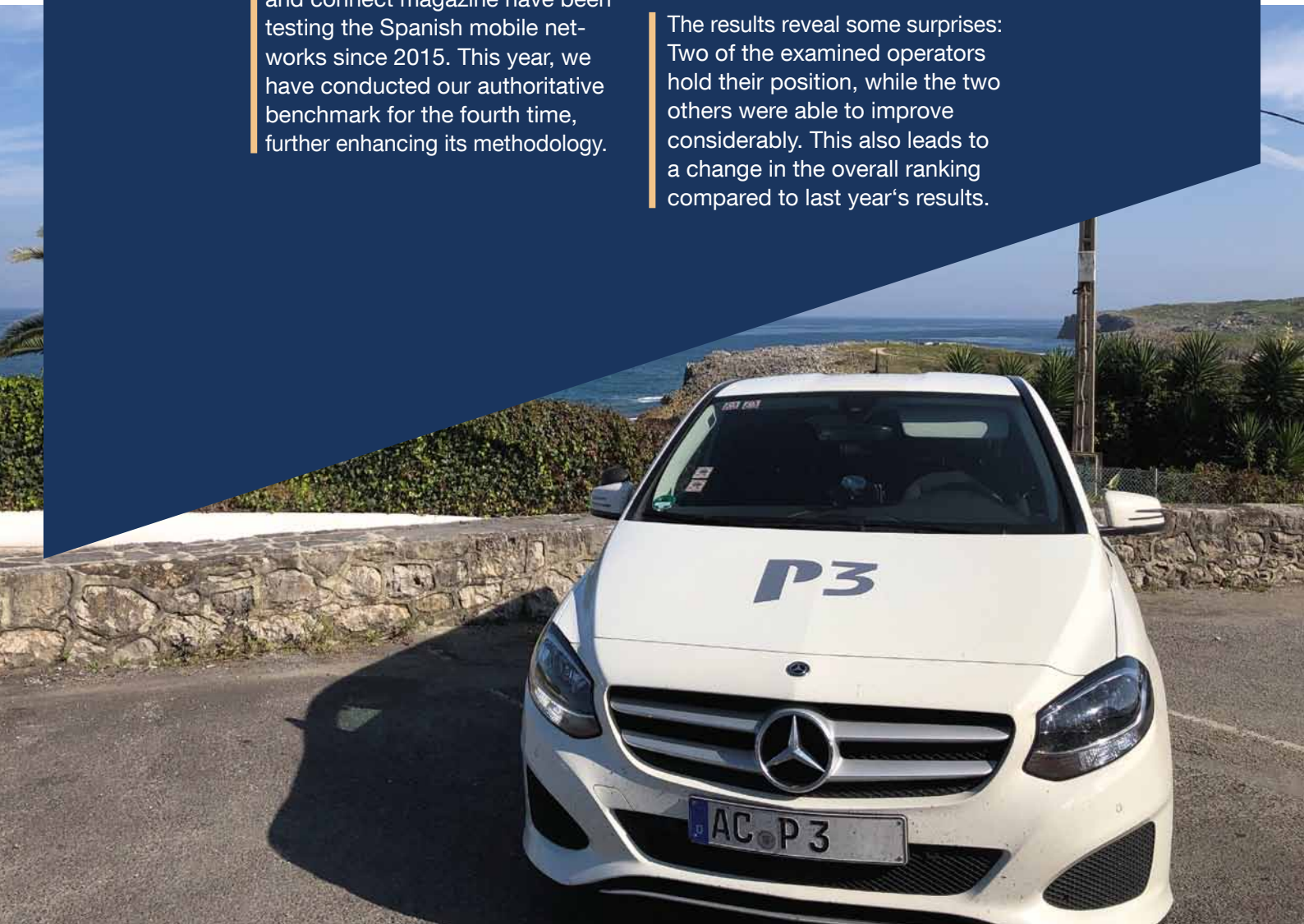
P3 connect MOBILE BENCHMARK


# THE 2018 MOBILE NETWORK TEST IN SPAIN

The benchmarking expert P3 and connect magazine have been testing the Spanish mobile networks since 2015. This year, we have conducted our authoritative benchmark for the fourth time, further enhancing its methodology.

The results reveal some surprises: Two of the examined operators hold their position, while the two others were able to improve considerably. This also leads to a change in the overall ranking compared to last year's results.



# RESULTS IN A NUTSHELL

*Vodafone has won the P3 connect Mobile Benchmark Spain the fourth time in a row, with Orange and Movistar constantly competing for the second rank, and Yoigo steadily working on improvements. These overall trends are still true for 2018.*

> Vodafone keeps its performance, Orange and Yoigo improved their scores considerably. Movistar lost a couple of points but still achieves good results.

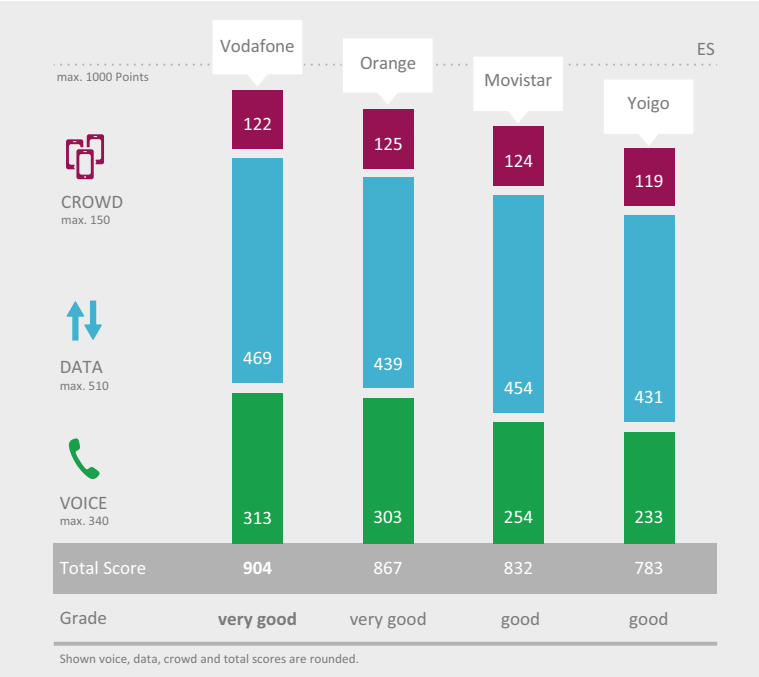
P3's network benchmarks are widely accepted as the de-facto industry standard being highly objective. The carefully designed methodology of our 2018 benchmark in Spain combines drivetests and walktests for executing detailed voice and data measurements under controlled circumstances with a sophisticated crowdsourcing approach. This provides profound insights into the overall coverage of voice, data and 4G services, real-world User Download Speeds and Data Service Availability.

P3's holistic approach to network benchmarking includes both drivetest and walktest measurements as well as crowdsourcing. The drive- and walktests allow for evaluating the cutting edge of the networks' capabilities. Crowdsourcing unveils the service quality and performance actually experienced by the users. We have thoroughly weighted these components in order to give a realistic and authoritative assessment of the rated networks' true potential and performance.

## VODAFONE IS THE OVERALL WINNER, ORANGE OVERTAKES MOVISTAR, YOIGO IMPROVES CLEARLY

As in the three previous years, the overall winner is Vodafone. On the second rank, Orange manages to overtake Movistar thanks to distinct improvements particularly in its voice results. Movistar still shows a strong performance especially in the data category, but in the overall assessment only achieves the third rank this time. The smallest operator in Spain, Yoigo, has considerably improved compared to its results in the previous years. This is true in the data and also especially in the voice category. In a direct comparison to last year's results, Vodafone overall kept the same performance while Movistar dropped slightly.

In the additional crowdsourced assessment which contributes 15 per cent to the total result this year, Orange takes the overall lead, scoring slightly ahead of Movistar. Vodafone achieves the best score for User Download Speed, Orange and Movistar are on par. However, all operators show some room for improvement. Yoigo's improvements are also reflected in a decent crowd score. The Data Service Availability is excellent in all four Spanish networks.




