SYSTEMICS PAB
Network Quality Experts

CERTIFICATE

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

hereby certifies that

Orange Belgium N.V.
Avenue du Bourget 3, 1140 Brussels, Belgium

Received the title for

THE BEST BELGIAN MOBILE NETWORK IN THE TEST

This certificate is based on the results of the measurement campaign, which was carried out by Systemics-PAB in May 2021. The measurement campaign assessed the quality of experience of mobile voice and data services in Belgium. All mobile Network Operators in Belgium: Orange Belgium N.V. (Orange), Telenet Group N.V. (Telenet), Proximus N.V. (Proximus) were tested. Systemics-PAB performed the benchmarking measurements throughout Belgium covering 18 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 Belgium.

Orange Belgium N.V. can therefore be certified as the operator with the highest overall quality of mobile services in the test.

Certificate Date: 27.05.2021

Jan Kondej
Chief Technical Officer

Quality Management System (DIN EN ISO 9001:2018) certified by DEKRA

DEKRA

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Test Route

The periodic drive tests of mobile networks play the vital role in maintaining the highest standards of the telecommunication services quality and customer experience when using the network. It allows to assess the situation in the market and is one of the tools for stimulating the competitiveness. It is even more important if new technologies are implemented in the network as it happened recently with 5G in Belgium.

As a part of DSBO project Systemics-PAB delivered an extensive benchmarking campaign to measure the quality of mobile telecommunication services offered by mobile networks operators in Belgium across the country.

The benchmarking measurements took place between May 11th and May 22nd of 2021 and covered representative areas of Belgium including most important cities and roads.

The total distance covered by each of 2 drive test cars used was over 5000 km. Measurements took close to 80 hours delivering ~2400 voice tests and ~1500 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**: 115 sec call window 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
Tests and Route Types	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 provides for 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 the 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

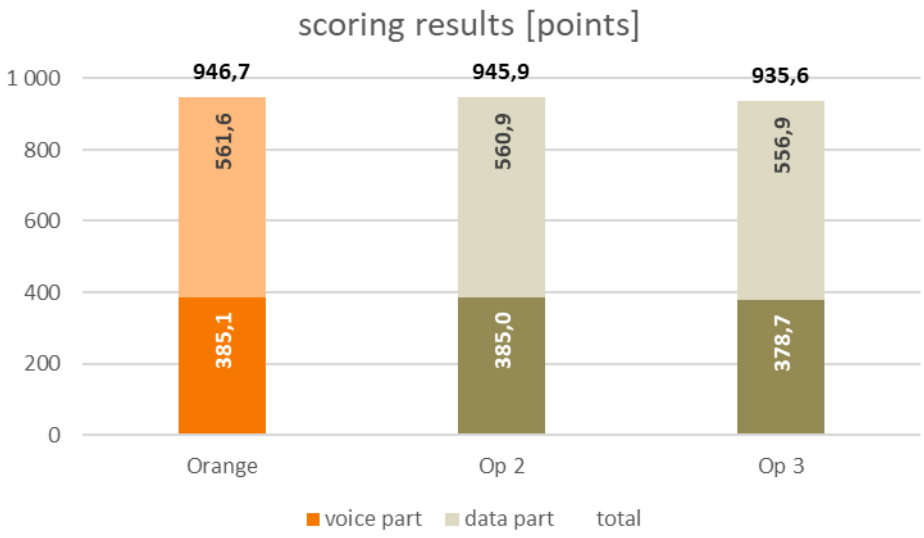
The test area was designed to cover cities and connecting roads (with villages along roads) that constitute around 50% of the Belgian population.

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 also took 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 the SIM cards used in the project. Commercial tariffs were used.

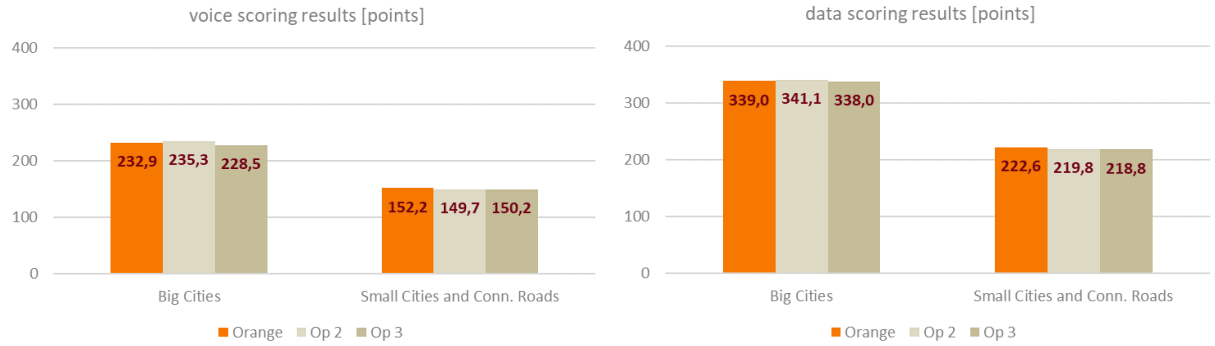
The selection of web pages to be tested was done based on Alexa rank of most popular web destinations in Belgium which are accessible for drive testing (automated test by robots).

