SYSTEMICS PAB
Network Quality Experts

CERTIFICATE

Systemics-PAB Sp. z o.o.
Wolodyjowskiego 46B, 02-724 Warsaw, Poland

hereby certifies that

Orange Espagne S.A.U.
Paseo Club Deportivo, 1, 28223 Pozuelo de Alarcón, España

received the title for

THE BEST SPANISH MOBILE NETWORK IN THE TEST

This certificate is based on the results of the measurement campaign, which was carried out by Systemics-PAB in June and July 2021. The measurement campaign assessed the quality of experience of mobile voice and data services in Spain. All mobile Network Operators in Spain: Orange Espagne S.A.U. (Orange), Telefónica S.A (Movistar), Vodafone España, S.A.U. (Vodafone) and Xfera Móviles, S.A. (Yoigo) were tested. Systemics-PAB performed the benchmarking measurements throughout Spain covering 20 largest cities as measured by population, and national roads across the country. The project have also included testing 5G data networks. The measurements were carried out using Swissqual Smart Benchmarker system equipped with Samsung Galaxy S10 terminals for voice/VoLTE tests and Samsung Galaxy S21+ 5G terminals for data tests. For the coverage assessment Rohde and Schwarz radio scanners were used. Voice tests were done in mobile to mobile mode. The assessment of quality of services was done using international standards and Systemics-PAB expert knowledge.

The results of the measurements showed Orange as operator achieving the highest overall results for the quality of experience of mobile services in Spain.

Orange Espagne S.A.U. can therefore be certified as the operator with the highest overall quality of mobile services in the test.

Jan Kondej
Chief Technical Officer

DEKRA

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Test Route

The periodical drive tests of mobile networks allows operators to maintaining the highest standards of the telecommunication services quality and customer experience when using the network. It allows to assess the situation on the market and is one of the tools for stimulating the competitiveness.

As a part of DSBO 2021 project Systemics-PAB delivered extensive benchmarking campaign across the country to measure the quality of mobile telecommunication services offered by four mobile networks operators in Spain. The benchmarking measurements took place between 03.06.2021 and 01.07.2021 on representative areas of Spain including cities and roads covering more than 50% of the population.

The total distance covered by 2 drive test cars used was 11600 km. Measurements took around 170 hours delivering almost 5000 voice service tests and over 3000 for each of data services tests. All the tests were conducted using SwissQual (Rohde&Schwarz Group) benchmarking solution installed in the roof boxes on measurement cars.

Measurement Setup

	Voice/VOLTE testing	**Data testing**
Device	Samsung Galaxy S10 (SM-G973FDS) LTE / HSPA+ DC / HSUPA 5.76 attenuation - 7dB	Samsung Galaxy S21+ (SM-G996B) 5G NR / LTE / HSPA+ DC / HSUPA 5.76 attenuation - 7dB
Test Cases	**Mobile-to-Mobile** **Best available Voice technology**: 85 sec call duration 15 sec call setup time out HTTP Transfer 100kB Data traffic injection (1 test per call window)	**Data 5G preferred:** **APN with default IPv4/IPv6 settings** HTTP UL and DL stress test 7s HTTP 5MB UL and 10MB DL fixed file transfer Live Web Browsing 8 pages (http & https) YouTube Streaming
Testing scenario	100% Drive test Big Cities, Small Cities and Connecting Roads	

* attenuation inserted to simulate usage conditions

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Scoring Methodology

The quality assessment and the comparison between operators was prepared using the ETSI Technical Report 103559 Annex B approach. The Report was developed and published in August 2019. It fulfils market needs for open and "standardized" countrywide mobile network benchmarking and scoring. TR103599 allows to get results which are transparent about how the actual scoring has been achieved including methods and underlying assumptions.

The document discusses the construction and methods of such a countrywide measurement campaign, with respect to the area and population to be covered, the collection and aggregation of the test results and the weighting of the various aspects tested. The experienced quality of service varies over time so that the individual score of a particular throughput cannot be fixed once and for all. In order to reflect 5G implementation values for data KPIs thresholds were adopted and bigger files were used for emulation of receiving/sending attachments (fixed size file DL/UL test).