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

| Overall Results Voice and Data | | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|---|
| Voice | max. 340 | 313 | 303 | 254 | 233 |
| Cities (Drivetest) | 153 | 95% | 90% | 76% | 71% |
| Cities (Walktest) | 51 | 96% | 96% | 79% | 76% |
| Towns (Drivetest) | 68 | 90% | 92% | 71% | 71% |
| Roads (Drivetest) | 68 | 85% | 77% | 70% | 55% |
| Data | max. 510 | 469 | 439 | 454 | 431 |
| Cities (Drivetest) | 230 | 94% | 88% | 92% | 87% |
| Cities (Walktest) | 76 | 93% | 88% | 90% | 85% |
| Towns (Drivetest) | 102 | 91% | 86% | 86% | 85% |
| Roads (Drivetest) | 102 | 89% | 80% | 85% | 78% |
| Crowdsourced Quality | max. 150 | 122 | 125 | 124 | 119 |
| Crowd | 150 | 81% | 83% | 82% | 79% |
| Connect Rating | max. 1000 | 904 | 867 | 832 | 783 |

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

# SPAIN'S OPERATORS

*The three largest Spanish mobile network operators permanently compete for subscriber numbers and market share. Recently, Orange managed to surpass Vodafone in these key figures. Also, all four Spanish operators have constantly increased their LTE coverage and speeds.*

Movistar is the brand name the Spanish telecommunications company Telefónica uses for the mobile network in its home market. Telefónica S.A. itself is one of the largest telco companies in the world. The operator is active in 17 countries with a total of 122,700 employees and achieved worldwide revenues of over €52 billion in its fiscal year 2017.
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 about 17.6 million subscribers, which equals a market share of roughly 33 per cent.
It offers GSM service at 900 and 1800 MHz, UMTS/3G at 900 and 2100 MHz and LTE at 800, 1800 and 2600 MHz. Since the end of 2014, Movistar has supported 4G+ carrier aggregation with maximum speeds reaching today up to 375 Mbps. The operator claims to provide 4G coverage to approximatley 95 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 on the internet. Also, its network serves a number of mobile virtual network operators such as MasMovil, Carrefour Móvil and others. With 15.9 million customers, Orange is the second largest Spanish mobile operator with a market share of about 30 per cent. In the fiscal year 2017, Orange Spain achieved a revenue of €5.3 billion which contributed 13 per cent to the whole Orange Group's results.
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 96 per cent of the Spanish population. Also, Orange was the first Spanish operator to offer VoLTE to its 4G customers.

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. In Spain, Vodafone reports 14.1 million mobile customers, adding up to a market share of about 26 per cent and making Vodafone the third largest operator in the country following at close distance behind its competitor Orange. In the fiscal year 2017/2018, Vodafone Spain achieved revenues of €4.5 billion which contributes about eleven 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 carrier aggregation ("4G+") with maximum downlink speeds of 300 Mbps.
Vodafone España claims to offer the best LTE coverage in Spain, reaching approximately 97 per cent of the Spanish population, and is now also offering VoLTE.

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 (mobile virtual network operator) Másmóvil bought the company. For its fiscal year 2017, Másmóvil reported revenues in Spain of €1.3 billion.
Yoigo had a national roaming agreement with Movistar until the end of 2016. Since January 2017, Yoigo customers freely roam in the 2G and 3G networks of Orange at locations without Yoigo coverage. Yoigo claims a mobile customer base of 5.0 million mobile subscribers, which equals a market share of 11 per cent.
Today, Yoigo operates 3G at 2100 MHz as well as 4G at 1800 MHz. The operator currently claims a LTE coverage of approximately 89 per cent of the Spanish population.

*P3's network benchmarks are widely accepted as a completely objective authority. In 2018, we conduct the P3 connect Mobile Benchmark Spain for the fourth time, further enhancing its methodology.*

# A CLOSE LOOK AT THE SPANISH NETWORKS

P3, based in Aachen, Germany, is a world leader in mobile network testing. The company has over 3,700 employees worldwide and a turnover of more than 370 million Euros. P3 is partnering with the international telecommunications magazine connect, which has 25 years of editorial expertise and is one of the leading test authorities in Europe for telecommunications products and services. Together, P3 and connect have been conducting the most important network benchmark test in Germany for more than 15 years, extending it to other European countries since 2009.

In 2017 alone, P3 compiled approximately 60,000 measurement hours in more than 80 countries across five continents, with its test cars covering almost one million kilometres. As the de-facto industry standard, P3's benchmarking methodology focuses on customer-perceived network quality.

The 2018 P3 connect Mobile Benchmark Spain consists of drivetests and walktests conducted throughout September 2018. Four drive test cars together covered about 12,400 kilometres. The test areas account for more than 12 million people, or roughly 25.8 per cent of the total population of Spain. In addition, the results of extensive crowdsourcing analyses considering July, August and September (Data Service Availability: May to September) 2018 are included in the score.

"Our holistic benchmark clearly confirms that the Spanish operators have worked hard to improve their network performance and user experience. We are happy to see some considerable enhancements compared to the results of the previous years and are quite sure that our demanding benchmarks have played an important role in the serious efforts recently taken by the Spanish operators.

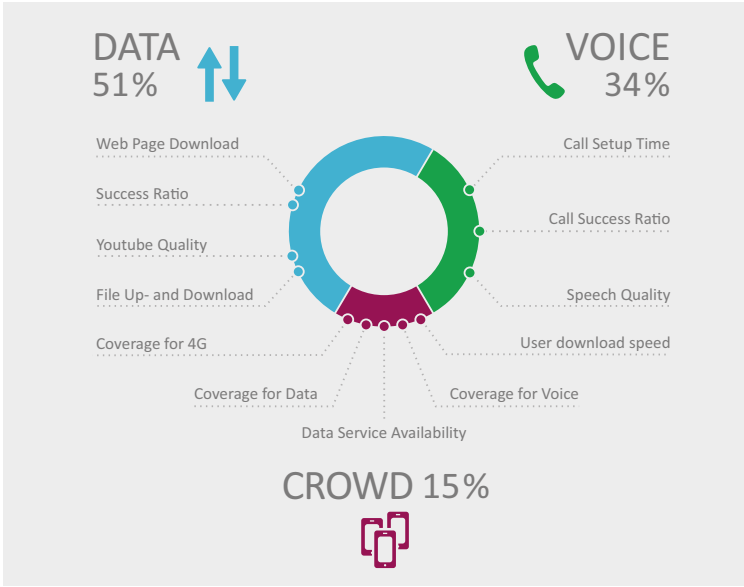
Hakan Ekmen,
CEO of P3
communications

## DRIVETEST AND WALKTEST FACTS

- **>12** million people covered
- **12,400** km drivetest
- **4,994** data samples
- **6,253** voice samples

## CROWDSOURCING FACTS

- **110,000** users
- **500** million samples
- **3** months (July to September 2018)
- **71%** of built-up area




P3 connect MOBILE BENCHMARK

# VOICE

*Many customers use voice services less intensely than data. However, when actually taking or placing a phone call, they expect reliable connections. How do the Spanish networks fulfil these expectations?*

## VODAFONE SHOWS THE BEST VOICE RESULTS, ORANGE RANKS SECOND.

Among the four Spanish operators, Orange and Vodafone support Voice over LTE (VoLTE) in their networks. VoLTE transmits voice calls as data packets over a 4G connection. This way, the otherwise necessary "circuit-switched fallback", which forces smartphones to switch back to 3G or 2G in order to take or place a phone call, can be avoided. Movistar and Yoigo still have to take this detour. Also, VoLTE codecs potentially support a wider audio bandwidth providing operators with the opportunity to deliver higher speech quality to their customers.

