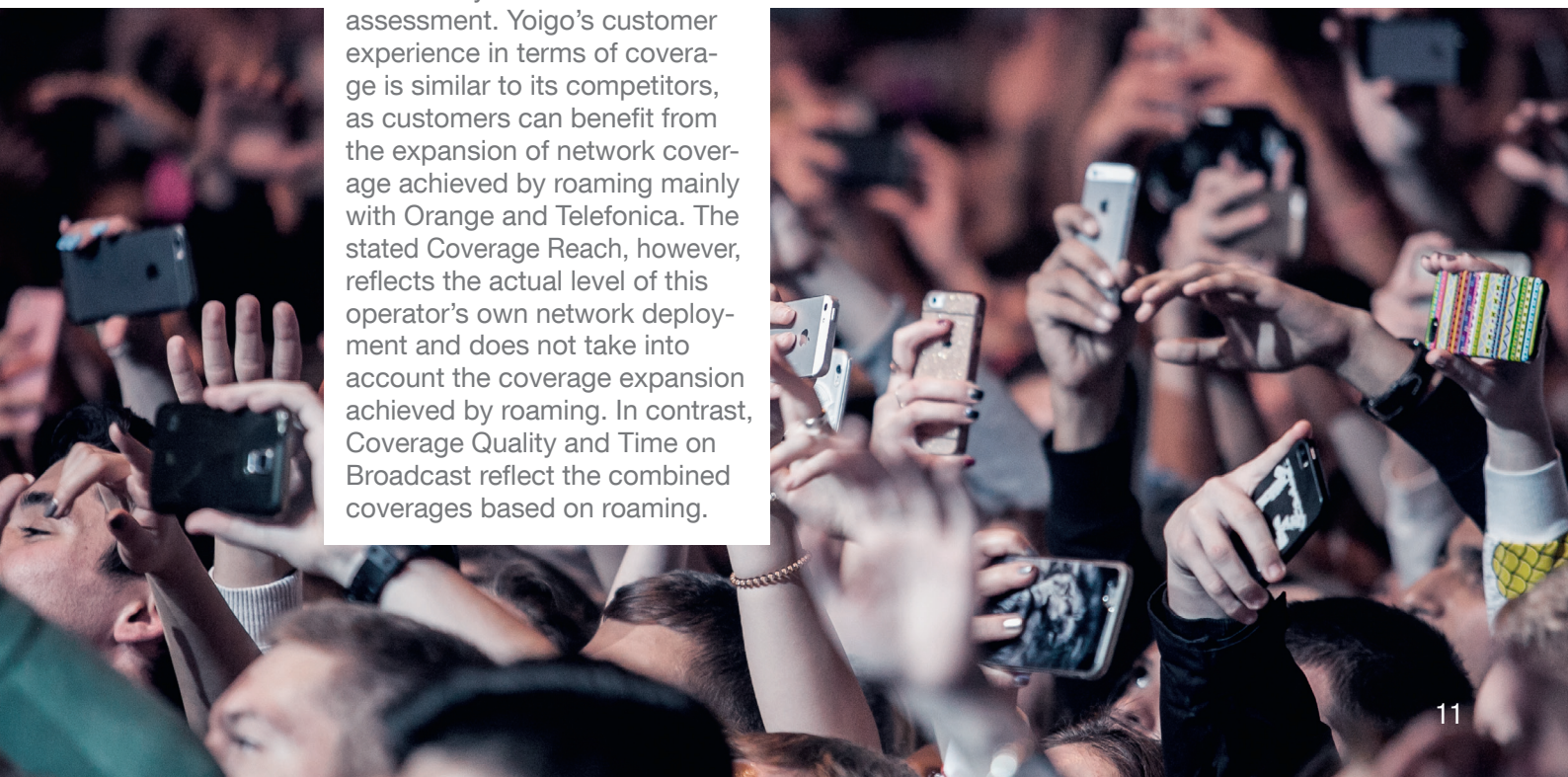
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**ORANGE & MOVISTAR**

**MOVISTAR AND ORANGE AHEAD IN COVERAGE METRIC. VODAFONE AND YOIGO FOLLOW AT MORE DISTINCT GAPS.**

In terms of Coverage Reach (the recorded 3G, 4G or 5G coverage related to the overall summation of all coverage areas) and Time on Broadband (how often an average user had 4G or 5G reception), Movistar is ahead. Orange offers the best Coverage Quality (the ratio of all Evaluation Areas to the “common footprint”), closely followed by Vodafone in this assessment. Yoigo’s customer experience in terms of coverage is similar to its competitors, as customers can benefit from the expansion of network coverage achieved by roaming mainly with Orange and Telefonica. The stated Coverage Reach, however, reflects the actual level of this operator’s own network deployment and does not take into account the coverage expansion achieved by roaming. In contrast, Coverage Quality and Time on Broadcast reflect the combined coverages based on roaming.

