

best in test

For adding something on top in Romania and reaching an overall score of 922 dots in mobile network benchmarking survey we proudly award this certificate to

Vodafone Romania

Score 922 out of 1000 in Total

Score 289 out of 300 in Voice Services

Score 415 out of 450 in Data Services

Score 218 out of 250 in Crowdsourced Quality



Hakan Ekmen

Chief Executive Officer Telecommunication





Measurement Overview

umlaut tested and measured the performance of its voice and data services on smartphones in comparison to other 5G/LTE/UMTS/GSM mobile radio networks in metropolitan and rural areas of Romania.

The audit was done as a performance benchmark performed by umlaut between 01.03.2022 and 24.03.2022 in cities and towns as well as on connection roads.

Dedicated measurements have been executed as drive tests outdoors using a Samsung Galaxy S21+.

All data measurements have been performed in 5G preferred mode. Voice measurements have been done in 5G/5G preferred mode on both sides, while call origin has been alternated.

In addition crowdsourced performance data has been collected and evaluated between CW39 2021 and CW10 2022.

The following pages provide a comparative overview about the performance results observed for the different tested service types.



Measurement setup

Drivetest	Voice	Data
Device	Samsung Galaxy S21+	Samsung Galaxy S21+
Test Cases	Mobile-to-Mobile (M2M) Side1 (VoLTE) to Side2 (VoLTE) 105 sec call window 70 sec call duration 15 sec call setup timeout Multi-RAB traffic injection on both sides	Data 5G preferred HTTP DL datastream 7s HTTP UL datastream 7s HTTP 10MB DL fixed file transfer HTTP 5MB UL fixed file transfer Web Browsing – Kepler ETSI Ref. Page 10 Live web pages 3 YouTube HD video ~ 45s
Mobility and Route Types	Drivetest and Walktest Drivetest: 52% in Cities, 20% in Towns and 28 % on Roads	
Samples	~ 35640	~ 156483
Dates	17 measurement days for Drivetest and 6 measurement days for Walktest 01.03.2022. – 24.03.2022.	
Crowd Data Assessment	24 weeks CW39 2021 – CW10 2022	