On their tour through Spain, P3's four test cars visited 19 cities with a population of more than 100,000 inhabitants, as well as 29 towns. Also, the cars covered about 8,400 km of connecting roads. Additionally, a walktest team conducted tests in seven cities. For the voice rating, each car carried a total of four Samsung Galaxy S8 smartphones (one per operator). The walktest team carried a total of four Galaxy S8 – one per operator. The phones in the cars always called a counterpart in one of the other cars. The phones carried by the walktest teams called a stationary counterpart. The connected testing equipment registered success ratios, setup times and speech quality. In order to simulate normal smartphone usage, data transfers took place in the background of the test calls.

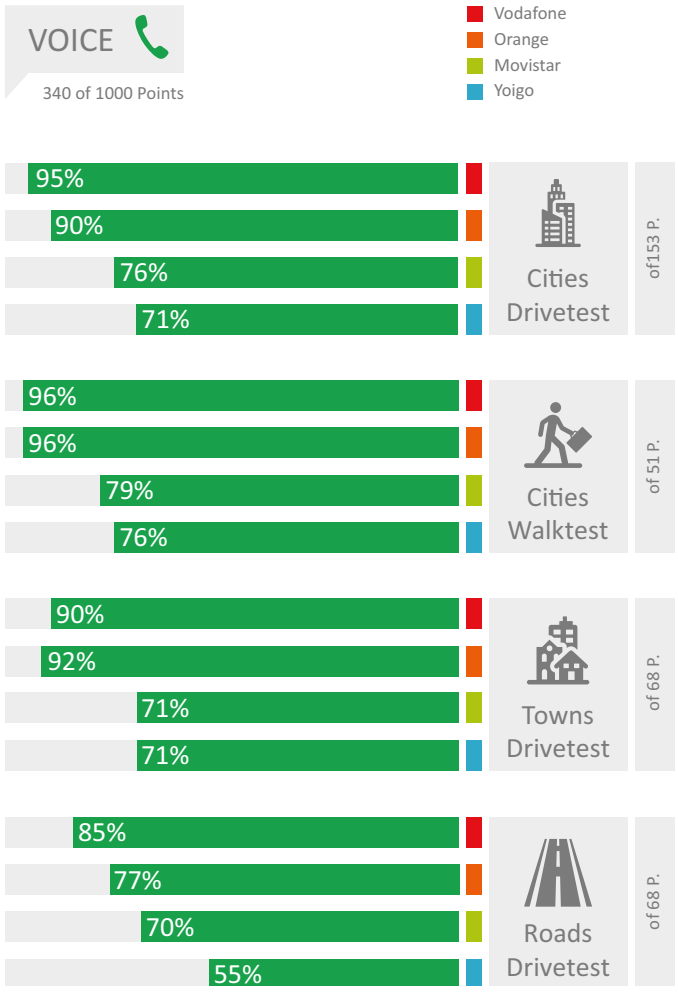
VODAFONE

### VODAFONE SHOWS STRONGEST VOICE RESULTS IN THE DRIVETESTS IN CITIES AND ON THE CONNECTING ROADS

In the detailled analysis of the measurement values gathered in the voice tests, Vodafone shows the strongest performance in the drivetests conducted in the larger cities and also on the connecting roads. In these scenarios, Movistar distinctly ranks third and Yoigo fourth. However, compared to the results of the previous years, Yoigo has clearly improved.

VODAFONE

Orange achieves the shortest connection times in all scenarios. In terms of speech quality, Vodafone and Orange offer the best results in all cases. On the roads, Vodafone is slightly ahead of Orange.



ORANGE

## IN SMALLER TOWNS, ORANGE IS SLIGHTLY AHEAD OF VODAFONE AND YOIGO BEATS MOVISTAR IN SOME KPIS

In the drivetests conducted in smaller towns, Orange is slightly ahead of Vodafone, particularly thanks to its excellent call success ratios in these cases. Yoigo and Movistar reach the same rank in the towns, but in some of the considered KPIs such as success ratios or call setup times Yoigo is even slightly ahead of the Telefónica network. This makes up for the fact that Yoigo is behind the competition especially on the connecting roads to a certain extent.

ORANGE & VODAFONE

## ORANGE AND VODAFONE ON PAR IN THE WALKTESTS, MOVISTAR AND YOIGO CLOSE TOGETHER

In the walktests that P3 conducted in seven larger cities (Barcelona, Madrid, Murcia, Palma de Mallorca, Sevilla, Valencia and Zaragoza), Orange and Vodafone are on a par. Movistar is ranking third, and Yoigo is following at close distance. So, for pedestrians or cyclists in the larger cities, Yoigo has definitely become a viable alternative to its bigger competitors.

## VOICE RESULTS AT A GLANCE

The clear winner in the voice discipline is Vodafone, with Orange ranking second but still showing very good results. Movistar scores clearly behind the leading two contenders and ranks third in this discipline. Yoigo is behind its competitors particularly on the connecting roads but has improved considerably. In the towns, it even scores better than Movistar.

| Voice | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|
| Cities - Drivetest | | | | |
| Call Success Ratio (%) | 99.4 | 98.7 | 98.5 | 98.2 |
| Call Setup Time (s) | 2.4 | 2.1 | 7.6 | 7.3 |
| Call Setup Time P90 (s) | 2.8 | 2.5 | 8.5 | 8.5 |
| Speech Quality (MOS-LQO) | 3.9 | 3.9 | 3.6 | 3.1 |
| Towns - Drivetest | | | | |
| Call Success Ratio (%) | 98.5 | 98.9 | 97.6 | 98.1 |
| Call Setup Time (s) | 2.4 | 2.0 | 7.4 | 7.0 |
| Call Setup Time P90 (s) | 2.8 | 2.5 | 8.3 | 8.2 |
| Speech Quality (MOS-LQO) | 3.9 | 3.9 | 3.6 | 3.0 |
| Roads - Drivetest | | | | |
| Call Success Ratio (%) | 96.8 | 94.6 | 96.2 | 93.3 |
| Call Setup Time (s) | 2.7 | 2.3 | 7.8 | 7.2 |
| Call Setup Time P90 (s) | 3.6 | 3.4 | 8.9 | 9.1 |
| Speech Quality (MOS-LQO) | 3.8 | 3.7 | 3.6 | 2.8 |
| Cities - Walktest | | | | |
| Call Success Ratio (%) | 99.6 | 99.6 | 98.8 | 98.6 |
| Call Setup Time (s) | 2.3 | 2.0 | 7.0 | 6.5 |
| Call Setup Time P90 (s) | 2.7 | 2.4 | 8.0 | 7.2 |
| Speech Quality (MOS-LQO) | 4.0 | 4.0 | 3.6 | 3.1 |

# DATA

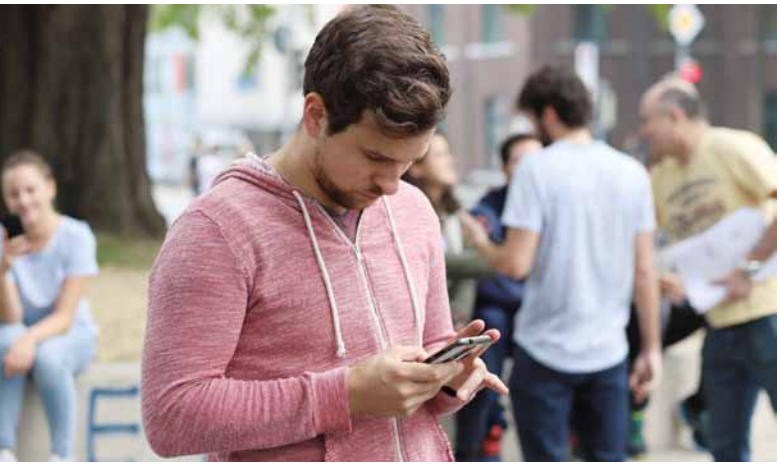
*With the volume of transmitted data permanently growing, the data discipline constantly becomes more important. How do the Spanish operators keep up with the increasing demand resulting from this development?*

