

best in test

For adding something on top of telecommunication services and network connectivity in Greece and reaching an overall score of 897 dots in the annual umlaut benchmarking survey we proudly award this certificate to

Cosmote Mobile Telecommunications S.A.

Score 897 of 1000 in Total
Score 295 of 320 in Voice Services
Score 434 of 480 in Data Services
Score 169 of 200 in Crowdsourced Quality



Hakan Ekmen
Chief Executive Officer Telecommunication umlaut

Best
09 **in** 19
Test



||E umlaut
Mobile Benchmark
Greece



umlaut



Measurement Overview

umlaut communications GmbH tested and measured the performance of its voice and data services on smart-phones in comparison to other LTE/UMTS/GSM mobile radio networks in metropolitan and rural areas of Greece. The audit was done as a performance benchmark performed by umlaut communications between 04.09.2019 and 19.09.2019 in cities and towns as well as on connection roads.

Dedicated measurements have been executed as drive tests outdoors using a Samsung Galaxy S9 cat18 Smart-phone 1200 Mbit/s Download / 200 Mbit/s Upload. All data measurements have been performed in 4G preferred mode. Voice measurements have been done in 4G/4G preferred mode on both sides, while call origin has been alternated.

In addition crowdsourced performance data has been collected and evaluated between CW14 2019 and CW37 2019.