The basic philosophy of the scoring is driven by customer's experience with the network and service quality. In assessing the overall performance and overall score of each mobile network, 2 main categories of services (with subcategories)have been evaluated:

- Voice services, affecting 40% of the overall score
- Data services, affecting 60% of the overall score and consisting of following tests:
  - Fixed Size File DL
  - Fixed Size File UL
  - Fixed Duration File DL
  - Fixed Duration File UL
  - Web Browsing
  - YouTube streaming

Additional assumptions

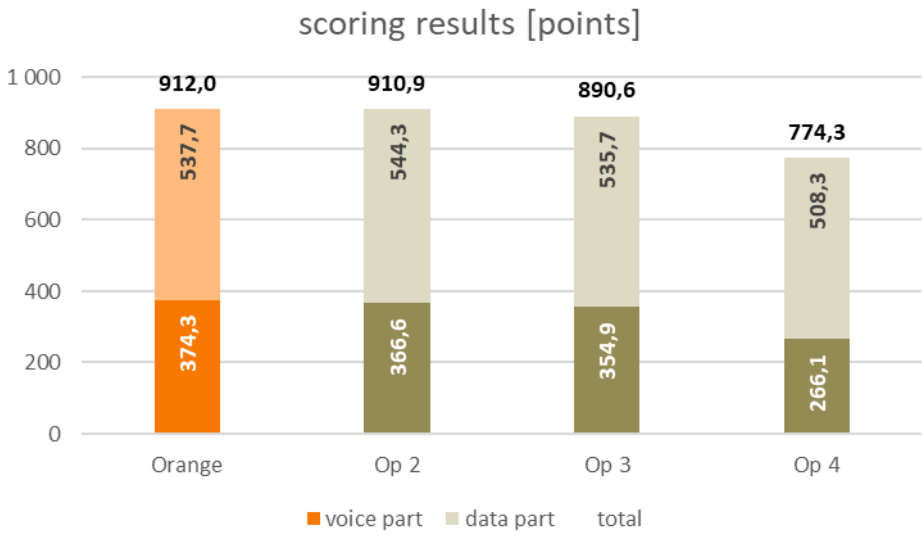
The test area was designed to cover cities and connecting roads (with villages along roads) that constitute around 50% of the population of Spain.

In order to keep the fairness of testing methodology all the operators in the benchmark were tested using the same measurement terminal type supporting functionalities offered by networks to achieve the best performance. The selection of measurement terminals models for data and voice tests took also into account the stability of the terminal itself as well as availability of the appropriate firmware version to support VoLTE and high data throughputs. The quality of services was not limited by SIM cards used in the project. Commercial tariffs were used.

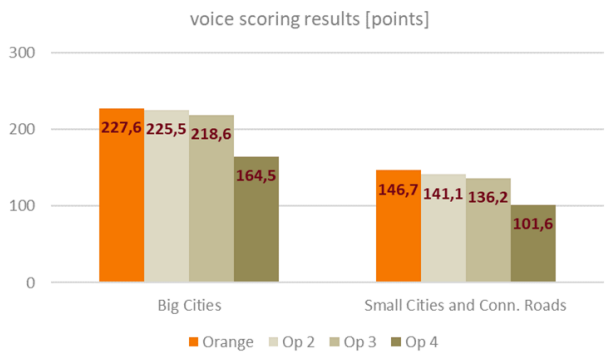
The selection of web pages to be tested was done based on Alexa rank of most popular web destinations in Spain which are accessible for drive testing (automated test by robots).

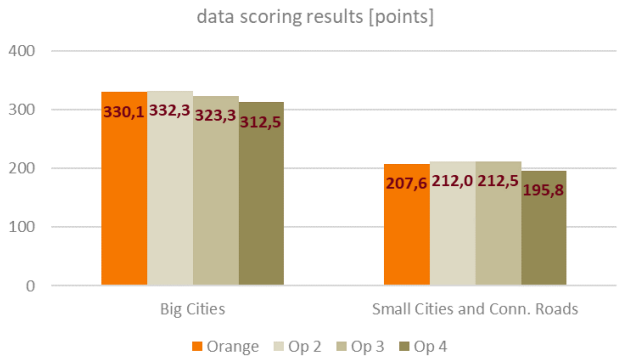
Scoring Results

With applied scoring methodology the highest number of points in overall scoring was achieved by Orange and was equal to 912.0 out of 1000 of maximum achievable. The other operators scored 910.9, 890.6 and 774.3. Orange was the best in voice scoring with the lead to get best overall score even being second in data scoring.