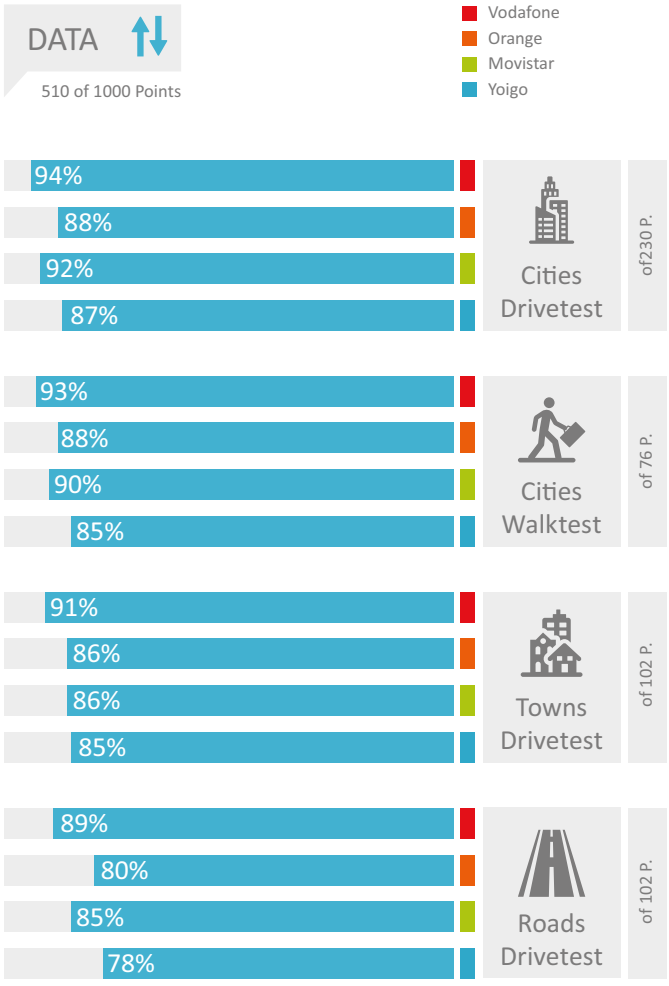
**VODAFONE IS THE CLEAR WINNER IN THE DATA DISCIPLINE, MOVISTAR ACHIEVES THE SECOND RANK.**

According to their own claims (also see page 3), Movistar, Orange and Vodafone are competing for the best LTE coverage as well as for delivering the highest data rates to their customers. Yoigo is still mainly concentrating on expanding its 4G footprint and claims to have reached 89 per cent LTE coverage of the Spanish population now.

In order to assess the performance and reliability of data connections, each of our four drivetest cars and also the walktest team carried one Samsung Galaxy S8 per operator. Supporting the LTE category 9, these smartphone types were able to benefit from the so-called carrier aggregation – the combined use of three LTE carrier frequencies which can theoretically transmit up to 450 Mbps. P3's testing considers 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 determination of success ratios and assessing YouTube playouts concentrate on reliability aspects. As YouTube streams videos at adaptive bitrates, the average value of the received video resolution is another important performance indicator.





VODAFONE & MOVISTAR

## CLOSE RACE BETWEEN VODAFONE AND MOVISTAR IN DATA DRIVETESTS CONDUCTED IN LARGER CITIES

In the drive tests conducted in 19 cities with a population of more than 100,000 inhabitants, we see a close race between Vodafone and Movistar. Orange and Yoigo follow behind, with Yoigo ranking only one per cent behind its big competitor.

All operators achieve excellent success ratios in the cities. Only in the category of YouTube live videos, Movistar performs slightly weaker. Overall, Vodafone achieves the highest score for web browsing. In the cities, it is on par with Movistar regarding this KPI. This also applies to file downloads and uploads, where Vodafone and the Telefónica network are on a par as well.

VODAFONE & MOVISTAR

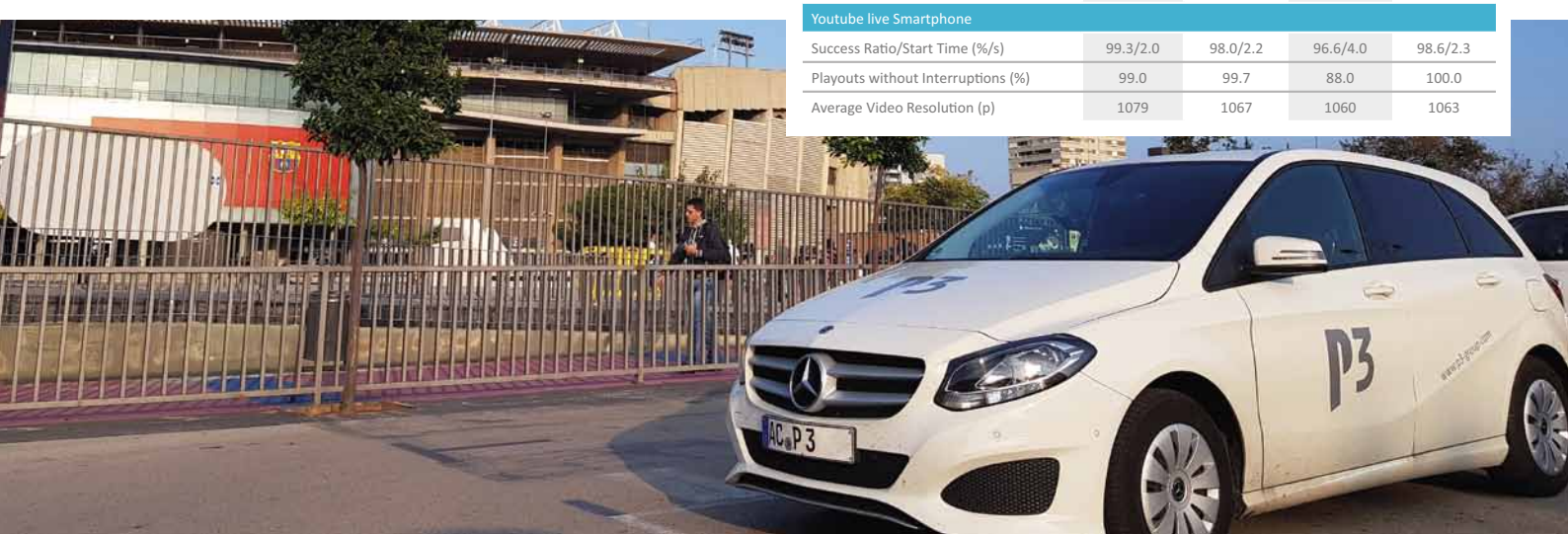
## VODAFONE AND MOVISTAR LEAD THE FIELD IN THE DATA WALKTESTS THAT TOOK PLACE IN LARGER CITIES

The results of the walktests conducted in Barcelona, Madrid, Murcia, Palma de Mallorca, Sevilla, Valencia and Zaragoza are similar to those of the drivetests that took place in the larger cities: Vodafone and Movistar lead the field, with Orange and Yoigo follow as runner-ups at a not too big distance.