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



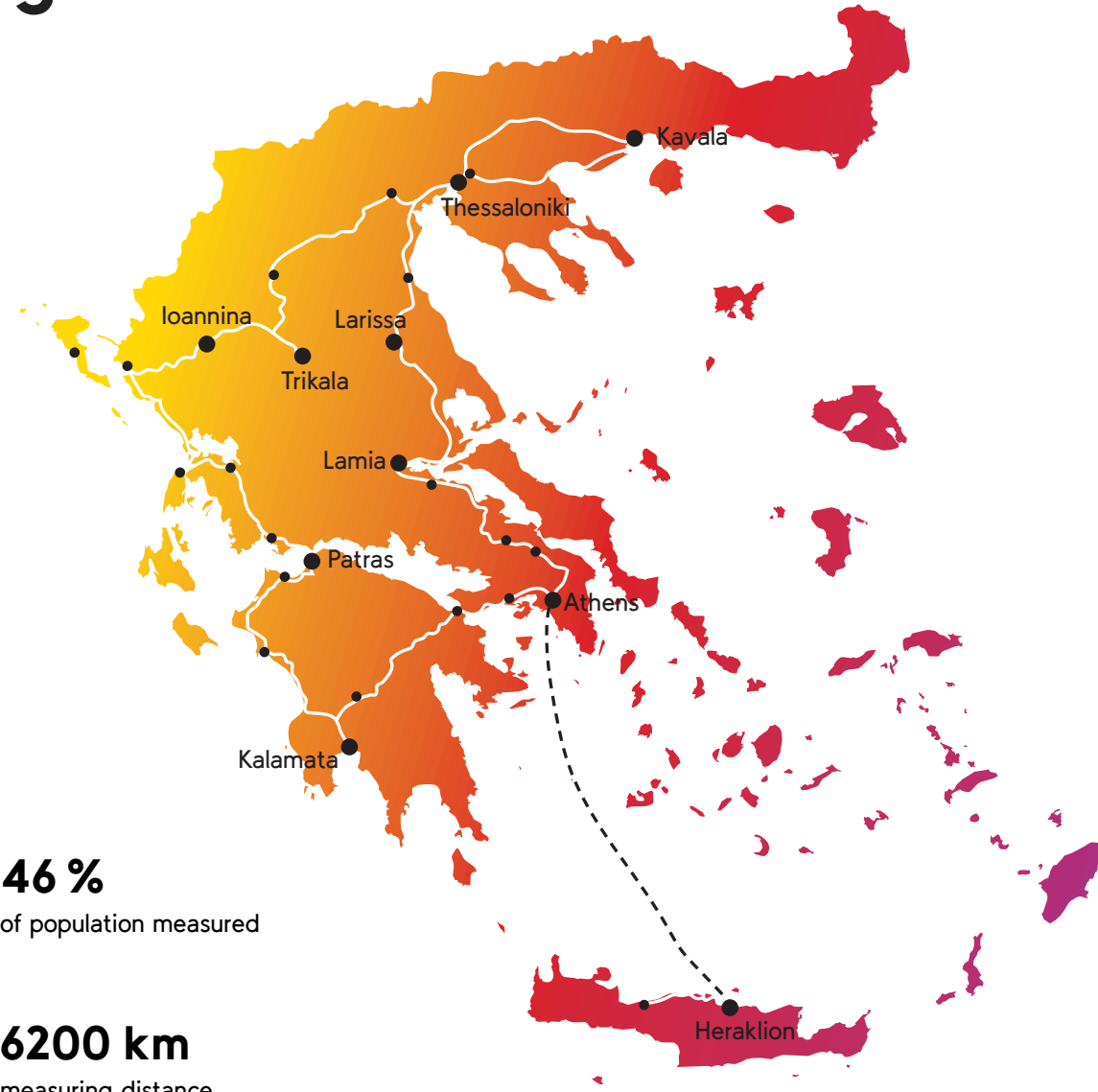
Measurement setup

Drivetest	Voice	Data
Device	Samsung Galaxy S9	Samsung Galaxy S9
Test Cases	Mobile-to-Mobile (M2M) Side1 (4G preferred: Volte) to Side2 (4G preferred: Volte) 115 sec call window 70 sec call duration 15 sec call setup timeout Multi-RAB traffic injection on both sides	Data 4G preferred CA HTTP DL datastream 7s HTTP UL datastream 7s HTTP 5MB DL fixed file transfer HTTP 2.5MB UL fixed file transfer Web Browsing – Kepler ETSI Ref. Page 10 Live web pages (5 http / 5 https) 2 YouTube HD video ~ 45s 1 YouTube live stream ~ 45s
Mobility and Route Types	Drive test 100% 55% in Cities, 13% in Towns and 32% on Roads	
Samples	~ 2300 per Operator	~ 1750 per Operator
Dates	13 measurement days September 4th 2019 – September 19th 2019	
Crowd Data Assessment	24 weeks CW14 2019 – CW37 2019	