Scoring Results

Using the applied scoring methodology the highest number of points in overall scoring was achieved by Orange and was equal to 946,7 out of the 1000 maximum achievable. The other operators scored 945,9 and 935,6. Orange achieved the best score in both voice and data tests.

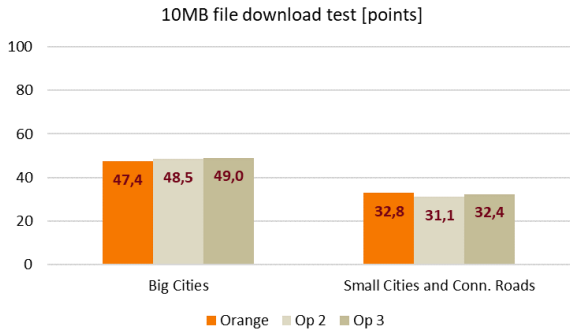


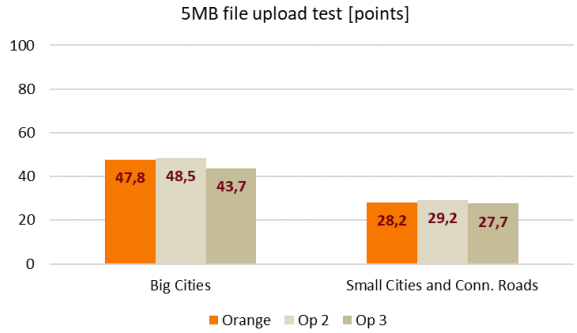
Operators' scoring for quality of services in measured aggregations as Large Cities, Small Cities and on Roads are presented on charts below.

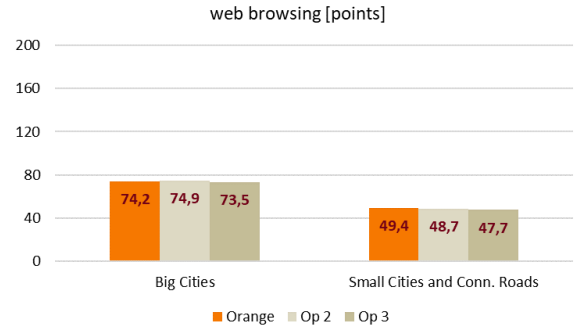


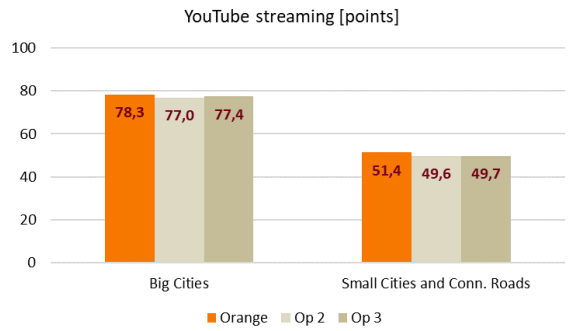
In Small Cities and on the Connecting Roads, the results of Orange are the best among operators. The scoring difference varies in specific test types and geographical locations.