The lead of Vodafone and Movistar is mainly based on higher data rates and also on strong performance when playing back YouTube videos. In terms of success ratios, all four Spanish operators achieve very good results except for Movistar when it comes to playing back YouTube live videos.

| Data in Cities - Drivetest | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|
| Web-Page Download (Live/Static) | | | | |
| Success Ratio (%/%) | 99.7/99.8 | 99.2/99.8 | 99.7/99.9 | 99.5/99.8 |
| Static: Avg. Session Time (s) | 1.2 | 1.3 | 1.2 | 1.3 |
| Live: Reaction Time (ms) | 375 | 444 | 394 | 509 |
| Live: Initial DL Speed 1st second (kB/s) | 635 | 577 | 633 | 546 |
| File Download (3 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99.9/1.2 | 99.9/2.3 | 100.0/1.1 | 100.0/2.2 |
| 90%/10% faster than (kbit/s) | 13839/60606 | 6154/38462 | 15748/59791 | 6833/36731 |
| File Upload (1 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99.9/0.7 | 99.9/0.9 | 99.8/0.6 | 99.8/1.1 |
| 90%/10% faster than (kbit/s) | 9683/29851 | 6742/23188 | 10962/28060 | 4817/20202 |
| File Download (7 Seconds) | | | | |
| Success Ratio (%) | 100.0 | 99.8 | 99.9 | 99.9 |
| Avg. Throughput (kbit/s) | 55870 | 32567 | 56560 | 26967 |
| 90%/10% faster than (kbit/s) | 14206/107148 | 9316/61508 | 18018/102105 | 8861/47884 |
| File Upload (7 Seconds) | | | | |
| Success Ratio (%) | 99.8 | 99.6 | 99.8 | 99.6 |
| Avg. Throughput (kbit/s) | 38726 | 31284 | 37017 | 20567 |
| 90%/10% faster than (kbit/s) | 13098/60267 | 8795/54210 | 14807/56328 | 5883/35402 |
| Youtube Video | | | | |
| Success Ratio/Start Time (%/s) | 99.7/1.4 | 99.6/1.6 | 99.7/1.4 | 99.6/1.7 |
| Playouts without Interruptions (%) | 99.5 | 99.3 | 99.1 | 99.6 |
| Average Video Resolution (p) | 1075 | 1072 | 1071 | 1076 |
| Youtube live Smartphone | | | | |
| Success Ratio/Start Time (%/s) | 99.6/2.1 | 98.4/2.4 | 95.7/3.4 | 99.3/2.5 |
| Playouts without Interruptions (%) | 99.6 | 98.3 | 92.9 | 99.0 |
| Average Video Resolution (p) | 1083 | 1077 | 1080 | 1079 |

| Data in Cities - Walktest | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|
| Web-Page Download (Live/Static) | | | | |
| Success Ratio (%/%) | 99.5/100.0 | 99.4/100.0 | 99.4/99.9 | 99.2/99.6 |
| Static: Avg. Session Time (s) | 1.2 | 1.2 | 1.2 | 1.2 |
| Live: Reaction Time (ms) | 377 | 432 | 402 | 500 |
| Live: Initial DL Speed 1st second (kB/s) | 610 | 574 | 626 | 549 |
| File Download (3 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 100.0/1.2 | 99.7/2.1 | 99.7/1.2 | 99.8/2.4 |
| 90%/10% faster than (kbit/s) | 13436/60545 | 6892/42712 | 14548/63325 | 6685/39474 |
| File Upload (1 MB) | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99.8/0.9 | 100.0/1.0 | 99.7/0.9 | 98.8/1.3 |
| 90%/10% faster than (kbit/s) | 7917/30189 | 5719/25462 | 7808/27082 | 3537/21517 |
| File Download (7 Seconds) | | | | |
| Success Ratio (%) | 99.7 | 99.7 | 99.7 | 99.8 |
| Avg. Throughput (kbit/s) | 59733 | 37268 | 63448 | 29932 |
| 90%/10% faster than (kbit/s) | 15504/117974 | 10159/70881 | 16767/120613 | 9666/53867 |
| File Upload (7 Seconds) | | | | |
| Success Ratio (%) | 99.2 | 99.8 | 99.3 | 98.5 |
| Avg. Throughput (kbit/s) | 36562 | 30944 | 32555 | 20567 |
| 90%/10% faster than (kbit/s) | 9343/60216 | 6499/57664 | 9098/53389 | 4350/38658 |
| Youtube Video | | | | |
| Success Ratio/Start Time (%/s) | 99.7/1.3 | 98.5/1.5 | 99.7/1.4 | 99.5/1.5 |
| Playouts without Interruptions (%) | 99.7 | 99.2 | 99.7 | 99.1 |
| Average Video Resolution (p) | 1075 | 1068 | 1062 | 1071 |
| Youtube live Smartphone | | | | |
| Success Ratio/Start Time (%/s) | 99.3/2.0 | 98.0/2.2 | 96.6/4.0 | 98.6/2.3 |
| Playouts without Interruptions (%) | 99.0 | 99.7 | 88.0 | 100.0 |
| Average Video Resolution (p) | 1079 | 1067 | 1060 | 1063 |



VODAFONE

## VODAFONE LEADS IN DATA DRIVE-TESTS IN SMALLER CITIES, THE OTHER THREE OPERATORS ALMOST ON PAR

In the data drivetests that our measurement cars performed in 29 smaller Spanish towns, the ranking is a little more distinct: In this discipline, Vodafone is clearly leading, the rest of the field follows at some distance – including Yoigo which scores only one per cent behind Orange and Movistar ranking equally. Vodafone's lead is largely based on its strong performance in the file download and upload tests, while Yoigo somehow surprises with very good YouTube results in the towns.

VODAFONE & MOVISTAR

## VODAFONE AND MOVISTAR SHOW BEST RESULTS ON CONNECTING ROADS, ORANGE AND YOIGO CLOSE TOGETHER

On the 8,400 km of connecting roads covered by our test cars, Vodafone and Movistar performed particularly well. Here, Orange and Yoigo lag a little behind – with Yoigo only scoring two per cent behind Orange. Still, all four Spanish operators show pleasantly good results in this especially demanding category.

## DATA RESULTS AT A GLANCE

Vodafone is the clear winner in the data discipline as well. Movistar manages to outperform Orange in this category and competes in a neck-and-neck race with Vodafone, reaching the second rank in the data tests. Orange and Yoigo each follow at some distance. Still, both perform pleasantly well in the important data discipline – including their performance and availability on the 8,400 kilometres of connecting roads that were covered by our measurement cars.

| Data in Towns - Drivetest | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|
| **Web-Page Download (Live/Static)** | | | | |
| Success Ratio (%/%) | 99.2/99.7 | 98.9/99.6 | 99.1/99.4 | 99.3/99.5 |
| Static: Avg. Session Time (s) | 1.2 | 1.5 | 1.3 | 1.3 |
| Live: Reaction Time (ms) | 391 | 468 | 394 | 533 |
| Live: Initial DL Speed 1st second (kB/s) | 641 | 532 | 605 | 531 |
| **File Download (3 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99.6/1.4 | 99.7/2.6 | 99.5/1.4 | 99.3/2.2 |
| 90%/10% faster than (kbit/s) | 11127/60759 | 5740/34523 | 10824/57721 | 6693/35529 |
| **File Upload (1 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99.7/0.8 | 99.2/1.0 | 99.6/0.9 | 99.3/1.4 |
| 90%/10% faster than (kbit/s) | 6688/28269 | 5171/21108 | 6401/24126 | 3581/18349 |
| **File Download (7 Seconds)** | | | | |
| Success Ratio (%) | 100.0 | 99.9 | 99.5 | 99.9 |
| Avg. Throughput (kbit/s) | 54678 | 31517 | 54028 | 28270 |
| 90%/10% faster than (kbit/s) | 13897/104737 | 10175/60026 | 12924/107062 | 10294/48599 |
| **File Upload (7 Seconds)** | | | | |
| Success Ratio (%) | 99.1 | 98.8 | 99.5 | 99.0 |
| Avg. Throughput (kbit/s) | 32751 | 27951 | 27176 | 18291 |
| 90%/10% faster than (kbit/s) | 9461/59859 | 7323/53550 | 7953/48796 | 3581/35362 |
| **Youtube Video** | | | | |
| Success Ratio/Start Time (%/s) | 99.5/1.4 | 99.3/1.7 | 98.8/1.6 | 99.4/1.7 |
| Playouts without Interruptions (%) | 99.6 | 100.0 | 98.9 | 99.9 |
| Average Video Resolution (p) | 1074 | 1071 | 1061 | 1067 |
| **Youtube live Smartphone** | | | | |
| Success Ratio/Start Time (%/s) | 98.8/2.1 | 98.2/2.6 | 94.2/4.0 | 99.1/2.5 |
| Playouts without Interruptions (%) | 98.8 | 99.7 | 88.5 | 98.8 |
| Average Video Resolution (p) | 1081 | 1075 | 1066 | 1081 |