Testing areas

Drive route



46 %
of population measured

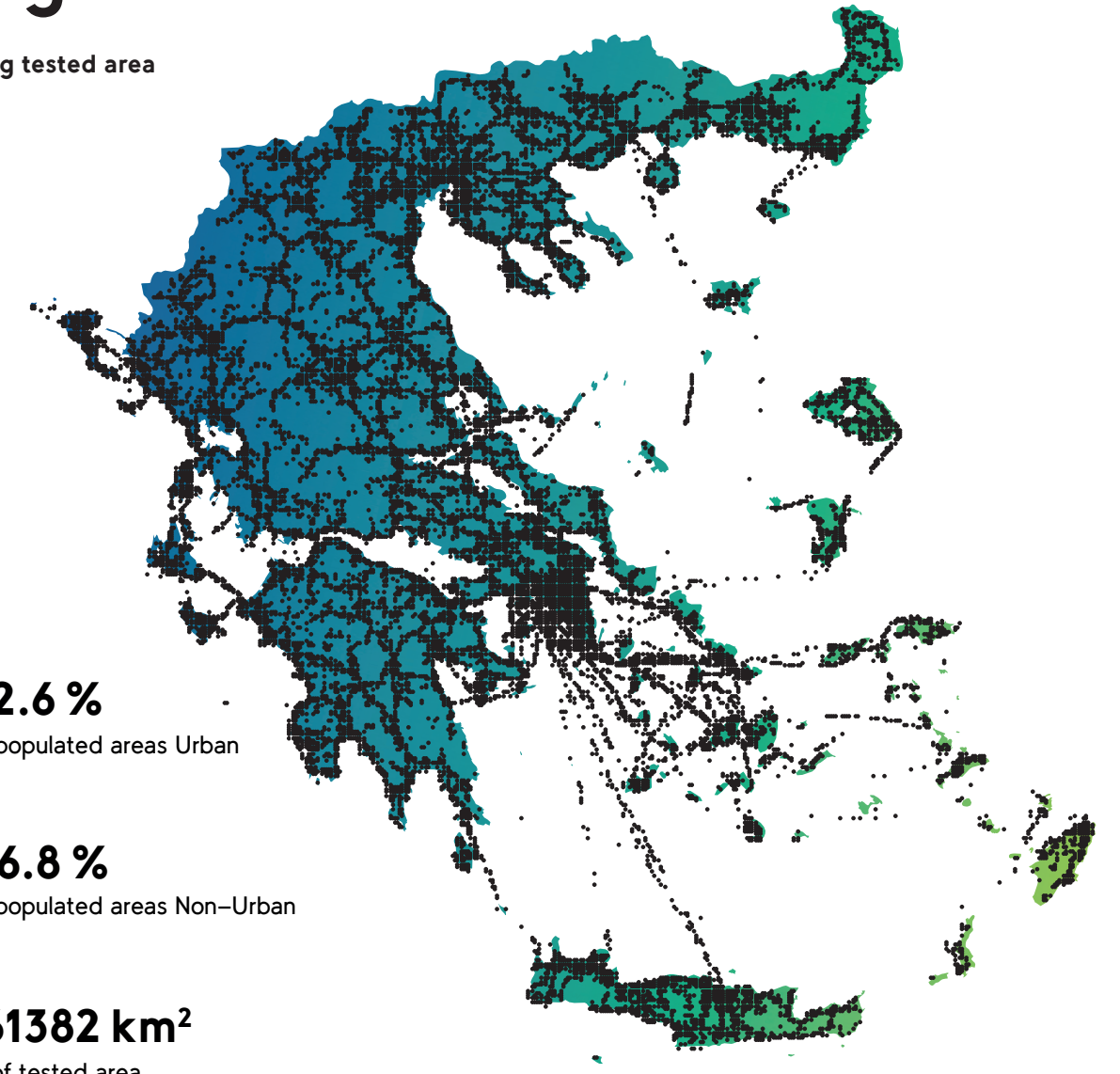


6200 km
measuring distance



Testing areas

Crowdsourcing tested area



92.6 %
of populated areas Urban



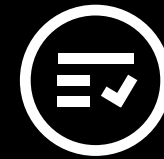
46.8 %
of populated areas Non-Urban



~ 61382 km²
size of tested area



Claims



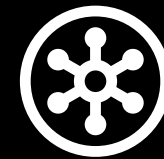
Best in test
Cosmote



Best in data
Cosmote



Best in voice
Cosmote



Best in crowd-sourced quality
Cosmote



Methodology

The leader in mobile benchmarking, umlaut, has analyzed the mobile networks of Greece with regards to mobile network performance.

We measure smartphone voice and data performance based on extensive drive-tests – from major metropolitan areas to smaller cities, roads and railways, complemented by walk-tests in big cities with special focus on busy areas, on public transport and in frequently visited buildings, like shopping malls, main station, etc.

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.

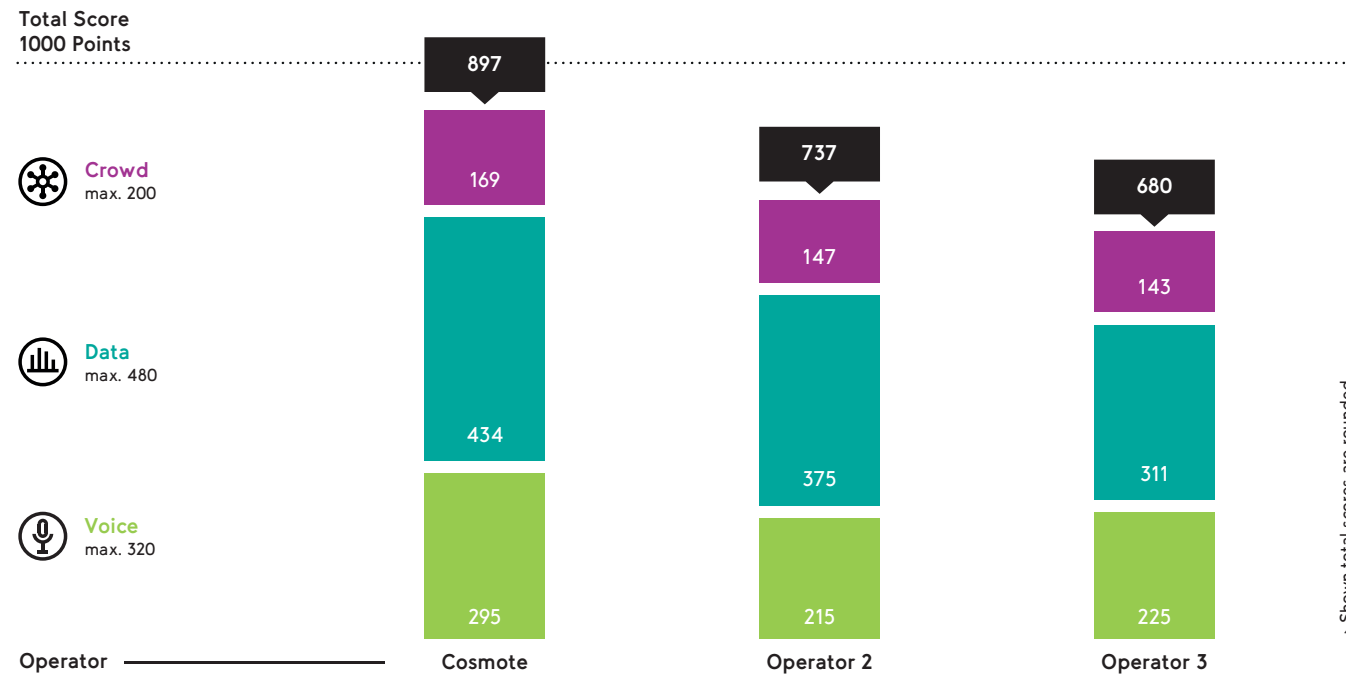
Today, more than 200 mobile networks in more than

