



**SYSTEMICS PAB**  
Network Quality Experts

# CERTIFICATE

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

hereby certifies that

**Orange Slovensko a.s.**  
Metodova 8, 821 08 Bratislava, Slovakia

received the title for

## THE BEST SLOVAKIAN 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 2022. The measurement campaign assessed the quality of experience of mobile voice and data services in Slovakia. All mobile Network Operators in Slovakia: Orange Slovensko a.s. (Orange), SWAN a.s. (SWAN), Slovak Telekom a.s. (Telekom) and O2 Slovakia s.r.o. (O2) were tested. Systemics-PAB performed the benchmarking measurements throughout Slovakia covering 24 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 with the best overall score for the quality of experience of mobile services in Slovakia. Orange Slovakia presented very good results for data services achieving highest data speeds in capacity tests and shortest session times for file transfer tests. These results were possible due to the deployment of 5G NR bands in cities and use of widest bandwidth in data services tested.

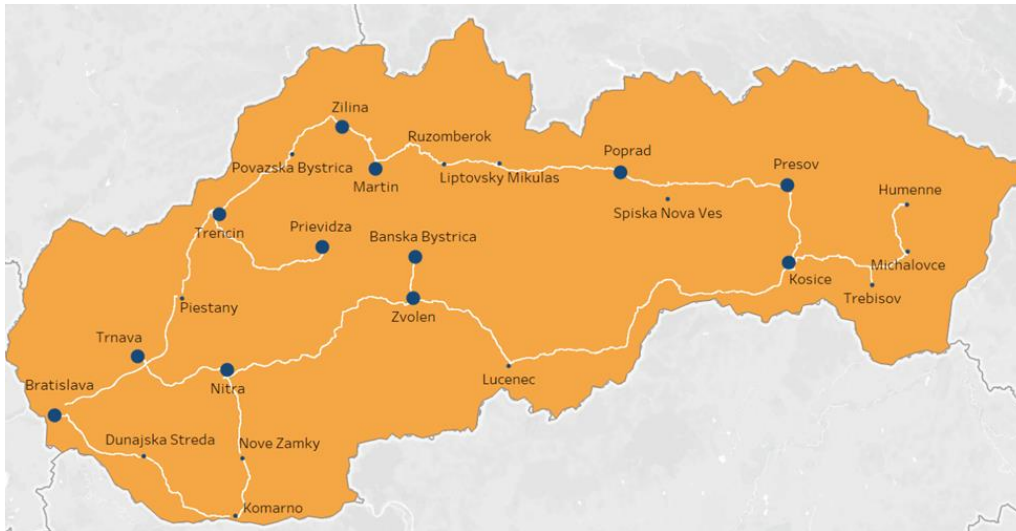
Orange Slovensko a.s. can therefore be certified as the operator with the fastest data services and the highest overall quality of mobile services in the test.

Certificate Date: 08.07.2022

  
Jan Kondej  
Chief Technical Officer

## 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 project Systemics-PAB delivered extensive benchmarking campaign to measure the quality of mobile telecommunication services offered by mobile networks operators in Slovakia across the country. The benchmarking measurements took place between June 16<sup>th</sup> and 30<sup>th</sup> of 2022 and covered representative areas of Slovakia including 24 cities and Slovakian roads. The total distance covered by each of 2 drive test cars used was over 3000 km. Measurements took around 100 hours delivering ~2660 voice service tests and ~1680 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	<b>Mobile-to-Mobile</b> <b>Best available Voice technology:</b> 85 sec call duration 15 sec call setup time out HTTP Transfer 100kB Data traffic injection (1 test per call window)	<b>Data 5G preferred:</b> <b>APN with default IPv4/IPv6 settings</b> 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	