Operators	Orange	Vodafone	Movistar	Yoigo
<b>Broadband Coverage</b>				
Coverage Quality (%)	93.5	93.2	92.0	89.4
Coverage Reach (%)	92.0	88.8	93.1	78.2
Time on Broadband (%)	95.0	94.7	96.3	94.8
<b>Download Speed</b>				
Basic Internet Class (%)	94.0	94.3	95.0	93.9
HD Video Class (%)	78.5	78.1	79.2	76.6
UHD Video Class (%)	19.4	20.8	21.8	16.9
<b>Latency</b>				
Gaming Class (%)	62.5	64.2	75.0	48.5
OTT Voice Class (%)	96.7	97.3	98.3	95.6



## DOWNLOAD SPEEDS

MOVISTAR

**MOVISTAR RANKS FIRST IN EACH OF THE THROUGHPUT CLASSES. VODAFONE RANKS SECOND AND ORANGE THIRD, BOTH CLOSE TOGETHER.**

In our crowdsourced assessment of Download Speeds, Movistar is leading in the consideration over all speed classes.

In the Basic Internet sub-category, Movistar shows 95.0 per cent of the analysed samples with (throughputs above 2 Mbps). Vodafone ranks second with 94.3 per cent, closely followed by Orange with 94.0 per cent and Yoigo with 93.9 per cent.

In “HD Video” (above 5 Mbps), Movistar is ahead with 79.2 per cent of the samples fulfilling this requirement, followed by Orange with 78.5 per cent, Vodafone with 78.1 per cent and Yoigo with 76.6 per cent.

In the most demanding sub-category, “UHD Video”, Movistar leads with 21.8 per cent, closely followed by Vodafone with 20.8 per cent and Movistar with 19.4 per cent. Yoigo falls a little behind with 16.9 per cent.

## LATENCY

MOVISTAR

**MOVISTAR ALSO AHEAD IN LATENCY METRIC, FOLLOWED BY VODAFONE, ORANGE AND THEN YOIGO**

In our examinations of Latency, Movistar is the leader in the Voice category by showing 98.3 per cent of the samples below 100 ms. Vodafone follows with 97.3 per cent and Orange with 96.7 per cent. Yoigo is not too far behind with 95.6 per cent.

Movistar is also ahead in the more demanding Gaming category with 75.0 per cent of the samples gathered below the threshold of 50 ms. Vodafone follows on second place with 64.2 per cent and Orange on the third with 62.5 per cent. With 48.5 per cent, Yoigo falls back at a distinct gap.



## CROWD RESULTS AT A GLANCE

In the crowdbased score, Movistar leads the Spanish market in each of the main categories, coverage, speeds and latency. Looking closer at the Coverage, we find Orange showing the best Coverage Quality, followed closely by Vodafone, while Movistar takes the lead in Coverage Reach and Time on Broadband. Regarding Download Speeds, Movistar also ranks first in each of the throughput classes. Vodafone is on the second rank in the Basic Internet and UHD videos classes, while Orange ranks second in the HD video class. Movistar also scores best in the Latency metrics for both the Voice and Gaming classes, followed by Vodafone. Yoigo ranks last in all crowdsourced assessments.



**Cities:** Almeria, Badajoz, Barcelona (W), Bilbao (W), Gijon, Jerez de la Frontera, Leon, Logrono, Madrid (W), Malaga (W), Murcia, Sabadell, Santander, Sevilla (W), Valencia (W), Valladolid, Vigo, Zaragoza (W); (W) designates walk test cities.

**Towns:** Almansa, Almendralejo, Benavente, Betanzos, El Ejido, Estepona, Huesca, Linares, Lorca, Merida, Mieres, Miranda de Ebro, Motril, Navalmodal de la Mata, Orihuela, Plasencia, Roquetas de Mar, Tarrega, Tudela, Vera, Verin, Vilafranca del Penedes, Villaviciosa, Xativa, Zafra, Zamora

# TESTING METHODOLOGY

*The methodology of the umlaut connect Mobile Benchmark is the result of almost 20 years of testing mobile networks. Today, network tests are conducted in more than 120 countries. Our methodology was carefully designed to evaluate and objectively compare the performance and service quality of mobile networks from the users' perspective.*

The umlaut connect Mobile Benchmark in Spain comprises of the results of extensive voice and data drive tests and walk tests as well as a sophisticated crowdsourcing approach.