120 countries are being evaluated by our unique scoring methodology. It allows a technical analysis that is unprecedented 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

Cosmote achieved the highest overall score among competitors with 897 dots out of maximum 1000.



→ Shown total scores are rounded.

The graphic indicates the score points achieved by the networks under test in the modules "Voice", "Data Services" and "Crowdsourced Quality".

Total score

		Cosmote	Operator 2	Operator 3
Voice	max. 320	295	215	225
Cities Drivetest	192	93%	67%	78%
Towns Drivetest	64	95%	75%	72%
Roads Drivetest	64	85%	58%	46%
Data	max. 480	434	375	311
Cities Drivetest	288	91%	80%	72%
Towns Drivetest	96	89%	78%	47%
Roads Drivetest	96	90%	72%	62%
Crowdsourced Quality	max. 200	169	147	143
Crowd	200	84%	73%	72%
Total	1000	897	737	680

Shown scores are rounded.



The following table indicates the achieved percentage of the maximum score in each of the different data services.

Data	Service Group	max	Cosmote	Operator 2	Operator 3
Cities	Web Browsing	64	94%	91%	82%
	File Download	80	89%	74%	68%
	File Upload	80	88%	79%	66%
	YouTube	64	94%	79%	74%
Towns	Web Browsing	21,3	93%	89%	63%
	File Download	26,7	90%	76%	51%
	File Upload	26,7	82%	77%	23%
	YouTube	21,3	94%	69%	53%
Roads	Web Browsing	21,3	91%	83%	74%
	File Download	26,7	94%	72%	65%
	File Upload	26,7	86%	68%	53%
	YouTube	21,3	88%	67%	57%



The following table indicates the achieved percentage of the maximum score in each of the different data services.

Crowd	Service Group	max	Cosmote	Operator 2	Operator 3
Country	Operational Excellence	60	97%	100%	100%
Urban	Voice Coverage	13	86%	93%	90%
	Data Coverage	17	92%	83%	78%
	4G Coverage	29	77%	30%	54%
	DL Data Speed	17	59%	41%	15%
	UL Data Speed	8	49%	32%	8%
Non-urban (Benchmark view)	Voice Coverage	7	100%	100%	100%
	Data Coverage	9	100%	100%	95%
	4G Coverage	15	99%	94%	93%
	DL Data Speed	9	64%	34%	10%
Non-urban (Own network view)	UL Data Speed	4	39%	31%	29%
	Voice Coverage	2	100%	100%	99%
	Data Coverage	2	99%	100%	96%
	4G Coverage	4	99%	92%	94%
	DL Data Speed	2	48%	11%	9%
UL Data Speed	1	26%	25%	29%	