## 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

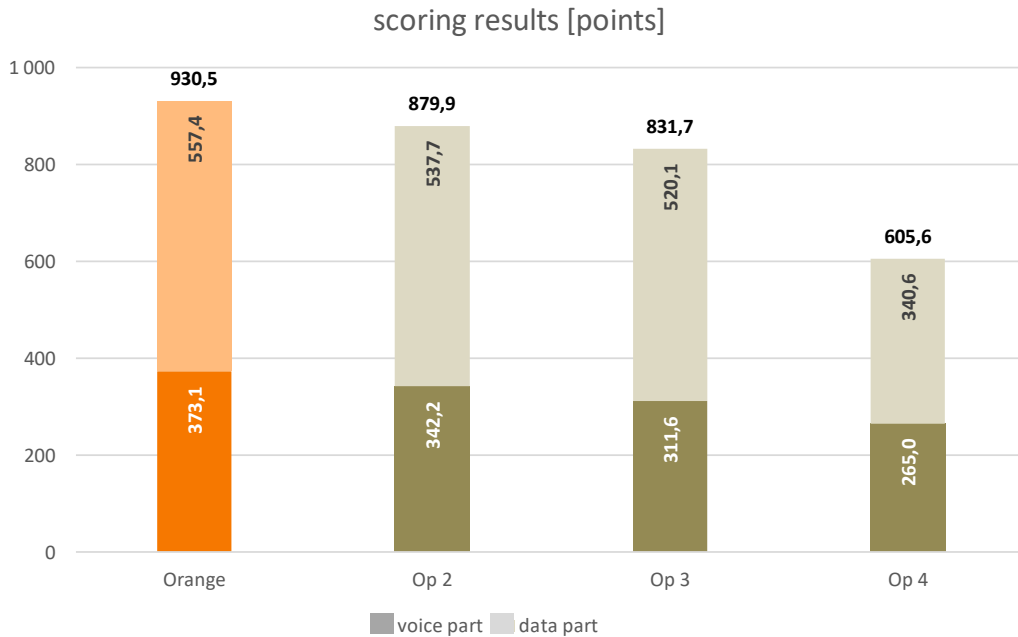
The test area was designed to cover cities and connecting roads (with villages along roads) that constitute around 50% of the population of Slovakia.

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.

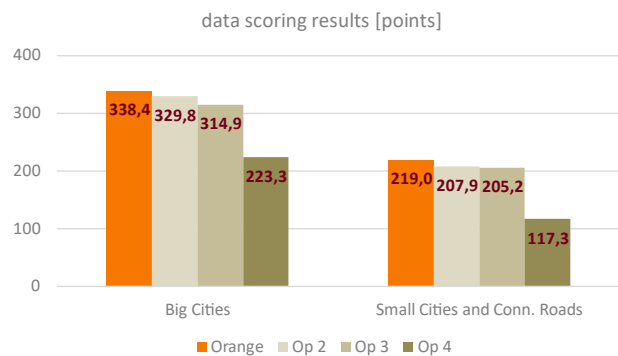
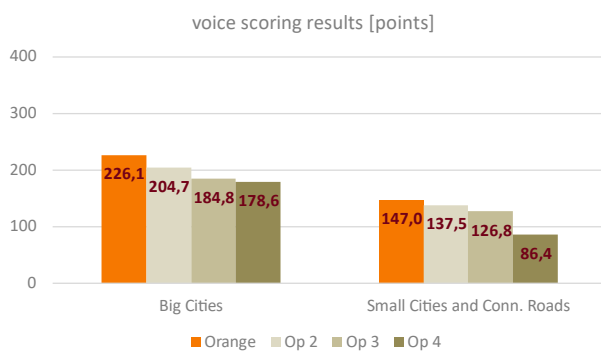
The selection of web pages to be tested was done based on Alexa rank of most popular web destinations in Slovakia which are accessible for drive testing (automated test by robots).

