

# CERTIFICATE

## **P3 communications GmbH**

Am Kraftversorgungsturm 3, D-52070 Aachen, Germany

hereby certifies that



**vodafone**

## **Vodafone Romania**

Globalworth Tower, Barbu Vacarescu 201, Bucuresti, Romania

achieved „**Best in Test**“ with a

Total Score of **870 of 1000**

in the **Mobile Benchmark Romania 12/2017.**

(Score 327 of 400 in Telephony, Score 543 of 600 in Data Services)

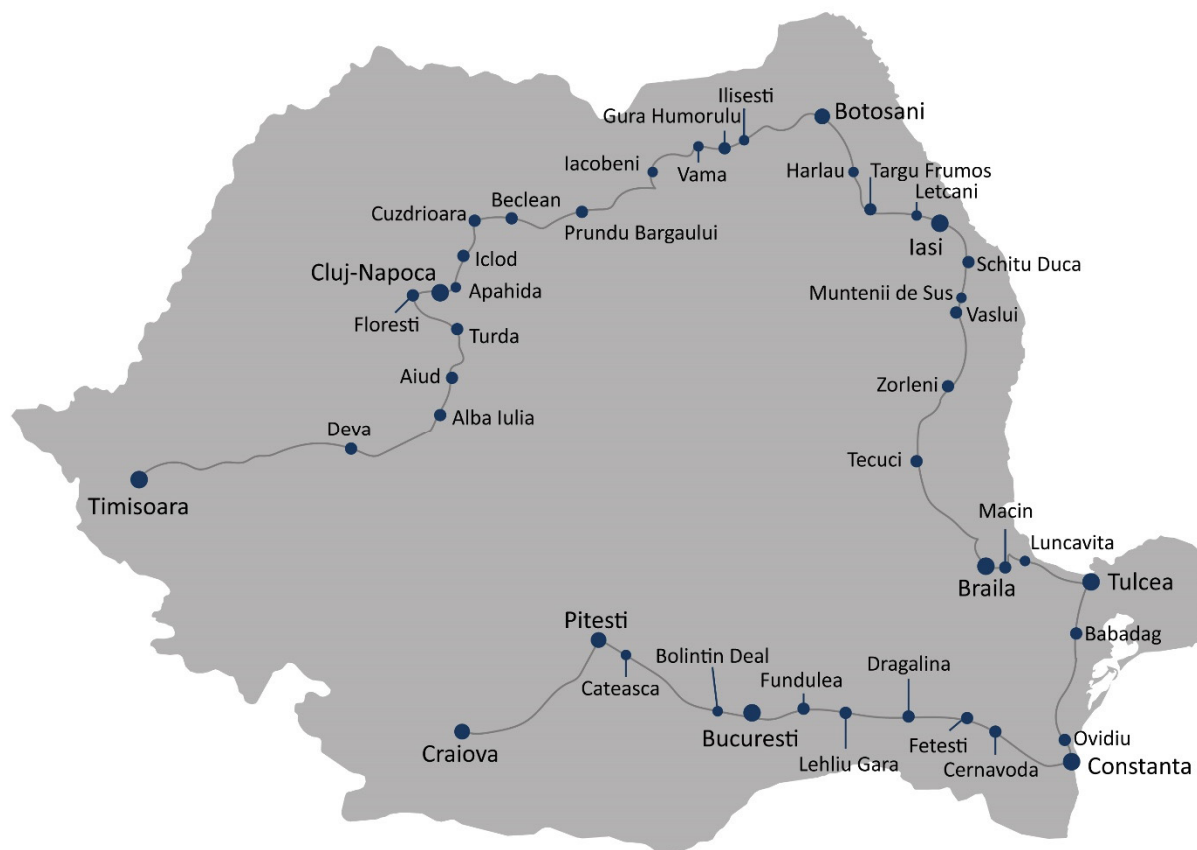


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*Head of Network Testing  
& Benchmarking*  
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## Measurement Setup

	<b>Voice</b>	<b>Data</b>
<b>Device</b>	Samsung Galaxy S7 cat9	Samsung Galaxy S7 cat9 Sony Xperia XZ cat9
<b>Test Cases</b>	<b>Mobile-to-Mobile (M2M)</b>  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	<b>Data 4G preferred CA</b>  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
<b>Mobility and Route Types</b>	100% Drivetest 63% in Cities, 17% in Towns and 20% on Roads	
<b>Samples</b>	~ 6900 per Operator	~ 2000 per Operator
<b>Dates</b>	<b>18 measurement days</b> <b>23.11.2017 – 16.12.2017</b>	