Testing areas

Drive route

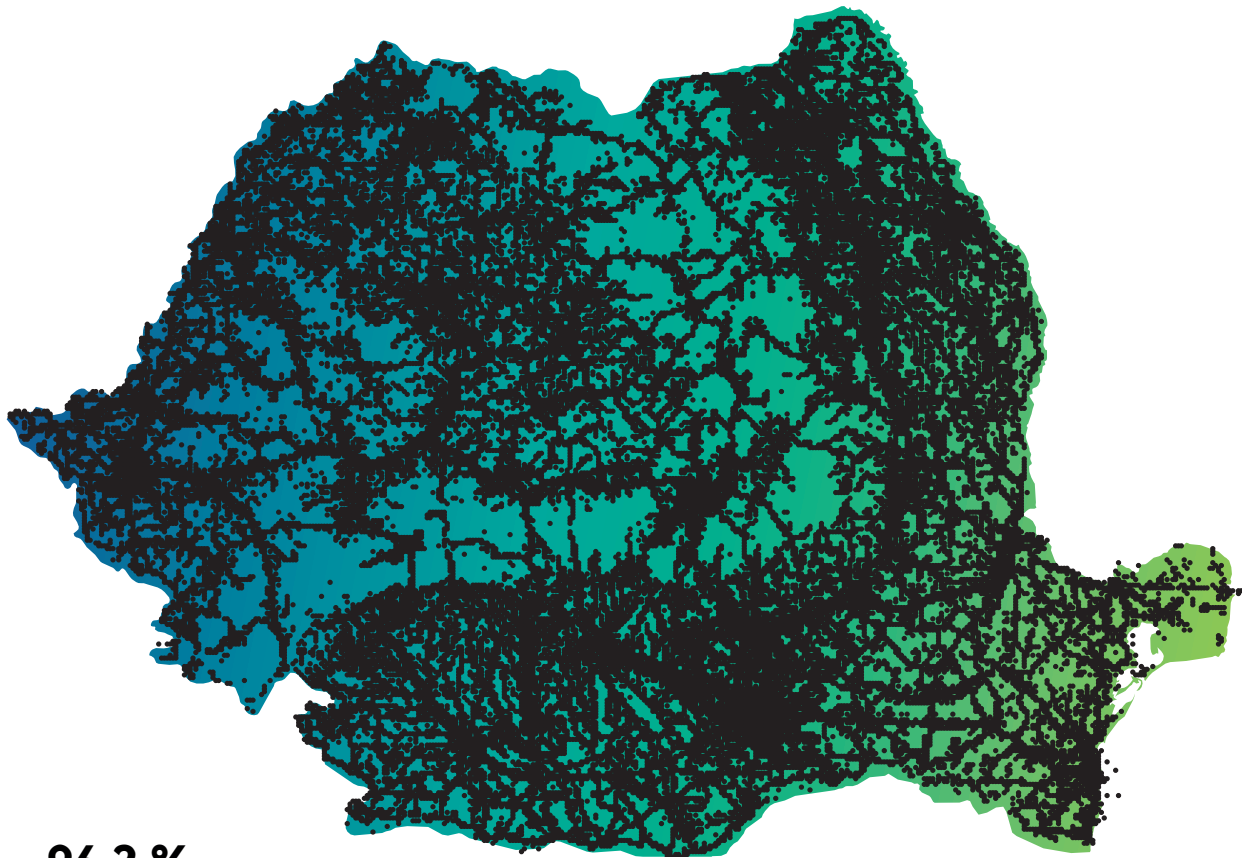


 **9360 km**
measuring distance

 **25 %**
of population measured



Crowdsourcing based test area



 **96.2 %**
of the 'build-up area' covered

 **97.7 %**
of the 'Population area' covered

 **118,229 km²**
size of tested area



Claims



Best in test
Vodafone Romania

Best in data
Vodafone Romania

Best in voice
Vodafone Romania

Best in Reliability
Vodafone Romania



Methodology

The leader in mobile benchmarking, umlaut, has analyzed the mobile networks of Romania with regards to mobile network performance. We measure smartphone voice and data performance based on extensive drivetests – from major metropolitan areas to smaller cities and connection roads.

We objectively define the routes and test methodology and publish the results through certificates or public benchmark reports.

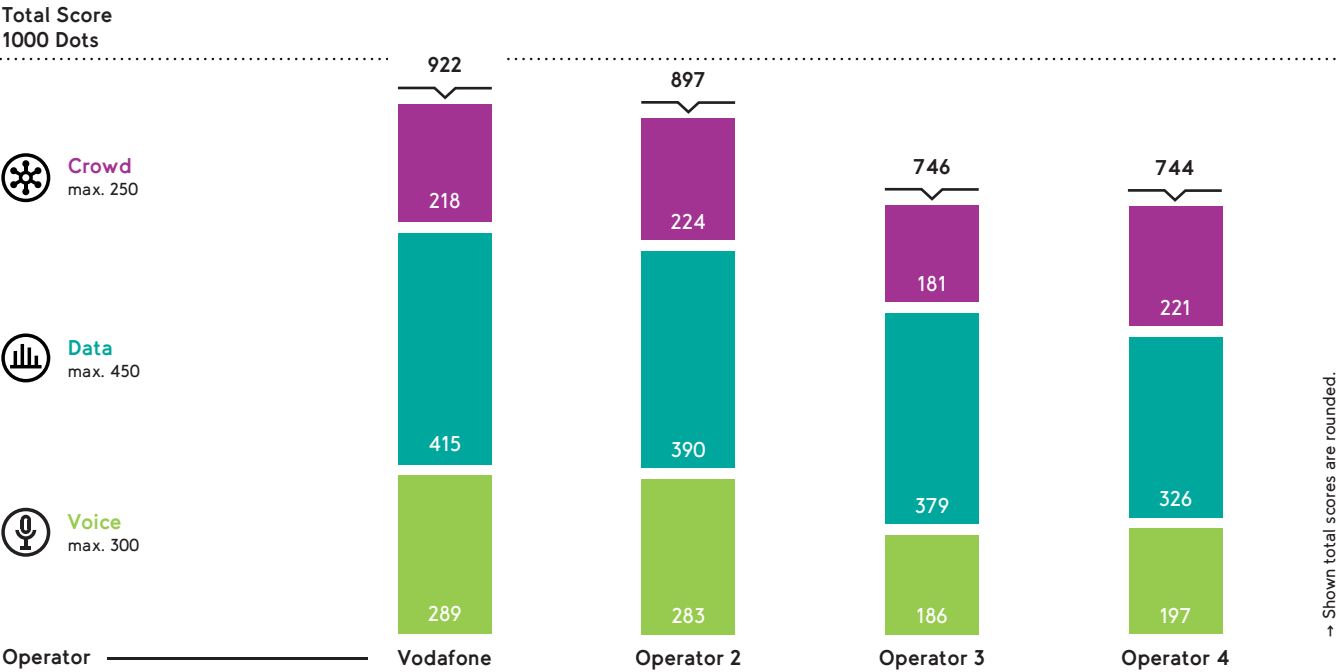
As the de-facto industry standard, our benchmarking methodology focuses on customer-perceived network quality and covers a wide range of mobile services. Today, more than 200 mobile networks in more than 120 countries are being evaluated by our unique scoring methodology. It allows a technical analysis that is unpre-