Voice KPI overview

The following table indicates the 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	Cosmote	Operator 2	Operator 3
Cities	Qualifier	[%]	99	98	97
	Call Setup Time	[s]	1,8	4,9	2,2
	Call Setup Time (P90)	[s]	2,7	6	2,9
	Speech Quality (AVG)	[MOS-LQO]	4,5	3,5	3,7
	Speech Quality (P10)	[MOS-LQO]	4,2	2,6	3,2
	Multirab connectivity	[%]	100	85	96
Towns	Qualifier	[%]	99,3	99	96,6
	Call Setup Time	[s]	1,7	4,9	2,4
	Call Setup Time (P90)	[s]	2,6	6,3	3,5
	Speech Quality (AVG)	[MOS-LQO]	4,5	3,6	3,7
	Speech Quality (P10)	[MOS-LQO]	4,3	2,7	2,9
	Multirab connectivity	[%]	99,3	85,8	90,8
Roads	Qualifier	[%]	95,9	93,2	87
	Call Setup Time	[s]	1,9	4,9	2,7
	Call Setup Time (P90)	[s]	2,7	6,1	4,6
	Speech Quality (AVG)	[MOS-LQO]	4,4	3,5	3,6
	Speech Quality (P10)	[MOS-LQO]	3,8	2,4	2,7
	Multirab connectivity	[%]	98,7	85,5	89,9



Data KPI overview

The following table indicates the achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Cities".

Data Cities	KPI Name	Unit	Cosmote	Operator 2	Operator 3
HTTP Live Page DL Smartphone	Qualifier	[%]	99,4	99,2	98,1
	Overall Session Time	[s]	1,5	1,5	1,7
HTTP Static Page DL Smartphone	Qualifier	[%]	99,8	99,2	97,8
	Overall Session Time	[s]	1	1,2	1,2
HTTP 5MB DL Smartphone	Qualifier	[%]	99,9	99,1	98,1
	Average Session Time	[s]	1,8	3,5	4,3
	90% faster than	[Mbit/s]	13,6	5,8	5,1
	10% faster than	[Mbit/s]	80,3	57	47,2
HTTP 2500KB UL Smartphone	Qualifier	[%]	99,8	99,2	99
	Average Session Time	[s]	2,2	2,9	4
	90% faster than	[Mbit/s]	5,1	3,5	2,3
	10% faster than	[Mbit/s]	35,6	34,9	22
HTTP DL FDDT	Qualifier	[%]	99,6	98,9	98,4
	Average Data Rate	[Mbit/s]	71,5	33,2	27,6
	90% faster than	[Mbit/s]	21,2	6,5	4,6
	10% faster than	[Mbit/s]	139,4	67,4	65,4
HTTP UL FDDT	Qualifier	[%]	99,7	98,4	97,1
	Average Data Rate	[Mbit/s]	28,1	24,7	11,9
	90% faster than	[Mbit/s]	5,6	3,8	2,2
	10% faster than	[Mbit/s]	52,3	53,1	24,7
YouTube	Qualifier	[%]	99,7	97,6	96,6
	Start Time	[s]	1,3	1,5	1,7
	AVG Resolution	[p]	916	900	877
YouTube Live Smartphone	Qualifier	[%]	99,6	96,7	96,4
	Start Time	[s]	1,7	1,9	1,8
	AVG Resolution	[p]	1018	1002	986



Data KPI Overview

The following table indicates the achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Towns".

Data Towns	KPI Name	Unit	Cosmote	Operator 2	Operator 3
HTTP Live Page DL Smartphone	Qualifier	[%]	99,3	98,5	95
	Overall Session Time	[s]	1,5	1,5	1,7
HTTP Static Page DL Smartphone	Qualifier	[%]	99,8	99,6	94,1
	Overall Session Time	[s]	1,1	1,3	1,3
HTTP 5MB DL Smartphone	Qualifier	[%]	100	99,6	95,3
	Average Session Time	[s]	1,9	4,3	4,8
	90% faster than	[Mbit/s]	12,2	4,8	4,3
	10% faster than	[Mbit/s]	82,5	47,6	64,2
HTTP 2500KB UL Smartphone	Qualifier	[%]	100	99,2	88,9
	Average Session Time	[s]	2,7	3,3	3,4
	90% faster than	[Mbit/s]	3,9	3,5	2,6
	10% faster than	[Mbit/s]	31	23,9	21,9
HTTP DL FDTT	Qualifier	[%]	100	99,6	95,7
	Average Data Rate	[Mbit/s]	77,4	27,8	31,4
	90% faster than	[Mbit/s]	18,2	5,4	2,4
	10% faster than	[Mbit/s]	140,7	55	75,6
HTTP UL FDTT	Qualifier	[%]	98,8	98,9	89,3
	Average Data Rate	[Mbit/s]	21,6	17	11,8
	90% faster than	[Mbit/s]	4,1	3,4	1,4
	10% faster than	[Mbit/s]	44,5	36,6	22,5
YouTube	Qualifier	[%]	100	95,4	92,7
	Start Time	[s]	1,3	1,5	1,7
	AVG Resolution	[p]	914	891	871
YouTube Live Smartphone	Qualifier	[%]	99,2	96,2	94,2
	Start Time	[s]	1,7	1,8	1,8
	AVG Resolution	[p]	1009	990	974



The following table indicates the achieved values of all networks under test in each of the relevant Data Key Performance Indicators (KPIs) for the geographical category "Roads".