## Scoring Results

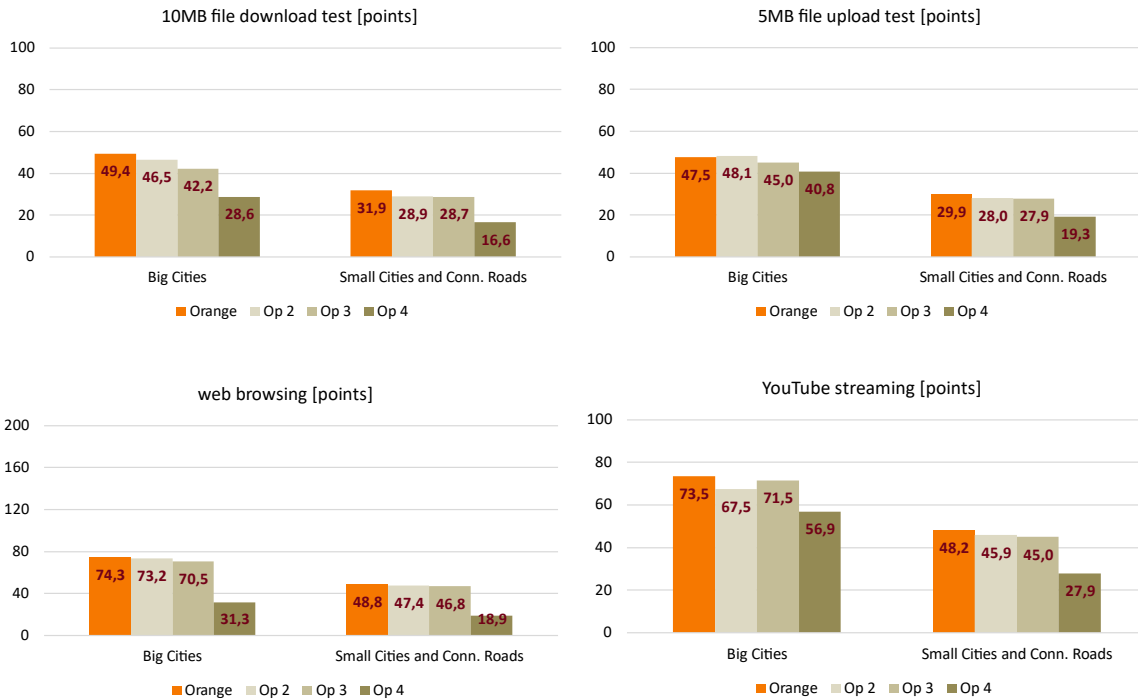
With applied scoring methodology the highest number of points in overall scoring was achieved by Orange and was equal to 930.5 out of 1000 of maximum achievable. The other operators scored 879.9, 831.7 and 605.6 respectively. Orange got the best score in both voice and data tests.



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. Op2 and Op3 are following Orange in voice testing results. In data tests Op2 only is close to Orange. Worst results in both voice and data tests in all aggregations are reported by Op4.

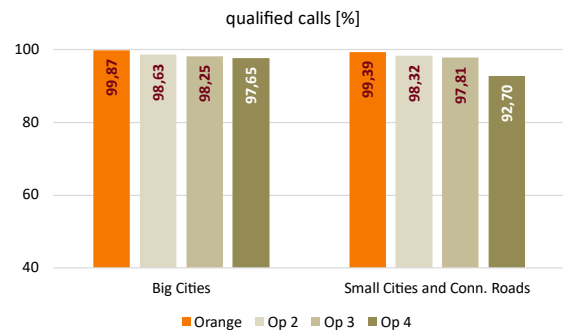


The comparison of the scoring results for selected tests for big cities and other areas is presented on charts below.