cedented in its level of detail and enables comparisons between the network performance and capability of each mobile network. Our public benchmarks as well as the certificate benchmarks help network operators to demonstrate how well they are delivering wireless connections to consumers, business users and enterprises and reveals the areas of improvement.



Score and breakdown

Vodafone Romania achieved the highest overall score among competitors with 922 dots out of 1000.



Overall score considering Voice, Data and Crowdsourcing.

Total score

		Vodafone	Operator 2	Operator 3	Operator 4
Voice	max. 300	289	283	186	197
Cities Drivetest	135	98%	94%	62%	56%
Cities Walktest	45	98%	95%	65%	84%
Towns Drivetest	60	98%	97%	64%	74%
Roads Drivetest	60	89%	92%	58%	64%
Data	max. 450	415	390	379	326
Cities Drivetest	203	94%	90%	85%	69%
Cities Walktest	68	93%	92%	81%	79%
Towns Drivetest	90	92%	81%	90%	71%
Roads Drivetest	90	89%	80%	81%	75%
Crowdsourced Quality	max. 250	218	224	181	221
Broadband Coverage	125	86%	91%	80%	94%
Download Speed	75	86%	88%	52%	79%
Latency	50	91%	87%	86%	88%
Total	1000	922	897	746	744

Shown scores are rounded.



Achieved percentage of the maximum score in each of the different data services.

Data	Service Group	max	Vodafone	Operator 2	Operator 3	Operator 4
Cities Drivetest	Web Browsing	50,6	95%	91%	90%	83%
	File Download	50,6	95%	90%	75%	59%
	File Upload	50,6	94%	93%	88%	61%
	YouTube	50,6	91%	87%	85%	74%
Cities Walktest	Web Browsing	16,9	96%	94%	88%	90%
	File Download	16,9	93%	96%	71%	74%
	File Upload	16,9	93%	90%	83%	70%
	YouTube	16,9	91%	89%	80%	82%
Towns Drivetest	Web Browsing	22,5	95%	88%	94%	84%
	File Download	22,5	91%	76%	84%	63%
	File Upload	22,5	92%	88%	90%	58%
	YouTube	22,5	91%	72%	90%	81%
Roads Drivetest	Web Browsing	22,5	95%	87%	87%	88%
	File Download	22,5	88%	74%	78%	74%
	File Upload	22,5	82%	82%	80%	62%
	YouTube	22,5	89%	78%	78%	76%