| Data on Roads - Drivetest | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|
| **Web-Page Download (Live/Static)** | | | | |
| Success Ratio (%/%) | 98.2/98.9 | 96.7/97.1 | 97.8/98.7 | 96.6/96.6 |
| Static: Avg. Session Time (s) | 1.4 | 1.7 | 1.5 | 1.7 |
| Live: Reaction Time (ms) | 431 | 514 | 443 | 586 |
| Live: Initial DL Speed 1st second (kB/s) | 578 | 504 | 546 | 463 |
| **File Download (3 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 99.6/2.2 | 98.4/3.4 | 99.4/2.5 | 97.8/3.7 |
| 90%/10% faster than (kbit/s) | 6055/54006 | 3915/35036 | 5574/53333 | 3245/35134 |
| **File Upload (1 MB)** | | | | |
| Success Ratio/Avg. Session Time (%/s) | 98.7/1.4 | 96.5/1.7 | 98.8/1.5 | 96.3/1.8 |
| 90%/10% faster than (kbit/s) | 3134/24768 | 2397/18605 | 2811/22409 | 2275/17529 |
| **File Download (7 Seconds)** | | | | |
| Success Ratio (%) | 99.3 | 97.8 | 98.6 | 97.6 |
| Avg. Throughput (kbit/s) | 41163 | 26671 | 41771 | 26440 |
| 90%/10% faster than (kbit/s) | 8150/87861 | 5704/54164 | 7724/97150 | 5768/51643 |
| **File Upload (7 Seconds)** | | | | |
| Success Ratio (%) | 98.3 | 96.1 | 98.0 | 96.1 |
| Avg. Throughput (kbit/s) | 22458 | 19672 | 21024 | 16104 |
| 90%/10% faster than (kbit/s) | 3711/47433 | 3140/41734 | 3525/42699 | 2555/31366 |
| **Youtube Video** | | | | |
| Success Ratio/Start Time (%/s) | 97.6/1.6 | 96.3/1.9 | 97.9/1.7 | 96.3/2.0 |
| Playouts without Interruptions (%) | 99.5 | 98.3 | 98.9 | 98.8 |
| Average Video Resolution (p) | 1040 | 1036 | 1032 | 1020 |
| **Youtube live Smartphone** | | | | |
| Success Ratio/Start Time (%/s) | 98.1/2.3 | 95.1/2.7 | 90.0/3.9 | 95.9/2.8 |
| Playouts without Interruptions (%) | 97.6 | 96.9 | 88.0 | 95.8 |
| Average Video Resolution (p) | 1034 | 1023 | 1008 | 1018 |

# CROWD

*110,000 Spanish users have contributed around 500 million measurement samples in the period of July to September 2018. A thorough and sophisticated analysis of this extensive data base allows us to add a distinct picture of the actual user experience to our test results.*

**ORANGE TAKES THE LEAD IN THE CROWD EVALUATION, MOVISTAR SCORES SLIGHTLY BEHIND.**

While the drivetests and walktests determine the peak performance of the examined networks, 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 13. Based on the total population count of 46.6 million people, one of 424 inhabitants of Spain have contributed to the gathering of our crowd data.The test area of our crowdsourcing represents 71 per cent of the built-up area of Spain.

ALL NETWORKS

## VERY GOOD VOICE AND DATA COVERAGE IN ALL FOUR NETWORKS, 4G COVERAGE SHOWS ROOM FOR IMROVEMENT

The determined coverage with voice and data services scores at high levels in the test area. The same applies for the so called Quality of Coverage which takes the actual availability of the respective services into account. As can be expected, both values are a little lower for the coverage with 4G services – especially here, the crowdsourcing results indicate some room for improvement.

| Crowd Overall | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|
| **Voice Coverage** | | | | |
| Quality of Coverage (%) | 99.2 | 99.0 | 99.4 | 99.2 |
| Test Area Coverage (%) | 99.6 | 99.5 | 99.8 | 99.6 |
| **Data Coverage** | | | | |
| Quality of Coverage (%) | 99.1 | 99.0 | 99.0 | 99.2 |
| Test Area Coverage (%) | 99.6 | 99.4 | 99.7 | 99.4 |
| **4G Coverage** | | | | |
| Quality of Coverage (%) | 73.8 | 79.9 | 77.8 | 77.2 |
| Test Area Coverage (%) | 92.9 | 95.2 | 95.4 | 91.8 |
| **User Download Speed** | | | | |
| 10% EA faster than (kbit/s) | 47451 | 47944 | 45061 | 33832 |
| 10% Users faster than (kbit/s) | 19611 | 18333 | 18939 | 17851 |
| Avg. Users Best Throughput (kbit/s) | 6855 | 6362 | 6413 | 6083 |
| **Data Service Availability** | | | | |
| Degraded days (d) | 0 | 0 | 2 | 1 |
| Degraded hours (h) | 0 | 0 | 3 | 1 |

## ASSESSING COVERAGE BASED ON CROWD KPIS

Our metrics show rather equal coverage values for all Spanish operators. However, it is no surprise that our crowdsourced KPIs for voice, data and 4G coverage deviate to a certain extent from the population coverage values typically stated by operators: P3's gathering of crowd data reflects where people actually are and move as opposed to their places of residence and working. Furthermore, our crowdsourcing also comprises indoor or other disadvantageous reception situations, while operators commonly base their specifications on outdoor reception only.

VODAFONE

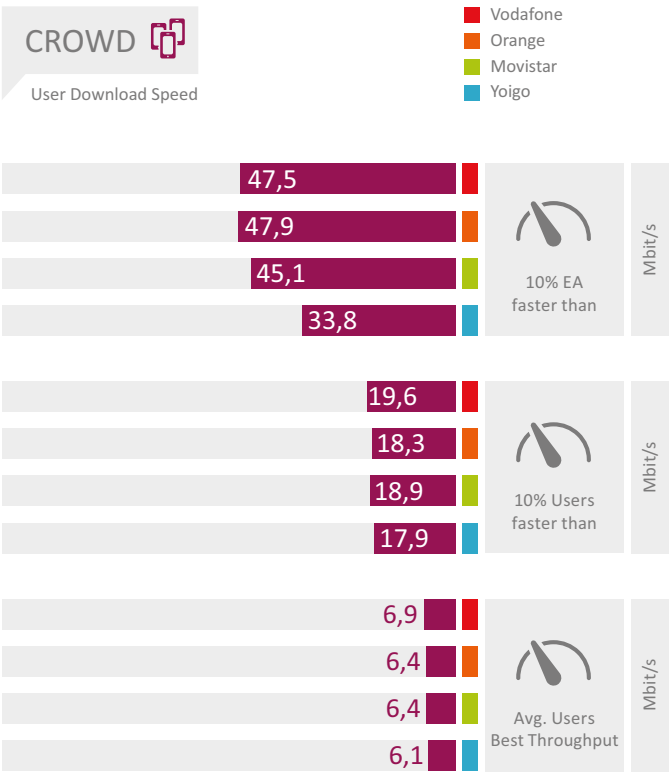
## VODAFONE DELIVERS BEST USER DOWNLOAD SPEEDS, SLIGHTLY AHEAD OF ORANGE AND MOVISTAR, YOIGO BEHIND

The results of the analysis of User Download Speeds on the whole confirms what could be expected based on the results of the data drivetests. In this category, Vodafone scores slightly ahead of Orange and Movistar with Yoigo following at a distinct distance.

In comparison to the theoretical maximum data speeds, all operators show room for improvement. However, it should be taken into consideration that a part of the actual user base probably experiences data speed limitations caused by their mobile tariffs.