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





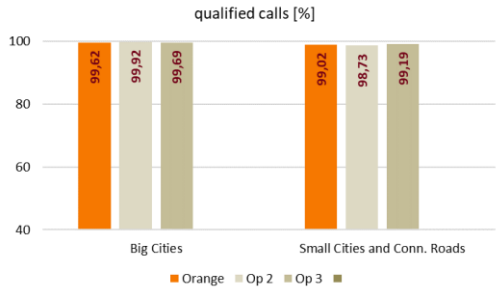


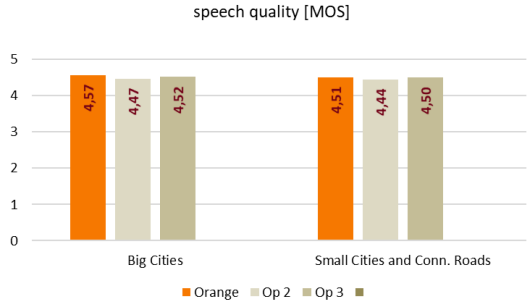


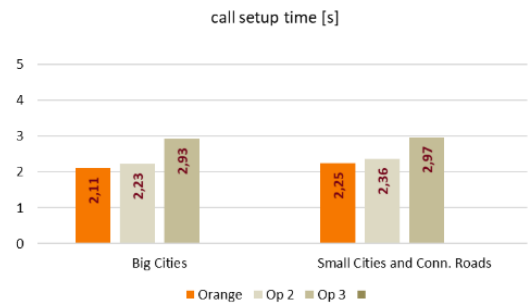
Tests Results in Details

All operators achieved good results in the Voice Call. All operators provided VoLTE connections. Orange demonstrates the best speech quality and shortest call setup time.

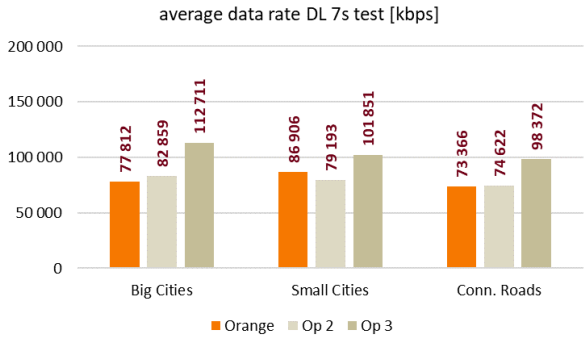
All operators support EVS 24.4kbps, which is VoLTE codec offering superior speech quality compared to legacy (2G/3G) codecs. Orange speech quality is achieved to some extent due to the least lossy speech samples (at least one transport packet lost).



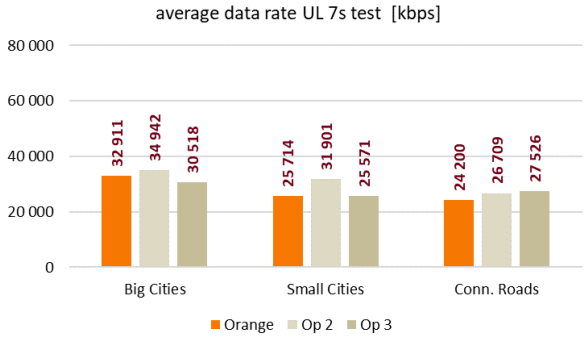




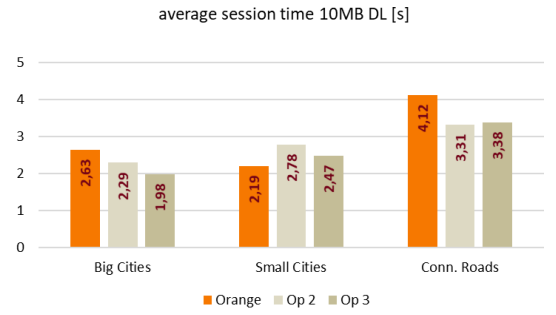
Orange and the second operator has the fastest call setup time thanks to the extensive use and very good performance of VoLTE-VoLTE calls. Other operators present longer call setup time even in case of pure VoLTE calls.



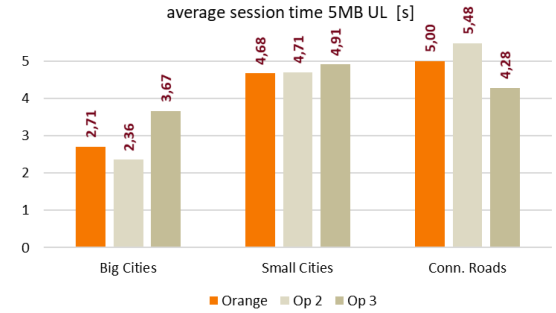
Orange average DL throughput performance is very close to the performance offered by Op2. The best results were achieved by Op3. Compared with the 2020 benchmark, a vast increase in Orange throughputs were observed, due to an increase of CA usage. The average DL throughput of Orange is better than 25Mbps comparing to 2020 tests. Op3 highest throughput was achieved thanks to highest bandwidth and the higher level of transmission with better coding schemes (MCS & CQI). Orange exhibits its good throughput comparing to Op2 thanks to high number of radio resources used. Op2 presented the implementation of 5G NR.



In case of Uplink throughput the difference between opertors is not so big. Orange has a potential to improve UL on Connecting Roads. Orange DL throughput results could be better by improving the use of higher coding schemes in the transmission.

