SYSTEMICS PAB
Network Quality Experts

CERTIFICATE

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

hereby certifies that

Orange Moldova S.A.
Alba Iulia 75 St., MD 2071, Chişinău, Republic of Moldova

received the title for

THE BEST MOLDAVIAN 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 and June 2021. The measurement campaign assessed the quality of experience of mobile voice and data services in Moldova. All mobile Network Operators in Moldova: Orange Moldova S.A. (Orange), Moldcell S.A. (Moldcell), Moldtelecom S.A. (Unite) were tested. Systemics-PAB performed the benchmarking measurements throughout Moldova covering 12 largest cities as measured by population, and national roads across the country. The measurements were carried out using Swissqual Smart Benchmarker system equipped with Samsung Galaxy S10 terminals for voice/VoLTE tests and Samsung Galaxy S21+ 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 Moldova.

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

Certificate Date: 21.06.2021

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 competitiveness.

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

The benchmarking measurements took place between May 25th and June 8th of 2021 and covered representative areas of cities and roads in Moldova. The total distance covered by each of the 2 drive test cars used was over 5500 km. Measurements took close to 90 hours delivering ~2700 voice service tests and ~1600 for each of data services tests. All the tests were conducted using SwissQual (Rohde & Schwarz Group) benchmarking solution installed in the roof boxes of the 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) LTE / HSPA+ DC / HSUPA 5.76 (5G capable) 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 4G 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

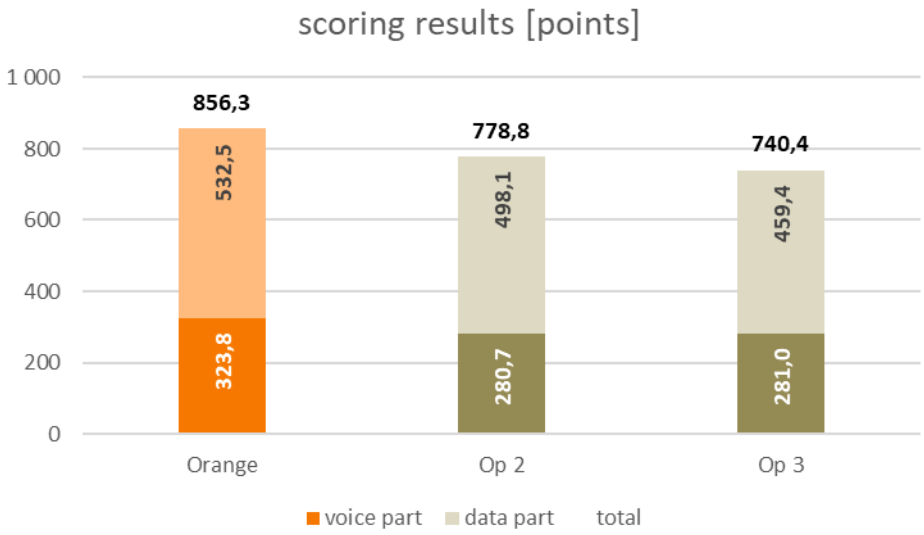
The test area was designed to cover cities and connecting roads (with villages along roads) that constitute around 50% of the Moldavian population.

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

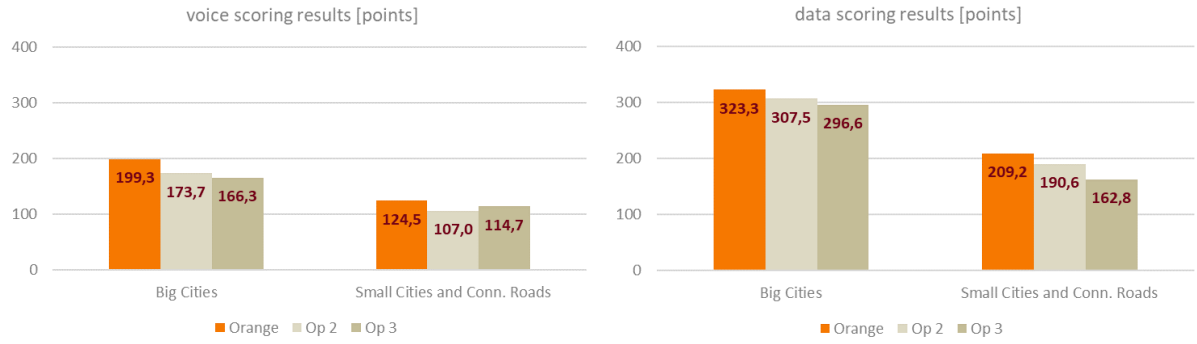
The selection of web pages to be tested was done based on Alexa rank of most popular web destinations in Moldova which are accessible for drive testing (automated test by robots).