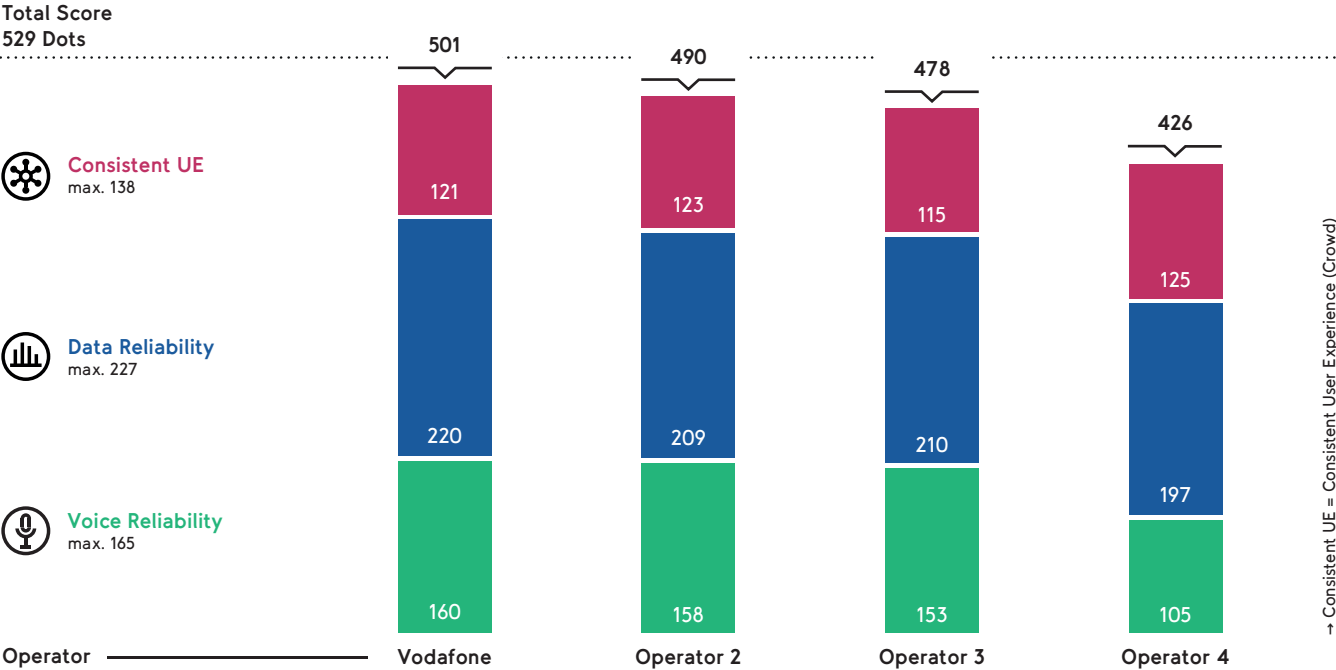


Achieved percentage of the maximum score in each of the different crowdsourcing services.

Crowd	Service Group	max	Vodafone	Operator 2	Operator 3	Operator 4
Crowdsourced Quality	Broadband Coverage	125	86%	91%	80%	94%
	DL Speed	75	86%	88%	52%	79%
	Latency	50	91%	87%	86%	88%



Reliability



Reliability score considering Voice Reliability, Data Reliability and Consistent UE.



Total score

	Service Group	max	Vodafone	Operator 2	Operator 3	Operator 4
Reliability	Voice Reliability	165	97%	96%	93%	64%
	Data Reliability	227	97%	92%	92%	87%
	Consistent User Experience	137,5	88%	90%	84%	91%

Score achievement in school grades:
outstanding ($\geq 95\%$), very good ($\geq 85\%$ and $<95\%$), good ($\geq 75\%$ and $\leq 85\%$), satisfactory ($\leq 65\%$ and $<75\%$), sufficient ($\leq 55\%$ and $<65\%$).



Voice KPI overview

Achieved values of all networks under test in each of the relevant Voice Key Performance Indicators (KPIs) for the geographical categories "Cities", "Towns" and "Roads".