## DRIVE TESTS AND WALK TESTS

The drive tests and walk tests in Spain took place between February 1st and February 24th, 2022. All samples were collected during the day, between 8.00 a.m. and 10.00 p.m. The network tests covered inner-city areas, outer metropolitan and suburban areas. Measurements were also taken in smaller towns and cities along connecting highways. Two cars conducted the drive tests.

The connecting routes between the cities and towns alone covered about 9600 kilometres in total. In addition, the cars covered 3160 km while driving through the cities and 740 km while driving through the smaller towns. Overall, the vehicles together covered about 13,500 km. The combination of test areas has been selected to provide representative test results

across the Spanish population. The areas selected for the 2022 test account for 12.27 million people, or roughly 25.9 per cent of the total population of Spain. The test routes are shown on page 1 of this report, all visited cities and towns are also listed in the box above.

The two drive-test cars were equipped with arrays of Samsung Galaxy S21+ smartphones for the simultaneous measurement of voice and data services.

## VOICE TESTING

One smartphone per operator in each car was used for the voice tests, setting up test calls from one car to another („mobile-to-mobile“). The walk test team also carried one smartphone per operator for the voice tests. In this case, the smartphones called a stationary (smartphone) counterpart. The audio quality of the transmitted speech samples was evaluated using the HD-voice capable and ITU standardised so-called POLQA wideband algorithm. All smartphones used for the voice tests were set to “5G preferred“

mode. In addition, they were set to “VoLTE preferred“. As Voice over 5G/Voice over New Radio is not yet supported in current 5G networks, this means that the devices would perform a fallback from 5G to 4G in order to establish voice calls.

In the assessment of call setup times we also rate the so-called P90 value. Such values specify the threshold in a statistical distribution, below which 90 per cent of the gathered values are ranging. For speech quality, we publish the P10 value (10 per cent of the values are lower than the specified threshold), because in this case higher values are better.

In order to account for typical smartphone use scenarios during the voice tests, background data traffic was generated in a controlled way through injection of data traffic (HTTP downloads). In the process, we also recorded Multi-RAB connectivity – the use of several “radio access bearers“ for the background data connections.

The voice scores account for 30 per cent of the total results.

## DATA TESTING

Data performance was measured by using four more Galaxy S21+ in each car and in the backpacks of the walk test team – one smartphone per operator. Their radio access technology was also set to 5G preferred mode.

For the web tests, they accessed web pages according to the widely recognised Alexa ranking. In addition, the static “Kepler“ test web page as specified by ETSI (European Telecommunications Standards Institute) was used.



Each drive test vehicle carried eight smartphones for conducting the voice and data tests.



A special control system monitors the smartphones and logs the measurement values they collect.



The walktest teams use trolleys in which powerful rechargeable batteries feed the test smartphones.

In order to test the data service performance, files of 10 MB for download and 5 MB for upload were transferred from or to a test server located in the cloud. In addition, the peak data performance was tested in uplink and downlink directions by assessing the amount of data that was transferred within a seven seconds time period.

The YouTube measurements take into account the “adaptive resolution” of the video platform: YouTube dynamically adjusts the played resolution to the available bandwidth. The rating therefore considers the average image resolution or number of lines of the videos. In addition, the video rating is based on the success rate, the time until playback starts and the proportion of video playbacks that went through without interruption.

All the tests were conducted with the best-performing mobile plan available from each operator. Data scores account for 45 per cent of the total results.

### CROWDSOURCING

Additionally, umlaut conducted crowd-based analyses of the Spanish networks which contribute 25 per cent to the end result. They are based on data gathered between calendar week 35 (early September), 2021, until calendar week 6 (mid-February), 2022.

In the process, a total of 1.264 billion samples from more than 422,923 users were evaluated. The area of Spain covered by these crowdsourcing analyses counts approx. 324,695 square km and 99.4 per cent of the country’s built-up areas, which correspond to approx. 99.5% of the population.

For the collection of crowd data, umlaut has integrated a background diagnosis process into more than 1000 diverse Android apps. If one of these applications is installed on the end-user’s phone and the user authorizes the background analysis, data collection takes place 24/7, 365 days a year. Reports are generated for every hour and sent daily to umlaut’s cloud servers. Such reports occupy just a small number of bytes per

message and do not include any personal user data.