Scoring Results

With applied scoring methodology the highest number of points in overall scoring was achieved by Orange and was equal to 856,3 out of 1000 of maximum achievable. The other operators scored 778,8 and 740,4 points. Orange got the best score in both voice and data tests.

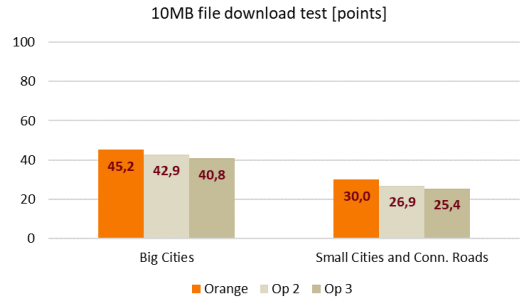


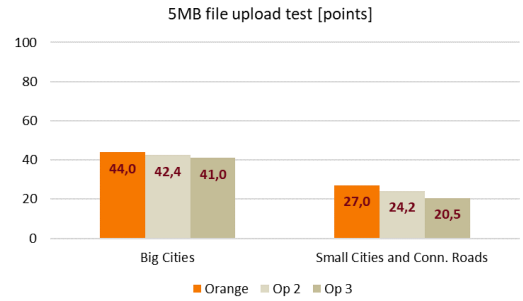
Orange achieved the highest overall score due to the best quality of services in all measured aggregations, in Large Cities, Small Cities and on Roads.

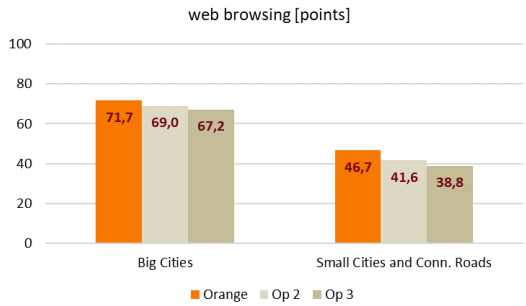


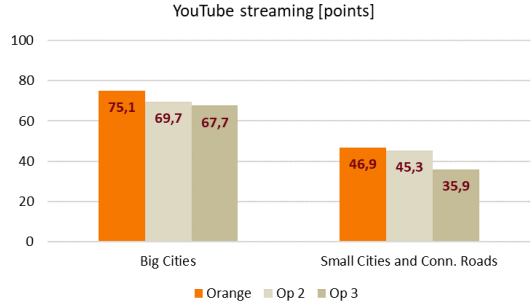
In case of voice services Orange is being ahead especially due to implementation of VoLTE. Close to 90% of conducted voice connections were offered with VoLTE. There is a noticeable scoring difference between Orange and other two operators for data services testing.

