

CERTIFICATE

P3 communications GmbH

Am Kraftversorgungsturm 3, D-52070 Aachen, Germany

hereby certifies that



Telekom Romania

319G Splaiul Independentei
SEMA Park / Atrium House Building, 1st and 2nd floor
060044, Bucharest, Romania

achieved a

Total Score of 752 of 1000

in the Mobile Benchmark Romania 08/2017

(Score 243 of 400 in Voice, Score 508 of 600 in Data Services)



Maziar Kianzad
*Head of Network Testing
& Benchmarking*
September 2017

Measurement Setup

	Voice	Data
Device	Samsung Galaxy S7 cat9	Samsung Galaxy S7 cat9 Sony Xperia XZ cat9
Test Cases	Mobile-to-Mobile Side1 (4G preferred) to Side2 (4G preferred) Side1 (VoLTE) to Side2 (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 3MB DL fixed file transfer HTTP 1MB UL fixed file transfer Web Browsing - Kepler ETSI Ref. Page 10 Live web pages (50% http / 50% https) 4 YouTube HD video ~ 45s
Mobility and Route Types	100% Drivetest 60% in Cities, 18% in Towns and 22% on Roads Cities, towns and roads	
Samples	~ 5800 per Operator	~ 1700 per Operator
Dates	16 measurement days 11.08.2017 – 31.08.2017	

Testing Route



Score Points and Breakdown

The following table indicates the score points achieved by the networks under test in the modules “Voice” and “Data Services” as well as the breakdown of achieved points in the geographical categories “Cities”, “Towns” and “Roads”.

Module	Infrastructure	Max.	Telekom	Operator 2	Operator 3	Operator 4
Voice	Total	400	243	302	312	214
	Cities	240	76%	81%	87%	63%
	Towns	80	39%	76%	69%	50%
	Roads	80	38%	57%	58%	29%
Data	Total	600	508	494	483	363
	Cities	360	94%	92%	94%	74%
	Towns	120	79%	70%	61%	39%
	Roads	120	63%	66%	58%	41%
TOTAL		1.000	752	796	794	578

Shown voice, data and total 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.	Telekom	Operator 2	Operator 3	Operator 4
Cities	Web Browsing	108	91%	85%	92%	84%
	File Download	90	90%	90%	92%	74%
	File Upload	90	98%	98%	97%	62%
	YouTube	72	97%	98%	97%	77%
Towns	Web Browsing	36	78%	72%	64%	38%
	File Download	30	78%	71%	71%	54%
	File Upload	30	82%	74%	56%	19%
	YouTube	24	79%	59%	50%	46%
Roads	Web Browsing	36	62%	68%	59%	34%
	File Download	30	68%	72%	66%	59%
	File Upload	30	63%	61%	58%	24%
	YouTube	24	59%	62%	48%	50%

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 M2M	KPI Name	Unit	Telekom	Operator 2	Operator 3	Operator 4
Cities	Qualifier	[%]	98,1	99,2	99,0	97,2
	Call Setup Time	[s]	6,3	5,8	4,1	7,1
	AVG Speech Quality	[MOS-LQO]	3,4	3,2	3,5	2,7
Towns	Qualifier	[%]	91,3	98,3	96,3	95,0
	Call Setup Time	[s]	6,4	6,2	5,2	6,9
	AVG Speech Quality	[MOS-LQO]	3,4	3,3	3,4	2,6
Roads	Qualifier	[%]	87,2	92,0	91,7	86,4
	Call Setup Time	[s]	7,3	6,4	5,7	7,2
	AVG Speech Quality	[MOS-LQO]	3,3	3,2	3,3	2,7

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 categories “Cities”, “Towns” and “Roads”.

Data Cities	KPI Name	Unit	Telekom	Operator 2	Operator 3	Operator 4
HTTP Live Page DL	Qualifier	[%]	99,2	99,6	99,4	98,8
	Time to first Byte	[ms]	554	724	538	582
	Kbytes first second	[KB]	477	356	510	390
HTTP Static Page DL	Qualifier	[%]	99,6	99,9	99,8	99,4
	Overall Session Time	[s]	1,1	1,2	1,2	1,7
HTTP file DL 3MB	Qualifier	[%]	99,8	100,0	99,8	99,5
	AVG Session Time	[s]	1,3	1,2	1,2	3,2
	90% faster than	[kbit/s]	16162	13453	14375	4101
	10% faster than	[kbit/s]	62016	57692	69445	32021
HTTP file UL 1MB	Qualifier	[%]	99,8	99,9	99,9	97,8
	AVG Session Time	[s]	0,7	0,7	0,6	3,2
	90% faster than	[kbit/s]	9894	10013	10283	1268
	10% faster than	[kbit/s]	26316	26846	25723	7093
HTTP DL FDTT 7s	Qualifier	[%]	99,8	99,9	100,0	99,0
	AVG throughput	[kbit/s]	55604	53932	67174	19496
	90% faster than	[kbit/s]	20184	16775	20156	4343
	10% faster than	[kbit/s]	96959	101108	126942	36943
HTTP UL FDTT 7s	Qualifier	[%]	99,9	99,9	99,7	97,4
	AVG throughput	[kbit/s]	34096	32728	31505	4581
	90% faster than	[kbit/s]	15657	14406	12287	1420
	10% faster than	[kbit/s]	46456	43076	43350	7541
YouTube	Qualifier	[%]	99,7	100,0	99,7	96,9
	Start Time	[s]	2,0	2,4	2,1	2,8
	Playouts w/o interruptions	[%]	99,7	99,8	99,8	97,5
	AVG Resolution	[p]	1077,6	1076,7	1078,5	1053,6