This unique crowdsourcing technology allows umlaut to collect data about real-world experience wherever and whenever customers use their smartphones.

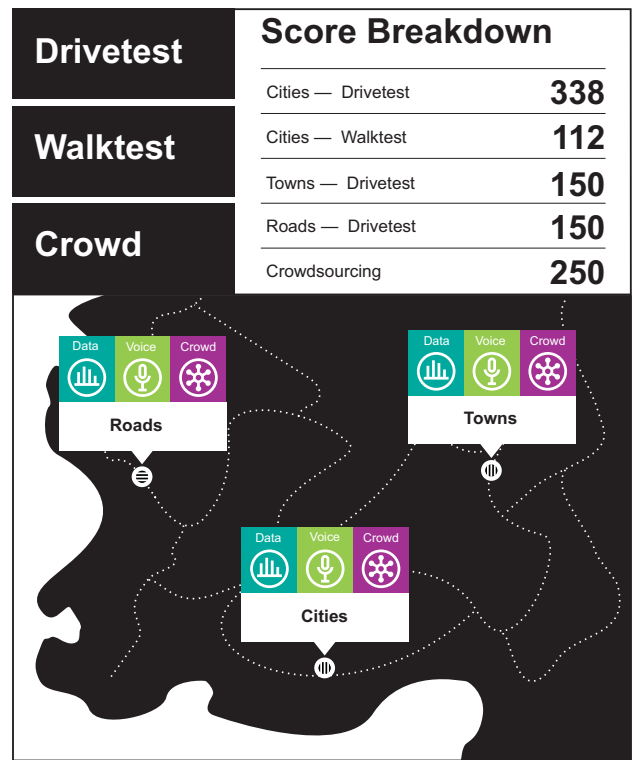
### NETWORK COVERAGE

In order to assess the “Coverage Reach”, the test area is divided by a grid of 2x2 km tiles (“Evaluation Areas” or EAs for short). A minimum number of users and measured values must be available for an EA to be considered in the analysis.

For the evaluation, umlaut awards one point per EA if the network under consideration offers 3G coverage. Three points are awarded if 4G or 5G is available in the EA. The number of points achieved in this way is then divided by the total number of points that can be achieved (three points per EA in the “common footprint” – i.e. the area of the country covered by all tested operators).

In addition, we look at the “Coverage Quality”. It puts the percentage of EAs in which a user had 4G or 5G coverage in relation to all EAs in the common footprint.

A third KPI for broadband quality is “Time on Broadband”. It tells us how often an individual 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 and published for all three parameters reflect the respective degree of fulfilment – they do not correspond to the percentage of 4G/5G mobile coverage in an area or in relation to the overall population.



### DATA RATES AND LATENCIES

The data rates determined are included in the crowd score at 30%, the latencies at 20%.

The investigation of these parameters is also carried out independently of the EAs and thus concentrates on the experience of each individual user. Samples that were recorded via WiFi or when flight mode was activated, for example, are filtered out before further analysis.

In order to take into account the fact that many mobile phone tariffs throttle the usable data throughput, umlaut has defined three application-related speed classes: “Basic internet” requires a minimum of 2 Mbps, “HD video” requires 5 Mbps and “UHD video” requires 20 Mbps. For a sample to be valid, a minimum amount of data must also have flowed in a 15-minute period.

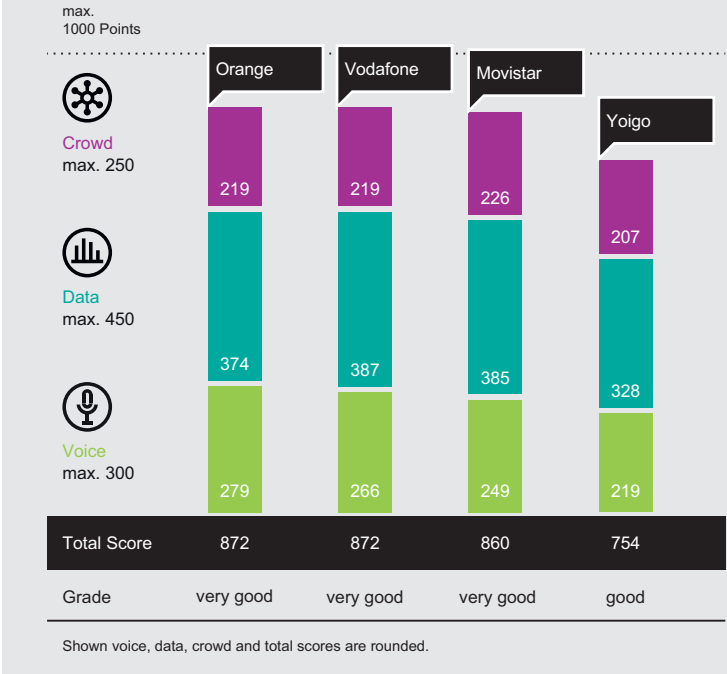
Similarly, the latency of the data packets is also assigned to an application-related class: Roundtrip times up to 100 ms are sufficient for “OTT voice services”, less than 50 ms qualify a sample for “gaming”.