Voice	Service Group	Unit	Vodafone	Operator 2	Operator 3	Operator 4
Cities Drivetest	Qualifier	[%]	99,8	99,6	99,2	94,7
	Call Setup Time (P90)	[s]	1,2	2,5	5,7	3,4
	Speech Quality (P10)	[MOS–LQO]	4,2	4,2	2,9	3,0
	Multirab connectivity	[%]	99,9	99,9	65,0	99,7
Cities Walktest	Qualifier	[%]	99,8	99,5	99,7	99,1
	Call Setup Time (P90)	[s]	1,2	2,3	4,8	3,3
	Speech Quality (P10)	[MOS–LQO]	4,2	4,4	2,4	3,6
	Multirab connectivity	[%]	99,7	99,6	85,3	100,0
Towns Drivetest	Qualifier	[%]	100,0	99,9	99,4	97,9
	Call Setup Time (P90)	[s]	1,5	2,1	6,0	3,4
	Speech Quality (P10)	[MOS–LQO]	4,3	4,3	2,9	3,1
	Multirab connectivity	[%]	99,4	99,9	59,4	100,0
Roads Drivetest	Qualifier	[%]	98,0	98,6	98,1	93,5
	Call Setup Time (P90)	[s]	2,0	2,4	7,7	3,4
	Speech Quality (P10)	[MOS–LQO]	3,9	4,0	2,7	3,0
	Multirab connectivity	[%]	98,6	99,0	31,9	98,9



Data Services KPI overview

Achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Cities Drivetest".

Data Cities DT	KPI Name	Unit	Vodafone	Operator 2	Operator 3	Operator 4
HTTP Web Page DL Smartphone	Qualifier	[%]	99,6	99,1	99,1	98,7
	Overall Session Time	[s]	1,4	1,6	1,8	2,0
HTTP 10MB DL Smartphone	Qualifier	[%]	100,0	99,8	99,4	99,2
	Overall Session Time	[s]	1,8	2,9	5,0	8,8
	90% faster than	[Mbit/s]	25,7	17,4	6,9	4,2
HTTP 5MB UL Smartphone	10% faster than	[Mbit/s]	175,8	169,7	84,7	40,3
	Qualifier	[%]	99,8	99,9	99,7	99,8
	Average Session Time	[s]	1,8	2,5	2,7	6,9
HTTP DL FDTT	90% faster than	[Mbit/s]	14,4	11,5	11,0	3,2
	10% faster than	[kbit/s]	52,2	49,3	43,3	17,2
	Qualifier	[%]	100,0	99,5	99,5	98,4
HTTP UL FDTT	10% faster than	[Mbit/s]	280,5	439,0	90,0	41,7
	faster than 5 Mbit/s	[%]	99,7	98,7	96,2	88,6
	faster than 20 Mbit/s	[%]	97,6	92,8	75,6	43,4
YouTube	Qualifier	[%]	99,9	99,9	99,0	98,6
	10% faster than	[Mbit/s]	74,5	82,0	54,1	17,4
	faster than 2 Mbit/s	[%]	99,6	99,5	99,5	93,5
YouTube Live Smartphone	faster than 5 Mbit/s	[%]	98,7	98,1	98,2	74,7
	Qualifier	[%]	99,8	99,5	99,2	98,1
	Start Time	[s]	2,2	2,4	2,3	2,6
YouTube 4K Smartphone	AVG Resolution	[p]	976,1	971,5	962,4	953,8
	Qualifier	[%]	99,3	98,3	98,0	96,2
	Start Time	[s]	1,6	1,6	1,8	2,2
YouTube 4K Smartphone	AVG Resolution	[p]	1078,3	1077,2	1076,5	1077,8
	Qualifier	[%]	100,0	98,8	99,2	96,4
	Start Time	[s]	2,3	2,4	2,4	2,9
YouTube 4K Smartphone	AVG Resolution	[p]	1686,2	1615,8	1531,3	1350,2



Data Services KPI Overview

Achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geo-graphical category “Cities Walktest”.