CROWD

User Download Speed

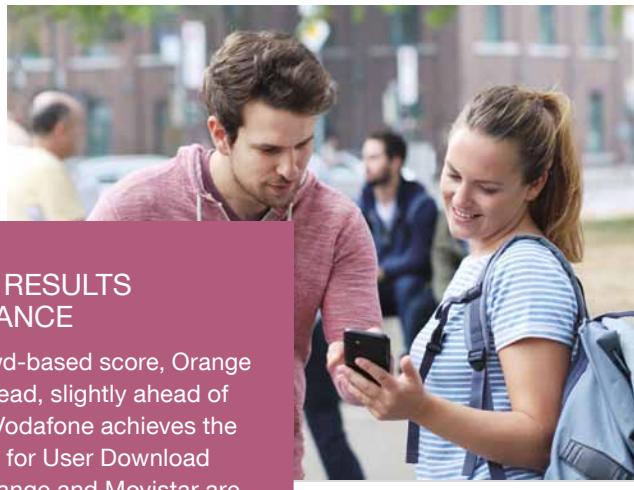



VODAFONE & ORANGE

## VODAFONE AND ORANGE SHOW NO DEGRADATIONS FROM MAY TO SEPTEMBER, OVERALL HIGH DATA SERVICE AVAILABILITY

Examining the Data Service Availability in the observation period (which for this KPI covered the five months from May to September 2018), shows pleasant results.

For Vodafone and Orange we did not identify any degrations. The other two contenders suffered from only minor outages: For Movistar, the analysis found three degraded hours on two days in May and June. For Yoigo, we determined an outage of up to one hour on one observation day in September.

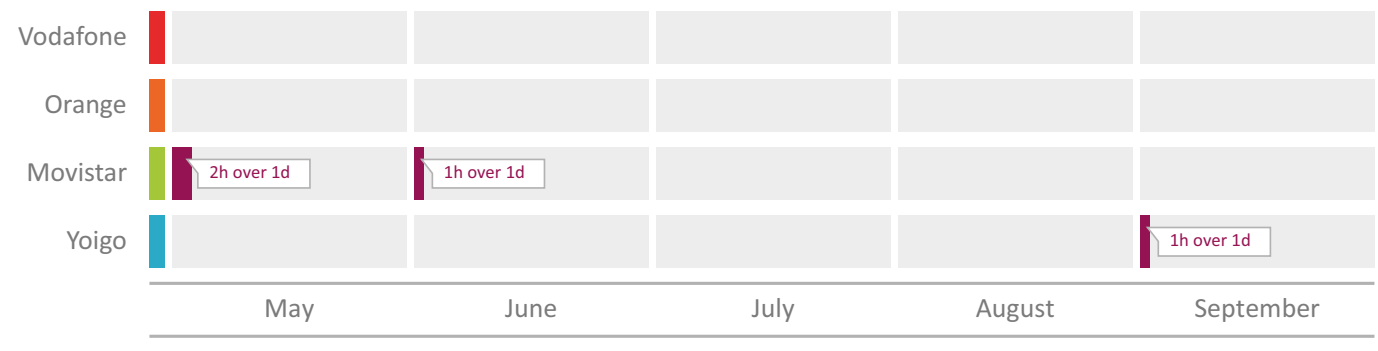


### CROWD RESULTS AT A GLANCE

In the crowd-based score, Orange takes the lead, slightly ahead of Movistar. Vodafone achieves the best score for User Download Speed, Orange and Movistar are on a par – but all operators show some room for improvement. Yoigo's improvements are also confirmed by a decent crowd score. The Data Service Availability is excellent in all four Spanish networks.

DATA SERVICE AVAILABILITY

Affected hours (h) and days (d) (2018)



# TESTING METHODOLOGY

*The methodology of the P3 connect Mobile Benchmark is the result of more than 15 years of testing mobile networks. Today, network tests are conducted in more than 80 countries. Our methodology was carefully designed to evaluate and objectively compare the performance and service quality of mobile networks from the users' perspective.*

The P3 connect Mobile Benchmark Spain comprises of the results of extensive voice and data drivetests and walktests as well as a sophisticated crowdsourcing approach.

## DRIVETESTS AND WALKTESTS

The drivetests and walktests in Spain took place throughout October 2018. 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. The connection routes between the cities alone covered about 2,100 kilometres per car – 8,400 kilometres for all four cars. In total, the four vehicles together have covered about 12,400 kilometres.

The combination of test areas has been selected to provide representative test results across the Spanish population. The areas selected for the 2018 test account for more than 12 million people, or roughly 25.8 per cent of the total population of Spain. The test routes and all visited cities and towns are shown on page 1 of this report.

The four drive-test cars were equipped with arrays of Samsung Galaxy S8 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. The walktest team also carried one smartphone per operator for the voice tests. In this case, the smartphones called a stationary 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 VoLTE preferred mode. In networks or areas where this modern 4G-based voice technology was not available, they would perform a fallback to 3G or 2G.

Two boxes were mounted into the rear and side windows of each measurement car in order to support eight smartphones per car.

As a new KPI in 2018, we assess the so-called P90 value for call set-up times. P90 values specify the threshold in a statistical distribution, below which 90 per cent of the gathered values are ranging.

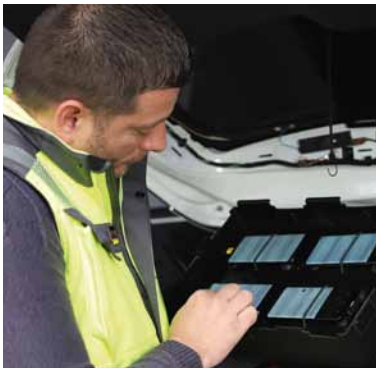
In order to account for typical smartphone-use scenarios during the voice tests, background data traffic was generated in a controlled way through random injection of small amounts of HTTP traffic. The voice scores account for 34 per cent of the total results.

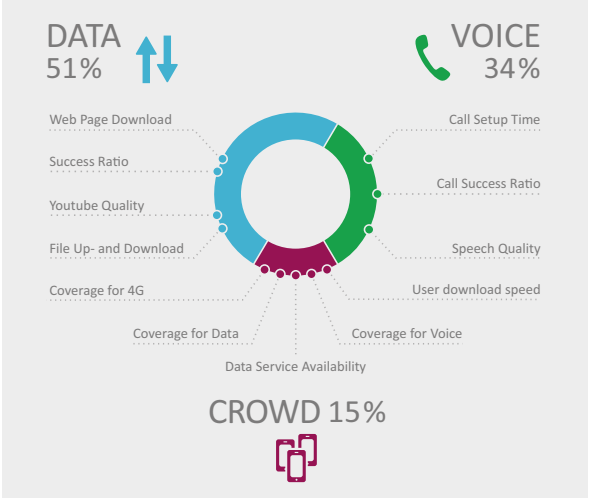
## DATA TESTING

Data performance was measured by using four more Galaxy S8 in each car – one per operator. Their radio access technology was set to LTE preferred mode.

For the web tests, they accessed web pages according to the widely recognised Alexa ranking.

One Samsung Galaxy S8 per operator took the voice measurements and one additional S8 per operator was used for the data tests. All test phones were operated and supervised by P3's unique control system.





In addition, the static “Kepler” test web page as specified by ETSI (European Telecommunications Standards Institute) was used. In order to test the data service performance, files of 3 MB and 1 MB for download and upload were transferred from or to a test server located on the Internet. 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 evaluation of YouTube playback takes into account that YouTube dynamically adapts the video resolution to the available bandwidth. So, in addition to success ratios, start times and playouts without interruptions, the measurements also determined average video resolution.

All the tests were conducted with the best-performing mobile plan available from each operator. Data scores account for 51 per cent of the total results.

## CROWDSOURCING

Additionally, P3 conducted crowd-based analyses of the Spanish networks which contribute 15 per cent to the end result. They are based on data that gathered in July, August and September, 2018.

For the collection of crowd data, P3 has integrated a background diagnosis processes into 800+ 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 P3‘s cloud servers.

Such reports generate just a small number of bytes per message and do not include any personal user data. Interested parties can deliberately take part in the data gathering with the specific ”U get“ app (see box on the right). This unique crowdsourcing technology allows P3 to collect data about real-world experience wherever and whenever customers use their smartphones.