In the evaluation, umlaut assigns the speeds and latencies determined in the samples to one of these classes. “Basic internet” then accounts for 55% of the data rate rating, “HD video” for 33.8% and “UHD video” for 11.3%. “OTT voice” services account for 55% of the latency rating and gaming for 45%.

# CONCLUSION

Orange and Vodafone rank on a par and thus both win the umlaur connect Mobile Benchmark in Spain together. While Orange is named “Best in test“ for the first time, Vodafone achieves the win for the seventh time in a row. Orange scores highest in the Voice category, while Vodafone leads in the Data assessment. Movistar also achieves the grade very good and scores highest in the Crowdsourcing. Yoigo ranks fourth with the grade good.

The 2022 umlaur connect Mobile Benchmark in Spain has two equally strong winners: Orange and Vodafone overall score on a par and thus both share the “Best in test“ accolade. Orange is ahead in the Voice category, Vodafone scores highest in the Data category, and both are on a par in the Crowdsourcing assessment. In comparison to our previous benchmark in Spain, which was executed in late 2020, Orange has made a huge leap forward and improved its score at 27 points. Orange also shows the highest 5G deployments according to our tests, which it also makes available to Yoigo due to their roaming agreement. Movistar ranks third, scoring only slightly behind Vodafone and ahead of Orange in the Data category. Also, Movistar achieves the highest score in the crowdsourced assessment. The distance to the leading duo comes from missing valuable points in the Voice category. Yoigo ranks fourth with an overall good result and mostly good results in the single assessments. Compared to our previous benchmark, this operator managed to improve its overall score by 19 points.



Overall Results		Orange	Vodafone	Movistar	Yoigo
<b>Voice</b>	max. 300.00 P.	279	266	249	219
Cities (Drivetest)	135.00	94%	90%	86%	75%
Cities (Walktest)	45.00	99%	96%	87%	88%
Towns (Drivetest)	60.00	95%	87%	85%	68%
Roads (Drivetest)	60.00	85%	81%	72%	62%
<b>Data</b>	max. 450.00 P.	374	387	385	328
Cities (Drivetest)	203.00	87%	87%	87%	76%
Cities (Walktest)	67.00	93%	90%	85%	83%
Towns (Drivetest)	90.00	72%	83%	83%	62%
Roads (Drivetest)	90.00	78%	83%	85%	69%
<b>Crowd</b>	max. 250.00 P.	219	219	226	207
Crowd	250.00	88%	88%	90%	83%
<b>Connect Rating</b>	max. 1000 P.	872	872	860	754

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

**BEST IN TEST**  
ORANGE  
3/2022  
MOBILE BENCHMARK SPAIN  
www.connect-testlab.com  
4 operators tested, 2 winners



1

With a significant improvement over its previous results, Orange fought its way to the top – winning our Benchmark for the first time. Orange leads in the Voice category and scores strongly also in the Data and Crowd evaluations. In terms of 5G deployment, Orange is ahead, according to our drive tests and walk tests.

**BEST IN TEST**  
VODAFONE  
3/2022  
MOBILE BENCHMARK SPAIN  
www.connect-testlab.com  
4 operators tested, 2 winners



2

For the seventh time in a row, Vodafone is the winner of our Mobile Benchmark in Spain. The operator scores highest in the Data category and is also strong in Voice and in the crowdsourced assessment. Vodafone also shows high data rates and already strong coverage with 5G in the larger Spanish cities.

3



The Telefónica brand shows also a very good result and is particularly convincing in terms of data performance in the smaller towns and on the roads. It also leads in our crowdsourced assessment. Its 5G deployment is still heavily based on DSS, but shows a good availability with this technology in our tests.

4



Spain's smallest operator ranks fourth, achieving the overall grade “good“. In comparison to its results in our previous Benchmark, Yoigo improved by 19 points. It shows mostly convincing results and due to its roaming agreement with Orange also a good 5G coverage in our drive tests and walk tests.