Data Towns	KPI Name	Unit	Telekom	Operator 2	Operator 3	Operator 4
HTTP Live Page DL	Qualifier	[%]	97,1	97,6	94,4	86,0
	Time to first Byte	[ms]	636	804	626	603
	Kbytes first second	[KB]	437	303	426	353
HTTP Static Page DL	Qualifier	[%]	98,2	99,2	95,9	94,3
	Overall Session Time	[s]	1,5	1,8	1,9	2,5
HTTP file DL 3MB	Qualifier	[%]	98,3	98,7	98,6	97,1
	AVG Session Time	[s]	2,3	4,9	3,7	5,8
	90% faster than	[kbit/s]	5983	2310	2873	1782
	10% faster than	[kbit/s]	57129	46593	66500	24390
HTTP file UL 1MB	Qualifier	[%]	99,0	98,7	93,8	86,4
	AVG Session Time	[s]	1,5	2,1	1,8	3,1
	90% faster than	[kbit/s]	2815	1607	2038	1390
	10% faster than	[kbit/s]	23015	21471	24155	8244
HTTP DL FDTT 7s	Qualifier	[%]	99,4	98,7	97,3	95,6
	AVG throughput	[kbit/s]	46054	23637	28548	11910
	90% faster than	[kbit/s]	6825	2495	2625	1765
	10% faster than	[kbit/s]	95038	59098	67832	25543
HTTP UL FDTT 7s	Qualifier	[%]	98,6	97,4	93,9	84,3
	AVG throughput	[kbit/s]	21369	14914	15767	5770
	90% faster than	[kbit/s]	2697	1587	2363	1287
	10% faster than	[kbit/s]	44470	35446	36926	9023
YouTube	Qualifier	[%]	95,6	92,7	91,3	90,5
	Start Time	[s]	2,2	2,9	2,8	3,5
	Playouts w/o interruptions	[%]	99,6	97,6	96,6	97,5
	AVG Resolution	[p]	1076,7	1044,4	1040,7	926,2

Data Roads	KPI Name	Unit	Telekom	Operator 2	Operator 3	Operator 4
HTTP Live Page DL	Qualifier	[%]	91,4	94,6	90,2	73,6
	Time to first Byte	[ms]	783	807	698	674
	Kbytes first second	[KB]	360	287	386	356
HTTP Static Page DL	Qualifier	[%]	93,7	95,5	92,5	87,8
	Overall Session Time	[s]	2,0	2,2	2,3	3,1
HTTP file DL 3MB	Qualifier	[%]	94,4	97,8	95,6	95,8
	AVG Session Time	[s]	4,5	5,8	6,4	7,4
	90% faster than	[kbit/s]	2675	1744	1733	1541
	10% faster than	[kbit/s]	50084	39697	42904	21201
HTTP file UL 1MB	Qualifier	[%]	94,2	92,6	91,5	73,4
	AVG Session Time	[s]	3,0	2,7	2,6	3,5
	90% faster than	[kbit/s]	1249	1333	1391	1164
	10% faster than	[kbit/s]	21036	16985	20101	8140
HTTP DL FDTT 7s	Qualifier	[%]	94,4	97,0	94,9	93,6
	AVG throughput	[kbit/s]	26209	16451	19695	11084
	90% faster than	[kbit/s]	3205	1716	2037	1452
	10% faster than	[kbit/s]	74118	44893	44533	25396
HTTP UL FDTT 7s	Qualifier	[%]	90,4	92,5	90,1	73,0
	AVG throughput	[kbit/s]	12830	12312	12404	5474
	90% faster than	[kbit/s]	1587	1193	1721	1390
	10% faster than	[kbit/s]	39726	30594	27628	8928
YouTube	Qualifier	[%]	88,3	90,6	85,8	86,6
	Start Time	[s]	3,1	3,3	3,1	3,8
	Playouts w/o interruptions	[%]	96,2	94,6	93,6	96,1
	AVG Resolution	[p]	1032,6	1016,6	1033,7	892,2