Data Roads	KPI Name	Unit	Cosmote	Operator 2	Operator 3
HTTP Live Page DL Smartphone	Qualifier	[%]	98,4	97	94,1
	Overall Session Time	[s]	1,5	1,7	1,8
HTTP Static Page DL Smartphone	Qualifier	[%]	98,6	96,9	94,5
	Overall Session Time	[s]	1,1	1,4	1,3
HTTP 5MB DL Smartphone	Qualifier	[%]	98,9	96	94,6
	Average Session Time	[s]	2	5	4,8
	90% faster than	[Mbit/s]	13,7	4	4,3
	10% faster than	[Mbit/s]	90,7	43,8	39,7
HTTP 2500KB UL Smartphone	Qualifier	[%]	98,7	96,9	90,40%
	Average Session Time	[s]	2,6	4,3	3,9
	90% faster than	[Mbit/s]	3,9	2,2	2,6
	10% faster than	[Mbit/s]	34,4	22,3	21,3
HTTP DL FDTT	Qualifier	[%]	98,4	96,7	94,6
	Average Data Rate	[Mbit/s]	74,4	22,1	22,9
	90% faster than	[Mbit/s]	18	4	3,2
	10% faster than	[Mbit/s]	141,7	50,8	47,5
HTTP UL FDTT	Qualifier	[%]	97,3	93,3	91,1
	Average Data Rate	[Mbit/s]	22,8	13,7	11,4
	90% faster than	[Mbit/s]	5	2,5	2,3
	10% faster than	[Mbit/s]	45,5	26,2	23,3
YouTube	Qualifier	[%]	98,4	91,4	88,5
	Start Time	[s]	1,3	1,8	1,7
	AVG Resolution	[p]	920	871	877
YouTube Live Smartphone	Qualifier	[%]	96	93	89,3
	Start Time	[s]	1,7	2,1	1,9
	AVG Resolution	[p]	1015	969	963



Crowd KPI overview

The following table indicates the achieved values of all networks under test in each of the relevant Crowd Key Performance Indicators (KPIs) for the geographical categories "country", "urban" and "non-urban".

Crowd	Service Group	Unit	Cosmote	Operator 2	Operator 3	
Country	Operational Excellence	Degraded days	[d]	1	0	0
		Degraded periods	[h]	3	0	0
Urban	4G Coverage	Quality of Coverage	[%]	94,4	82,5	88,5
	Data Coverage	Quality of Coverage	[%]	98,9	97,4	96,7
	DL Data Speed	P90 EA Top Throughput	[Mbit/s]	51,071	37,528	26,615
	UL Data Speed	P90 EA Top Throughput	[Mbit/s]	11,027	7,505	4,307
	Voice Coverage	Quality of Coverage	[%]	99,3	99,6	99,5
Non-urban (Benchmark view)	4G Coverage	Test Area Coverage	[%]	99,8	98,1	97,8
	Data Coverage	Test Area Coverage	[%]	99,9	99,9	99,1
	DL Data Speed	P90 EA Top Throughput	[Mbit/s]	25,173	17,882	14,794
	UL Data Speed	P90 EA Top Throughput	[Mbit/s]	3,961	3,263	3,075
	Voice Coverage	Test Area Coverage	[%]	100	100	100
Non-urban (Own network view)	4G Coverage	Test Area Coverage	[%]	99,6	97,6	98,3
	Data Coverage	Test Area Coverage	[%]	99,9	99,9	99,3
	DL Data Speed	P90 EA Top Throughput	[Mbit/s]	20,737	15,32	13,854
	UL Data Speed	P90 EA Top Throughput	[Mbit/s]	2,898	2,824	3,059
	Voice Coverage	Test Area Coverage	[%]	100	100	99,9



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