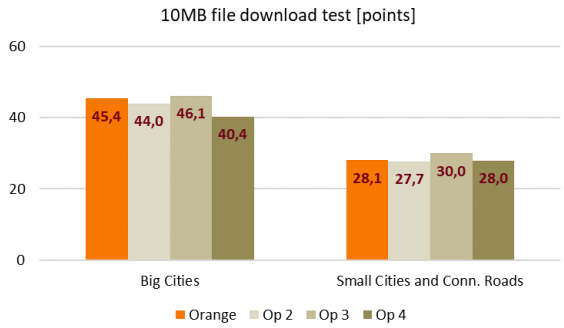


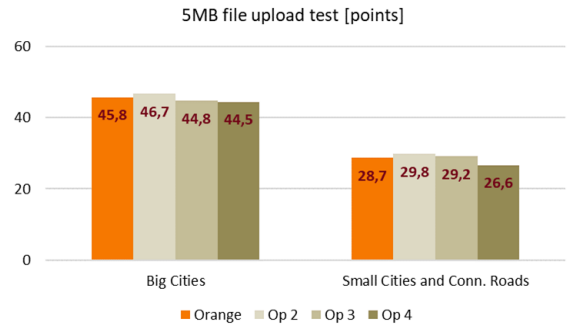
Orange achieved the highest overall score due to the best quality of voice services in all measured aggregations, in Large Cities, Small Cities and on Roads. Op2 and Op3 are following Orange in voice results. Orange was just behind Op2 in data services results. Worst results in both voice and data tests in all aggregations are reported by Op4 especially in voice testing.

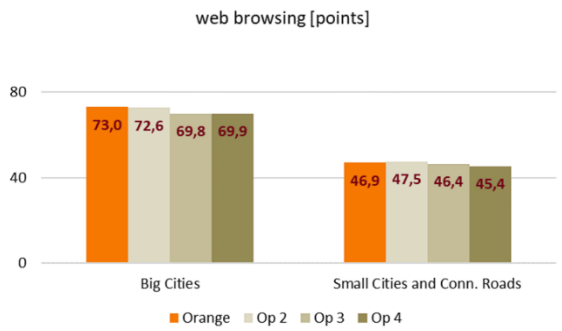


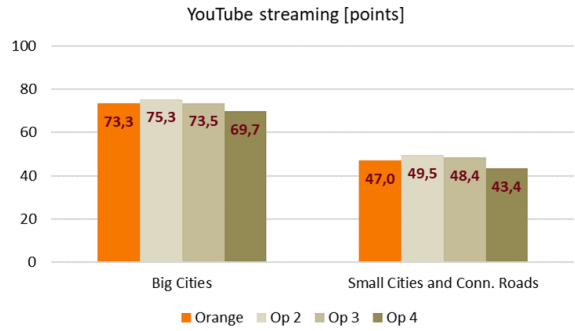


The comparison of the scoring results for selected data tests for big cities and other areas is presented on charts below.