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



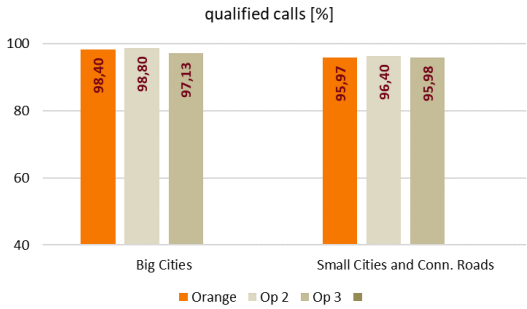


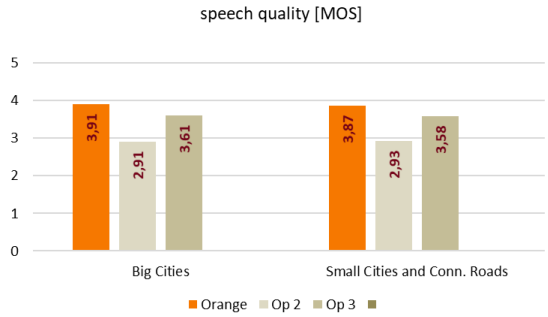


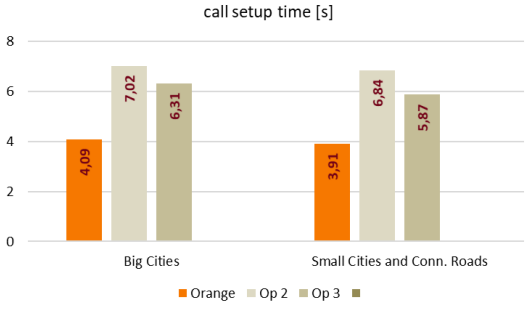


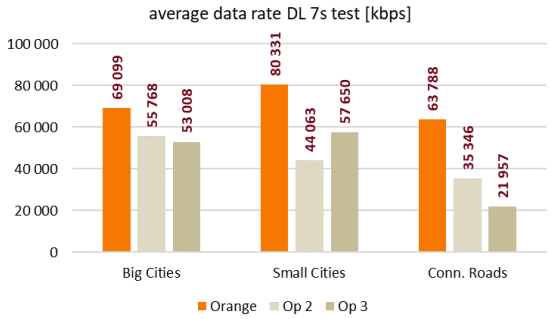
Tests Results in Details

All operators achieved reasonable results for voice services availability and stability represented by percentage of qualified calls. There is still room for improvement as none of the operators reached 99% for Big Cities and 97% for Small Cities and Roads. Orange is the only operator offering VoLTE which is reflected in speech quality and call setup time. These two KPIs could also be improved with wider use of VoLTE and implementation of better speech codecs like EVS. The worst voice service was offered by Op2 where speech quality is poor and call setup time much longer than in the best network. Surprisingly Op2 is on same level for voice services availability and stability as the other two operators.



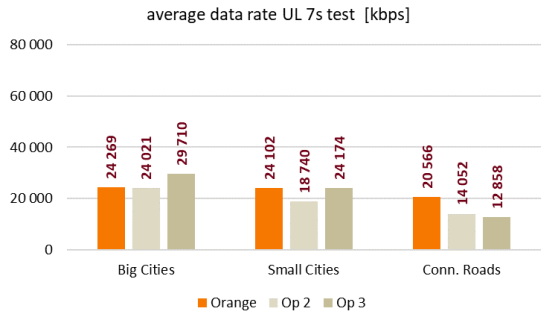




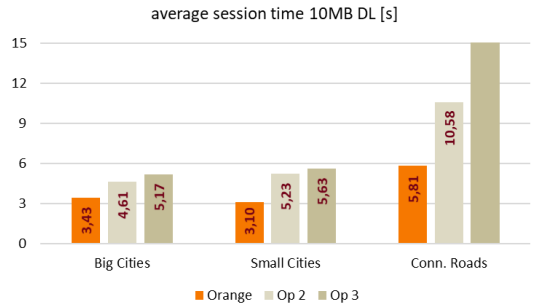


Orange DL throughput performance is significantly ahead of the competition. Compared with 2020 benchmark, increases in Orange throughput are observed, due to extension of 4G capacity by massive LTE CA deployment. The usage of CA increased from 58% to 61% and pure VoLTE connections reached 98%. Orange uses 3 carrier aggregation in Chisinau, Drochia and Vulcanesti while Op2 in Chisinau and Balti. In Op3 network maximum 2 carrier aggregation is in use.

Orange presents the highest LTE DL Bandwidth (average ~32MHz) thanks to highest CA usage and 20MHz in L800. Op2 follows with average BW ~26MHz using 10MHz in L800, 20MHz in L1800/L2600 and 5MHz in L2100. Op3 behind competitors with average BW ~21MHz using 2x L1800 carriers (20MHz and 5MHz)

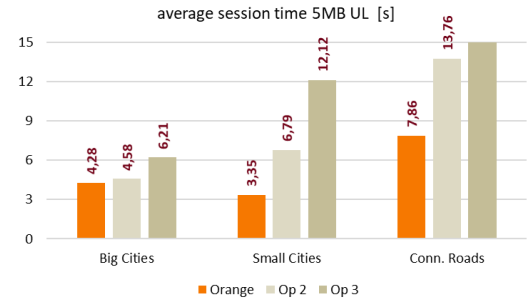


In the case of Uplink throughput, Orange and Op3 are on par in Small Cities, Orange is best on Connecting Roads but Op3 leads in Big cities. Orange and Op3 have higher uplink bandwidth than Op3 which is visible in cities. There is no UL carrier aggregation in use in Moldova.