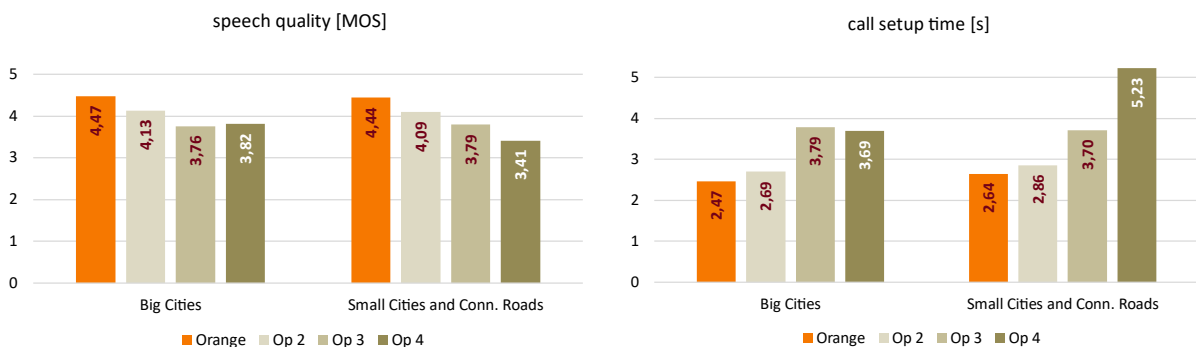


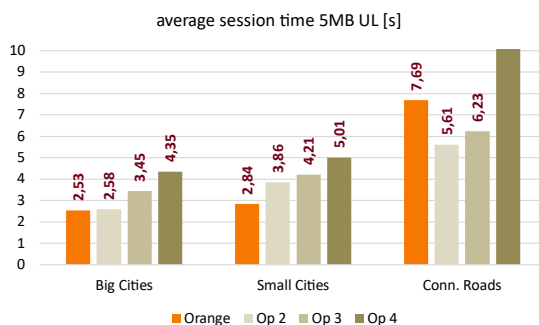
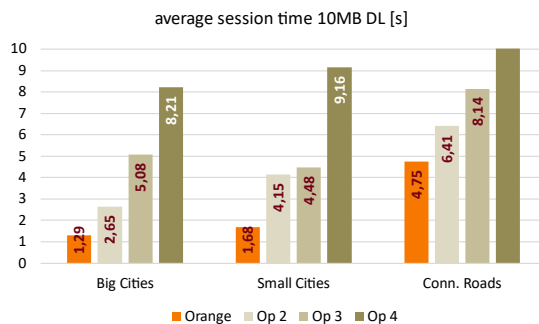
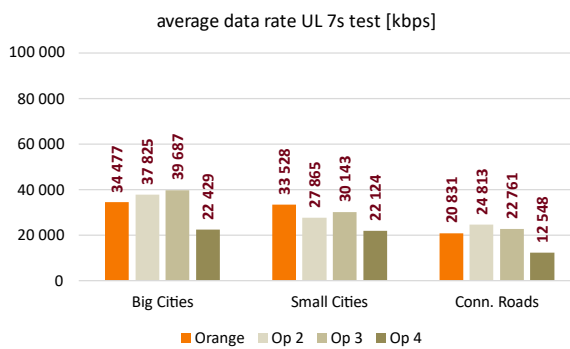
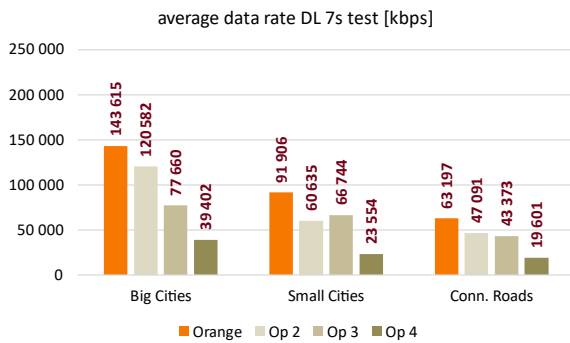
## Tests Results in Details

All operators present good availability of voice services except Op4 outside Big Cities. All operators provides VoLTE connections. Orange demonstrates the best speech quality and the shortest call setup time). Orange further improved VoLTE usage comparing to 2021 and is close to 100% while Op2 & Op3 report ~99% VoLTE usage in the test. Op4 VoLTE usage is 17% lower than others. Orange has best speech quality MOS ahead of Op2.



Both leading operators utilize EVS codec, which is VoLTE codec offering superior speech quality compared to legacy (2G/3G) codecs. Op3 and Op4 utilize AMR WB codecs, which provide lower speech quality score. Orange 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 VoLTE calls.





Orange DL throughput performance is significantly ahead of competition. Compared with 2021 benchmark, vast increase in Orange throughput are observed, due to use of LTE 4CA and implementation of 5G. Op2 scored as 2<sup>nd</sup> best operator, leading confidently over Op3 and Op4. Op4 downlink throughput results are much lower than of other competitors. The throughput of the best 10% of transfer DL tests in case of Orange was not worse than 250Mbps in big cities. For Op2 which was the second that value was 219Mbps.

In case of Uplink throughput, Orange and Op2 are broadly on par on Connecting Roads. In Small cities, Orange offers better throughput than Op2. In Big Cities Op2 presented the highest average upload throughput.

Orange achieved shortest average session time among all operators for 10MB file download in all tested area types. Op2 follows Orange in this competition. Other two operators and especially Op4 are much behind to leading ones.

Also for upload of 5MB file test the shortest upload time is in Orange network followed by Op2. In both tests Op4 presents much longer session times than competition with average close to 15 seconds. Connecting roads are very demanding also for Op3 with result close above 8 seconds.