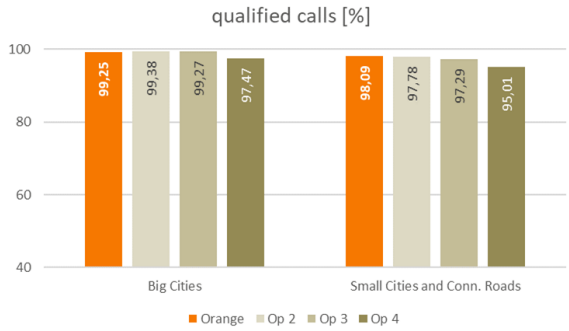




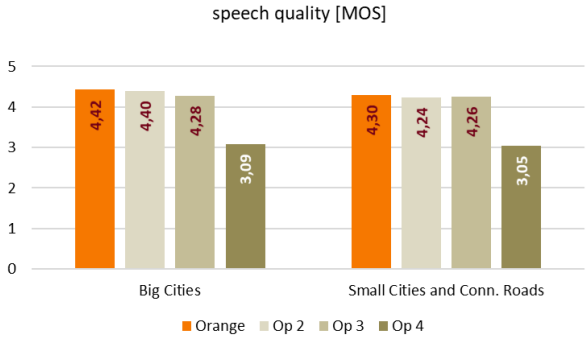


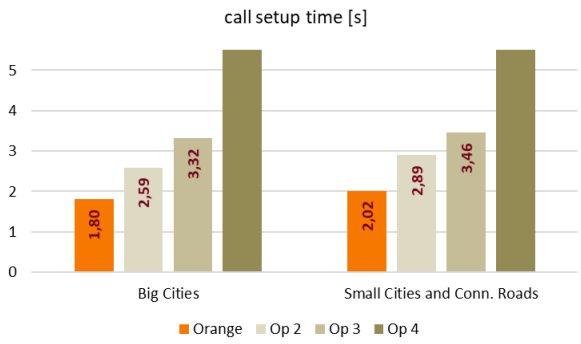
Tests Results in Details

All operators except Op4 presents good availability of voice services. Op4 doesn't offer VoLTE. Orange and Op3 provides VoLTE for over 98% of connections. Orange demonstrates the best speech quality and shortest call setup time). Orange and Op2 use EVS codec what boosts speech quality.



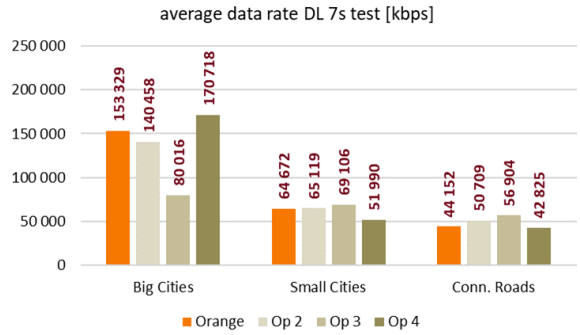
Orange has the fastest call setup time thanks to the extensive use and very good performance of VoLTE-VoLTE calls. EVS codec implementation in Op2 utilizes VoLTE and EVS to a lesser extent what is reflected in slightly worse performance. The longest call setup time in Op4 is caused by lack of VoLTE.

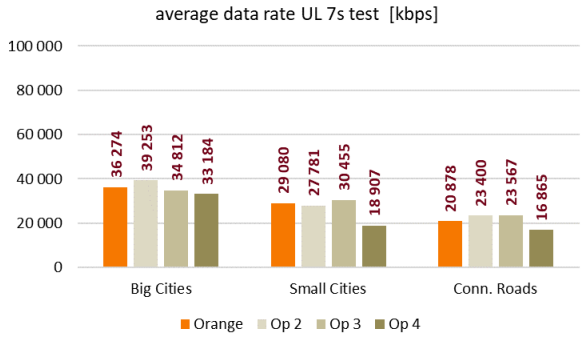




Orange DL throughput performance in capacity test (7s test) is on par with the competition in small cities and connecting roads. The best test results achieved by Op4 in big cities came from highest deployment of n78 band for 5G services. Orange DL throughput performance is the second best and has significantly improved its DL performance. These improvement was possible due to the deployment of 5G NR bands in cities tested. The throughput of the best 10% of transfer DL tests in case of Orange was not worse than 373 Mbps in big cities. For Op2 which was the best that value was 433Mbps.

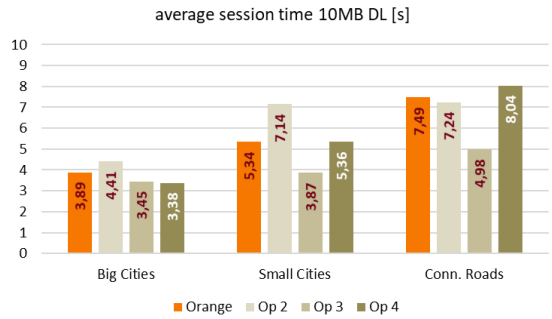
In case of UL throughput in 7s test, Orange and Op3 leads the competition with best everage throughput in big cities and very close competition between Orange, Op2 and Op3 in other areas. The throughput of the best 10% of transfer UL tests in case of Orange was not worse than 71Mbps in big cities. For Op2 that value was 79Mbps. Orange had this KPI better than Op2 in small cities and on connecting roads..