Data Cities WT	KPI Name	Unit	Vodafone	Operator 2	Operator 3	Operator 4
HTTP Web Page DL Smartphone	Qualifier	[%]	99,7	99,4	98,8	99,1
	Overall Session Time	[s]	1,3	1,5	1,8	1,8
HTTP 10MB DL Smartphone	Qualifier	[%]	99,8	100,0	99,3	99,8
	Overall Session Time	[s]	1,4	2,1	6,1	6,2
	90% faster than	[Mbit/s]	36,8	25,6	5,3	5,8
	10% faster than	[Mbit/s]	214,1	184,5	76,6	159,4
HTTP 5MB UL Smartphone	Qualifier	[%]	99,8	99,8	99,5	99,5
	Average Session Time	[s]	1,8	2,6	3,4	5,6
	90% faster than	[Mbit/s]	16,6	11,5	7,4	4,5
	10% faster than	[kbit/s]	54,0	53,9	43,4	23,4
HTTP DL FDTT	Qualifier	[%]	99,1	100,0	99,8	99,5
	10% faster than	[Mbit/s]	361,3	574,7	77,8	199,5
	faster than 5 Mbit/s	[%]	99,1	99,1	94,1	92,9
	faster than 20 Mbit/s	[%]	98,0	94,2	74,7	62,2
HTTP UL FDTT	Qualifier	[%]	99,6	99,3	99,3	98,6
	10% faster than	[Mbit/s]	77,6	83,6	54,6	28,2
	faster than 2 Mbit/s	[%]	98,9	98,9	97,5	96,7
	faster than 5 Mbit/s	[%]	97,4	97,6	95,0	87,0
YouTube	Qualifier	[%]	99,6	98,6	98,6	97,7
	Start Time	[s]	2,2	2,4	2,4	2,5
	AVG Resolution	[p]	973,6	973,8	947,0	960,6
YouTube Live Smartphone	Qualifier	[%]	99,6	99,5	96,2	98,6
	Start Time	[s]	1,5	1,5	1,7	1,9
	AVG Resolution	[p]	1078,8	1077,4	1078,7	1074,0
YouTube 4K Smartphone	Qualifier	[%]	100,0	100,0	99,5	99,5
	Start Time	[s]	2,2	2,4	2,6	2,6
	AVG Resolution	[p]	1704,7	1663,1	1484,1	1487,0



Achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geo-graphical category “Towns Drivetest”.

Data Towns DT	KPI Name	Unit	Vodafone	Operator 2	Operator 3	Operator 4
HTTP Web Page DL Smartphone	Qualifier	[%]	99,5	98,9	99,7	98,5
	Overall Session Time	[s]	1,4	1,8	1,7	1,9
HTTP 10MB DL Smartphone	Qualifier	[%]	99,8	99,8	100,0	99,3
	Overall Session Time	[s]	2,1	4,9	3,6	7,3
	90% faster than	[Mbit/s]	22,1	8,1	10,6	5,5
	10% faster than	[Mbit/s]	114,8	88,2	98,3	41,6
HTTP 5MB UL Smartphone	Qualifier	[%]	100,0	99,8	99,8	99,7
	Average Session Time	[s]	2,2	2,8	2,8	7,8
	90% faster than	[Mbit/s]	11,2	9,7	9,7	2,6
	10% faster than	[kbit/s]	41,0	33,9	44,1	16,6
HTTP DL FDTT	Qualifier	[%]	100,0	98,6	100,0	98,5
	10% faster than	[Mbit/s]	154,4	135,6	115,6	41,5
	faster than 5 Mbit/s	[%]	100,0	96,2	98,9	93,7
	faster than 20 Mbit/s	[%]	92,9	79,2	84,6	56,1
HTTP UL FDTT	Qualifier	[%]	100,0	100,0	99,7	98,7
	10% faster than	[Mbit/s]	54,3	47,1	57,2	17,0
	faster than 2 Mbit/s	[%]	100,0	99,4	99,7	91,5
	faster than 5 Mbit/s	[%]	98,0	96,4	98,9	70,1
YouTube	Qualifier	[%]	100,0	97,1	100,0	99,0
	Start Time	[s]	2,3	2,5	2,3	2,6
	AVG Resolution	[p]	975,8	964,8	973,1	961,9
YouTube Live Smartphone	Qualifier	[%]	99,4	94,5	99,3	97,0
	Start Time	[s]	1,6	1,7	1,7	2,0
	AVG Resolution	[p]	1078,2	1077,8	1078,9	1077,3
YouTube 4K Smartphone	Qualifier	[%]	99,7	96,4	99,7	99,0
	Start Time	[s]	2,3	2,6	2,3	2,7
	AVG Resolution	[p]	1638,3	1497,0	1613,7	1452,1