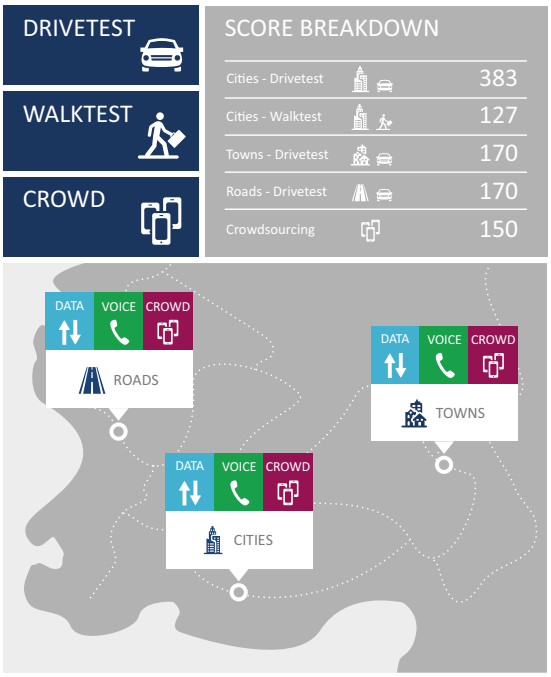
## NETWORK COVERAGE

For the assessment of network coverage, P3 lays a grid of 2 by 2 kilometres over the whole test area. The “evaluation areas“ generated this way are then sub-divided into 16 smaller tiles. To ensure statistical relevance, P3 requires a certain number of users and measurement values per operator for each tile and each evaluation area. If these thresholds are not met by one of the operators, this part of the map will not be considered in the assessment for the sake of fairness.

The “Quality of Coverage“ reveals whether voice and data services actually work in the respective evaluation area. P3 does this because not in each area that allegedly provides network reception, mobile services can actually be used. We specify these values for the coverage of voice services (2G, 3G and 4G combined), data (3G and 4G combined) and 4G only.

## DATA THROUGHPUTS

Additionally, P3 investigates the data rates that were actually available to each user. For this purpose, we determine the best obtained data rate for each user during the evaluation period and then calculate their average value. In addition, we determine the P90 values (see previous page) for the top throughput of each evaluation area as well as of each user‘s best throughput. These values depict how fast the network is under favorable conditions.




## DATA SERVICE AVAILABILITY

Formerly called “operational excellence“, this parameter indicates the number of outages or “service degradations“ – events where data connectivity is impacted by a number of cases that significantly exceeds the expectation level. To judge this, the algorithm looks at a sliding window around the hour of interest. This ensures that we only consider actual degradations as opposed to a simple loss of network coverage due to prolonged indoor stays or similar reasons.

In order to ensure statistical relevance, valid assessment months and hours must fulfil distinct requirements. Each operator must have sufficient statistics for trend and noise analyses per each evaluated hour. The exact number depends on the market size and number of operators. A valid assessment month must comprise of at least 90 per cent of valid assessment hours. Deviating from the other crowd score elements, Data Service Availability is rated based on a five-month observation period – in this case from May to September 2018.

## PARTICIPATE IN OUR CROWDSOURCING

Everybody interested in being a part of our global crowdsourcing panel and obtaining insights into the reliability of the mobile network that her or his smartphone is logged into, can most easily participate by installing and using the “U get“ app. This app exclusively concentrates on network analyses and is available under **http://uget-app.com** or via the adjoint QR code.

“U get“ checks and visualises the current mobile network performance and contributes the results to our crowdsourcing platform. Join the global community of users who understand their personal wireless performance, while contributing to the world’s most comprehensive picture of mobile customer experience.

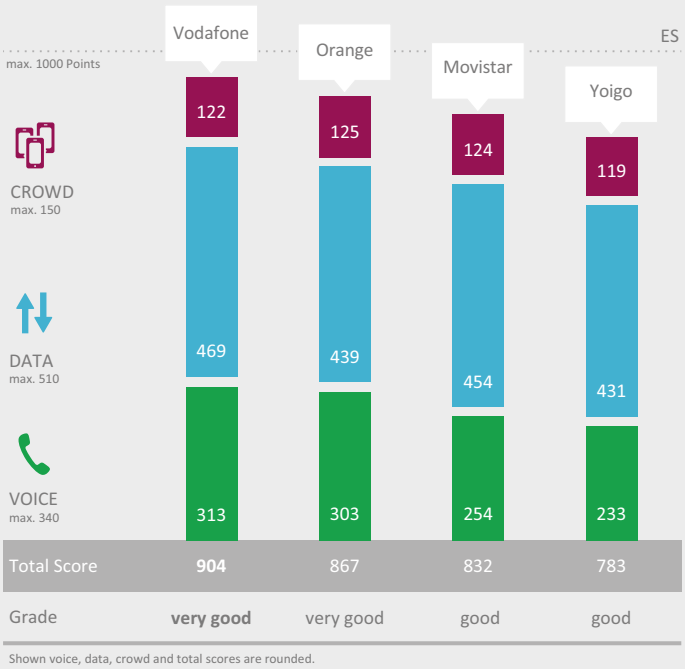
# CONCLUSION

*Vodafone wins for the fourth time, Orange takes the second rank from Movistar and manages to improve clearly over last year's results. And once again, Yoigo shows considerable progress compared to previous years.*

The clear winner of the P3 connect Mobile Benchmark Spain is Vodafone – for the fourth time in a row. On the second rank, we see a change in places: This year, Orange manages to overtake Movistar. Like the winner, Orange also achieves the overall grade „very good" and achieved the second rank thanks to excellent voice results. In the data discipline, the second rank is still held by Movistar, but in the overall assessment the Telefónica brand only achieves the third place and the grade „good". Yoigo shows considerable improvements over its results from previous years and now also achieves the grade "good".

In a direct comparison to last year's results, Orange also showsdistinct improvements, while Vodafone has maintained the same performance and Movistar dropped slightly.

In our crowdsourced assessment which is designed to augment and verify the drivetest and walktest results, Orange takes the lead, slightly ahead of Movistar. But also Vodafone and Yoigo achieve convincing results in this category.




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

| Overall Results Voice and Data | | Vodafone | Orange | Movistar | Yoigo |
|---|---|---|---|---|---|
| Voice | max. 340 | 313 | 303 | 254 | 233 |
| Cities (Drivetest) | 153 | 95% | 90% | 76% | 71% |
| Cities (Walktest) | 51 | 96% | 96% | 79% | 76% |
| Towns (Drivetest) | 68 | 90% | 92% | 71% | 71% |
| Roads (Drivetest) | 68 | 85% | 77% | 70% | 55% |
| Data | max. 510 | 469 | 439 | 454 | 431 |
| Cities (Drivetest) | 230 | 94% | 88% | 92% | 87% |
| Cities (Walktest) | 76 | 93% | 88% | 90% | 85% |
| Towns (Drivetest) | 102 | 91% | 86% | 86% | 85% |
| Roads (Drivetest) | 102 | 89% | 80% | 85% | 78% |
| Crowdsourced Quality | max. 150 | 122 | 125 | 124 | 119 |
| Crowd | 150 | 81% | 83% | 82% | 79% |
| Connect Rating | max. 1000 | 904 | 867 | 832 | 783 |

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


vodafone

**1**

For the fourth time in a row, Vodafone is the clear winner of the P3 connect Mobile Benchmark Spain thanks to a distinct lead both in the voice and data categories. At present being the third largest Spanish operator, Vodafone proves to be capable of delivering high performance and quality to its customers.

orange

**2**

A "very good" Orange has not only taken the second rank from its rival Movistar but also managed to increase its customer base, currently being the second largest mobile operator in Spain. This success is based on considerable improvement efforts – which is proven by our benchmark and not least its crowd component.

movistar

**3**

With strong data results and a still good voice score, the largest Spanish operator ranks third. Compared to its 2017 scores, the Telefónica brand has slightly improved in the voice discipline, and more or less kept the same performance in the data category. All in all, this operator achieves the grade "good".

yoigo

**4**

Although Spain's smallest operator scores fourth, the comparison to last year's result reveals a distinct improvement in the data and especially in the voice category. The other competitors may still be stronger, but this year, Yoigo's clear improvement efforts are rewarded with a well-deserved overall grade "good".