The throughput of the best 10% of 10MB file transfer DL tests in Orange network in Big Cities reached 134Mbps, 102Mbps in Small Cities and 100Mbps on Connecting Road. The second operator in this test Op3 achieved this KPI between 89Mbps and 68Mbps respectively.

Orange DL throughput performance is clearly ahead of competition mostly thanks to higher bandwidth and MIMO utilization. The performance of data services has improved when comparing to 2021. Orange DL performance was elevated by 5G implementation.

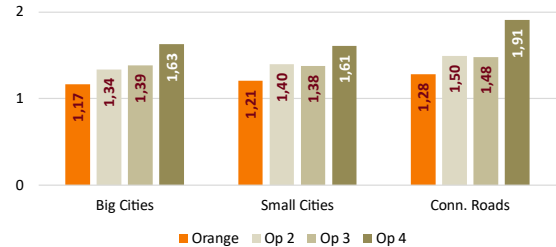
Orange UL throughput performance is broadly on par with Op2 which takes a lead in big cities while Orange shows better UL performance in small cities and on roads.

Orange with the shortest access to live web content (downloading first 500kB) and the best service reliability in all aggregations, Op2 stays very close (within 50ms behind) with good service reliability. Op4 well behind competition in term of service reliability especially on Connecting Roads.

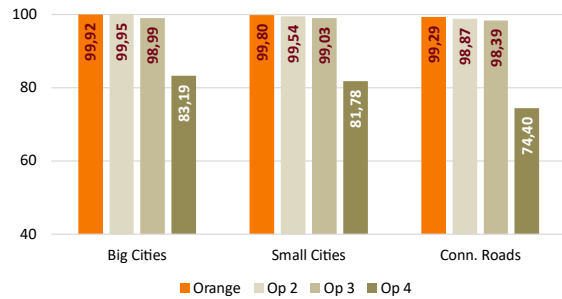
Orange, Op2 and Op3 show similarly fast Youtube payout start time and the best YouTube reliability. Almost all operators achieve similar VMOS scoring close or above 4 points. Orange and Op4 lead in term of avg. picture resolution with over 66% of the time video is played with played with 1080p. All operators has very similar results for the percentage of time the video is played with played with resolution not worse than 720p.

Orange shows the best latency in all aggregations (below 54ms for TCP round trip time test) and Op3 ranked the last with 79ms. Other operators achieved results jus few milliseconds worse in the same test.

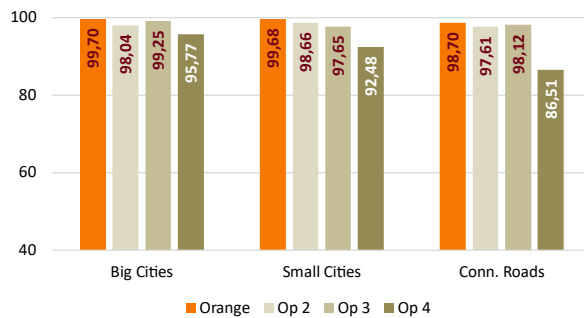
web browsing time to 1st 500kB[s]



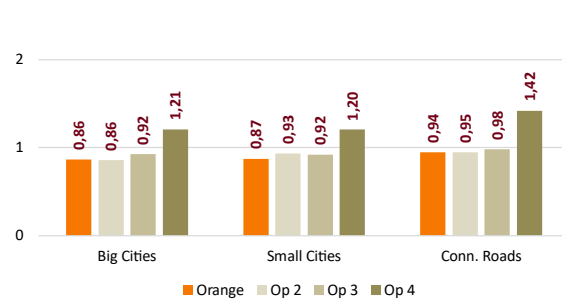
web browsing qualified sessions [%]



YouTube qualified playouts [%]



YouTube payout start time [s]



The testing included WhatsApp performance but it was not a part of the scoring. WhatsApp Application was up-to-date 2022 version. WhatsApp speech quality is similar in all networks and lays between 4,24 and 4,31. The speech quality of WhatsApp is better than speech quality offered by Legacy Voice technologies (3G/2G/4G CSFB) but close to VoLTE in Orange network. In other network Speech quality of WhatsApp is better that offered voice service. All MNOs demonstrate very similar performance in terms of Call Setup Time and speech quality. The availability of the service is very similar for Orange, Op2 and Op3. Results of Op4 are significantly worse.

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.