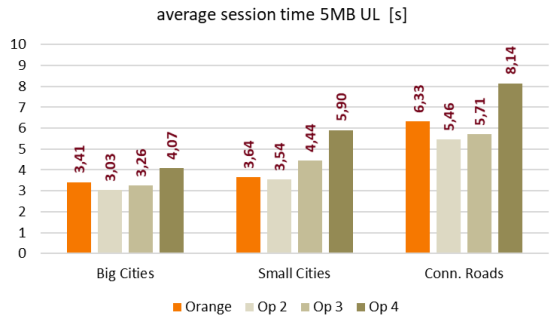




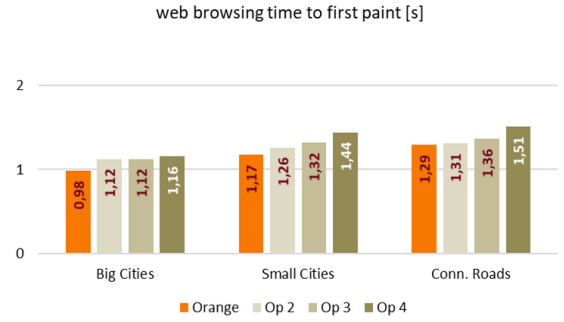
Op3 achieved shortest average session time among all operators for 10MB file download in. Orange follows Op3. There is a significant difference in results between big cities and other areas. Op3 has an advantage outside big cities due to n1 band usage for 5G network.

For upload of 5MB file test the shortest upload time is in Op2 network followed by Orange in big and small cities and by Op3 on connected roads. The throughput of the best 10% of 10MB file transfer DL tests is best in Big Cities for Op4 and not worse than 177 Mbps, Op3 is best in Small Cities and on Connecting Road with 58Mbps and 76Mbps respectively.

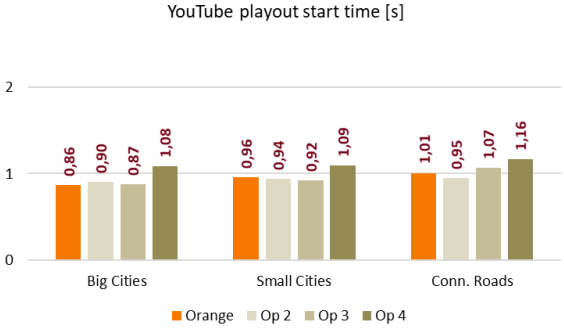




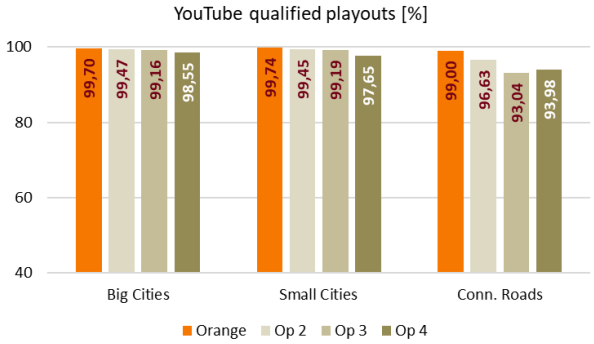
Orange reports the shortest access to live web content (time to 1st paint). The service reliability in all aggregations is similar for all measured operators. Orange is best in all tested areas.

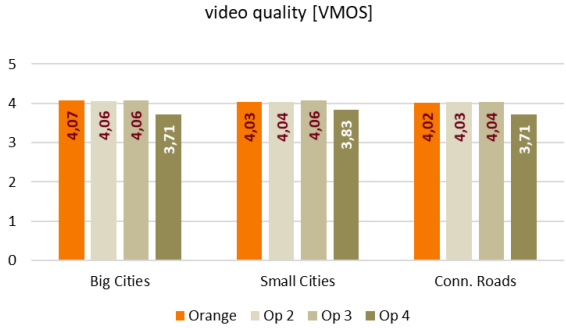


Orange shows the fastest Youtube playout start time. The best YouTube reliability was measured in Orange network. On connecting roads the result was more than 5 percent points better than Op3 and Op4. Orange, Op2 and Op3 achieved similar VMOS scoring above 4 points but Orange take a lead in term of avg. picture resolution which reached 927 lines in the test. For three best operators video is played with played with 1080p in more than 55% of the time and in over 66% of the time video is played with played with resolution not worse than 720p.



All operators except Op3 download video content mainly from Google Global Cache placed in their own network.





Orange latency (TCP round trip time test) the second best in the test slightly above 60ms. The lowest value measured in Op2 network was equal to 56ms. The longest round trip time above 70ms was measured in Op4 network.

Systemics-PAB is well known European company providing comprehensive surveys and measurements of the quality of network services and the end-user experience. Systemics-PAB conducts complex projects in multiple countries worldwide for telecom operators, regulators, network equipment providers, lab testing organizations and enterprises. Systemics-PAB offers the expert know-how developed over more than 15 years in this business.