Orange achieved shortest average session time among all operators for 10MB file download in all area types. For connecting roads, Op3 shows very long sessions times. In cities the session times of Op2 and Op3 are well behind Orange.

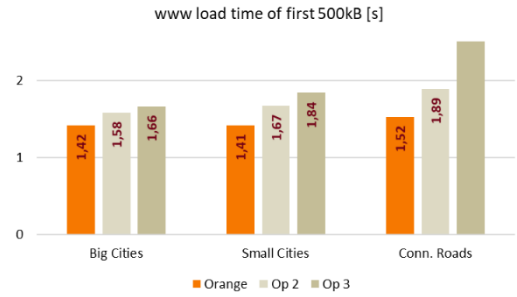
The data throughput for 10% of best tests in Orange network was best and reaching 130Mbps for DL and 44Mbps for UL tests.



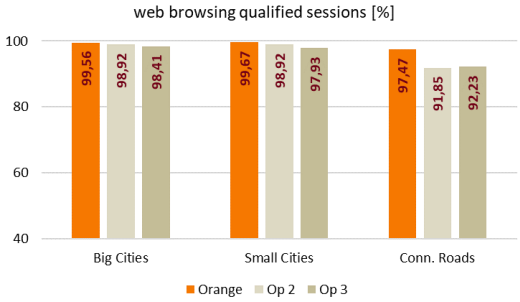
Orange also achieves the shortest session times among all operators for the 5MB file upload. The average session time of Op3 on connecting roads is few times longer than competition.

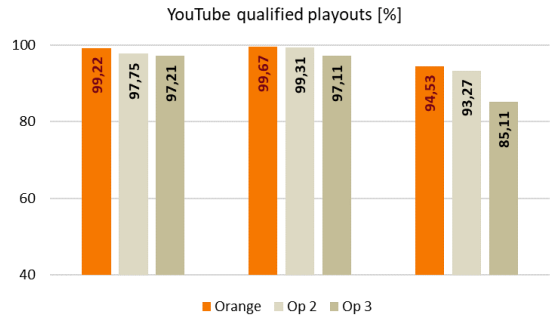
Almost all operators demonstrate very similar DL/UL reliability except Op2/Op3 with low UL reliability on connection roads.

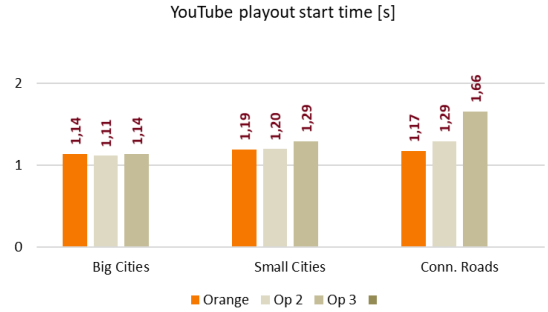
Orange was measured with the shortest access to live web content (time to load of the first 500kB) and the best service reliability in all aggregations, Op2 was second stays very close (~150ms behind) with good service reliability. Op3 well behind competition in term of service reliability and time to first picture.



Orange shows the fastest YouTube playout start time and the best YouTube reliability. Almost all operators achieve similar VMOS scoring above 4.2 in Big Cities and 4.1 in Small cities. Op3 was worst in Connecting roads with the result below 4 points. Orange take a lead in terms of picture resolution. Live video initial resolution is 720p; for the majority of cases, video is upgraded to 1080p based on YouTube algorithms and current network performance. Tests in Orange network shows 63% of playouts with 1080p resolution while Op2 and Op3 have 56% of highest resolution playouts.







5G network was not available in Moldova during test period.

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.