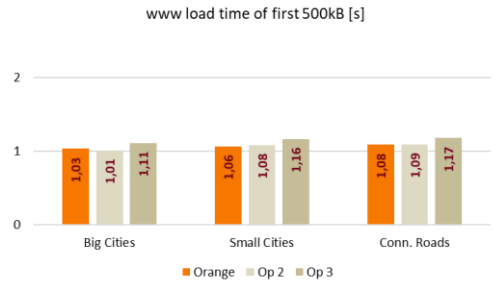


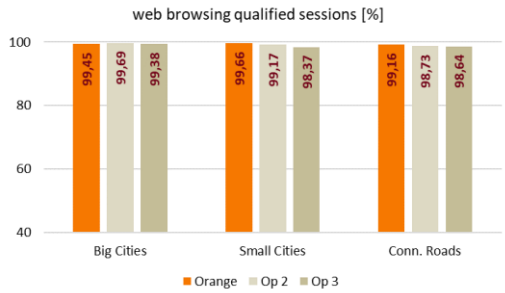
Orange presented good average session time for 10MB file download in Big and Small cities. For connecting roads, Op2 and Op3 showed the shortest session time. Op2 and Op3 are behind competitors, with Op3 results being severely impacted due to poorer service reliability on Connecting Roads. Orange achieved the best result for fastest DL throughputs in fixed size file test. The best 10% of test samples was transmitted with the throughput better than 122Mbps.



Orange in small cities achieved the shortest session time in average among operators for the 5MB file upload. Almost all operators demonstrate very similar UL reliability above 99%. For Orange in biggest cities the best 10% of test samples was transmitted with the throughput better than 47Mbps. Op2 achieved the highest throughput in this category in small cities with result above 43Mbps.

Orange with the shortest access to live web content (time to load of the first 500kB) and the best service reliability in all aggregations, all other operators stay very close (within ~100ms behind) with good service reliability. Orange ranks 1st in small cities and connecting roads with services qualifier, Op2 has best browsing qualifier in big cities, Op3 in last position in all aggregation levels.

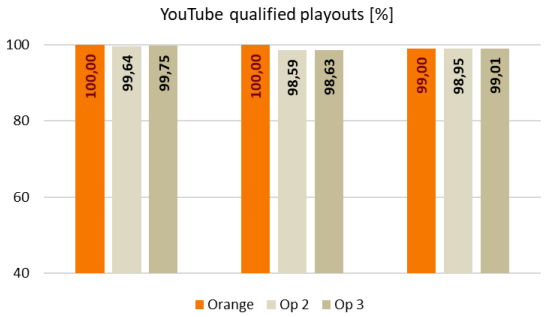


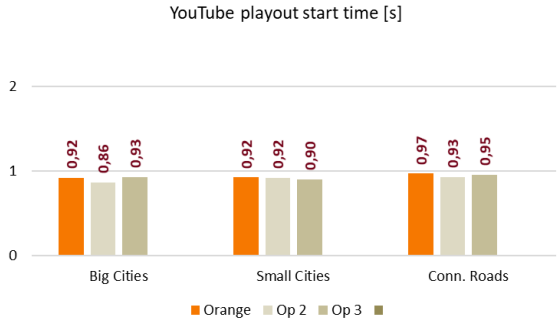


Orange and others show YouTube playout start time below 1 second. The best YouTube reliability was measured in the Orange network followed by Op2 and Op3 slightly behind but very close each the other.

Almost all operators achieve similar VMOS scoring well above 4 points. Live video initial resolution is 720p and for the majority of cases, video is quickly upgraded to 1080p. Over 2/3 of time video is played with 1080p while only around 1% of time the resolution is worse than 720p.

End user can reach YouTube video content via Google autonomous systems or Edge caching (Google Global Cache - GGC). The second option is faster. Orange & Proximus use GGC in their own network while no GGC was detected for Telenet network.





The project included WhatsApp performance testing but the results of those tests are not included in the scoring. In the test operators show very similar WhatsApp reliability. Orange shows the best WhatsApp reliability in big cities. If using Voice scoring algorithm for WhatsApp the higher number of points 389 could be assigned to Orange while Op2 got 379 and Op3 got 380 out maximum 400 points. Orange won the highest score thanks to better WhatsApp service reliability and faster Call Setup Time. Orange equals with competition in speech quality slightly behind Op3.

5G NR deployment in tests

The 5G NR deployment in Belgium is at the very early stage. As the services are not publicly available commercially for all Belgian mobile networks, Systemics performed scanning of the spectrum in order to get the picture of the current 5G presence. The widest coverage was measured in Op2 network covering with 5G signal parts of Antwerp, Bruges Geel, Hasselt, Kortijk, Leuven and Mechelen and Ghent. Orange is present in Antwerp and Op3 in Leuven.

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.