Data Services KPI Overview

Achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geo–graphical category “Roads Drivetest”.

Data Roads DT	KPI Name	Unit	Vodafone	Operator 2	Operator 3	Operator 4
HTTP Web Page DL Smartphone	Qualifier	[%]	99,3	97,2	97,9	97,4
	Overall Session Time	[s]	1,5	2,0	2,0	1,9
HTTP 10MB DL Smartphone	Qualifier	[%]	99,6	99,7	99,1	98,7
	Overall Session Time	[s]	3,9	7,7	7,1	6,8
	90% faster than	[Mbit/s]	11,4	4,3	5,1	4,9
	10% faster than	[Mbit/s]	98,1	79,3	87,2	53,6
HTTP 5MB UL Smartphone	Qualifier	[%]	98,7	99,5	98,9	98,5
	Average Session Time	[s]	4,6	4,5	6,3	8,3
	90% faster than	[Mbit/s]	4,2	4,8	2,8	2,2
	10% faster than	[kbit/s]	35,3	31,9	40,6	19,2
HTTP DL FDTT	Qualifier	[%]	99,9	97,6	98,8	97,9
	10% faster than	[Mbit/s]	119,0	94,7	94,8	56,0
	faster than 5 Mbit/s	[%]	97,2	88,7	93,4	91,3
	faster than 20 Mbit/s	[%]	78,6	60,7	60,0	59,5
HTTP UL FDTT	Qualifier	[%]	98,3	97,7	98,3	95,2
	10% faster than	[Mbit/s]	45,5	40,2	50,3	20,3
	faster than 2 Mbit/s	[%]	96,4	96,4	95,0	91,5
	faster than 5 Mbit/s	[%]	87,8	88,3	86,7	71,6
YouTube	Qualifier	[%]	99,5	97,6	96,7	96,5
	Start Time	[s]	2,3	2,6	2,5	2,6
	AVG Resolution	[p]	973,3	953,5	951,8	956,9
YouTube Live Smartphone	Qualifier	[%]	98,7	93,0	93,7	92,6
	Start Time	[s]	1,7	1,9	1,9	2,1
	AVG Resolution	[p]	1078,8	1072,7	1077,1	1075,7
YouTube 4K Smartphone	Qualifier	[%]	99,2	95,1	98,6	96,4
	Start Time	[s]	2,4	2,6	2,6	2,8
	AVG Resolution	[p]	1530,7	1382,5	1380,8	1424,7

Crowd KPI overview

Achieved values of all networks under test in each of the relevant Crowd Key Performance Indicators (KPIs) for the categories “Broadband Coverage”, “Download Speed” and “Latency”.

Category	KPI name	Unit	Vodafone	Operator 2	Operator 3	Operator 4
Broadband Coverage	Coverage Quali ty	[%]	92,5	96,3	84,2	97,5
	Coverage Reach	[%]	78,5	84,6	72,8	79,9
	Time on broadband	[%]	93,0	95,2	92,1	98,6
Download Speed	Basic internet class	[%]	91,2	92,8	86,6	89,1
	HD video class	[%]	75,1	75,4	49,2	68,6
	UHD video class	[%]	15,6	17,4	10,3	13,5
Latency	Gaming class	[%]	83,0	79,9	77,1	78,8
	OTT voice class	[%]	97,2	96,0	96,2	96,9



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