## 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.	Vodafone	Operator 2	Operator 3	Operator 4
<b>Voice</b>	<b>Total</b>	<b>400</b>	<b>327</b>	<b>338</b>	<b>302</b>	<b>231</b>
	Cities	240	86%	92%	81%	65%
	Towns	80	80%	78%	76%	60%
	Roads	80	71%	69%	60%	35%
<b>Data</b>	<b>Total</b>	<b>600</b>	<b>543</b>	<b>521</b>	<b>526</b>	<b>366</b>
	Cities	360	95%	94%	94%	73%
	Towns	120	84%	75%	79%	43%
	Roads	120	83%	76%	76%	44%
<b>TOTAL</b>		<b>1.000</b>	<b>870</b>	<b>859</b>	<b>828</b>	<b>597</b>

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.	Vodafone	Operator 2	Operator 3	Operator 4
<b>Cities</b>	Web Browsing	108	93%	91%	89%	78%
	File Download	90	92%	92%	93%	75%
	File Upload	90	98%	98%	98%	59%
	YouTube	72	99%	98%	99%	80%
<b>Towns</b>	Web Browsing	36	88%	76%	76%	43%
	File Download	30	82%	77%	77%	64%
	File Upload	30	79%	83%	79%	20%
	YouTube	24	86%	60%	89%	43%
<b>Roads</b>	Web Browsing	36	87%	78%	76%	35%
	File Download	30	83%	79%	81%	61%
	File Upload	30	77%	75%	75%	26%
	YouTube	24	85%	71%	74%	59%

## 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	Vodafone	Operator 2	Operator 3	Operator 4
<b>Cities</b>	Qualifier	[%]	99,4	99,5	97,9	97,5
	Call Setup Time	[s]	5,2	3,7	4,4	7,0
	AVG Speech Quality	[MOS-LQO]	3,4	3,6	3,4	2,7
<b>Towns</b>	Qualifier	[%]	98,7	97,8	97,4	96,7
	Call Setup Time	[s]	5,8	4,8	5,0	6,9
	AVG Speech Quality	[MOS-LQO]	3,3	3,4	3,4	2,6
<b>Roads</b>	Qualifier	[%]	95,6	94,2	92,0	87,9
	Call Setup Time	[s]	6,1	5,1	5,7	7,1
	AVG Speech Quality	[MOS-LQO]	3,3	3,4	3,3	2,6

## 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	Vodafone	Operator 2	Operator 3	Operator 4
HTTP Live Page DL	Qualifier	[%]	99,2	99,5	99,1	97,6
	Time to first Byte	[ms]	536	664	713	731
	KBytes first second	[KB]	559	564	588	413
HTTP Static Page DL	Qualifier	[%]	100,0	100,0	99,8	99,2
	Overall Session Time	[s]	1,0	1,2	1,0	1,7
HTTP file DL 3MB	Qualifier	[%]	99,9	99,8	100,0	99,4
	AVG Session Time	[s]	0,9	1,0	1,0	2,9
	90% faster than	[kbit/s]	18405	17270	19078	5062
	10% faster than	[kbit/s]	63325	70985	62016	31128
HTTP file UL 1MB	Qualifier	[%]	99,9	99,9	99,8	97,1
	AVG Session Time	[s]	0,6	0,6	0,7	3,4
	90% faster than	[kbit/s]	11779	12932	10216	1173
	10% faster than	[kbit/s]	25740	25806	26067	7436
HTTP DL FDTT 7s	Qualifier	[%]	99,9	99,9	99,9	99,5
	AVG throughput	[kbit/s]	59550	64396	56484	20045
	90% faster than	[kbit/s]	21591	20488	25054	4840
	10% faster than	[kbit/s]	106685	117400	93663	39334
HTTP UL FDTT 7s	Qualifier	[%]	100,0	99,8	99,8	97,1
	AVG throughput	[kbit/s]	33725	34068	33843	5506
	90% faster than	[kbit/s]	17394	17360	16565	1380
	10% faster than	[kbit/s]	43514	44305	46318	10402
YouTube	Qualifier	[%]	99,9	99,8	99,8	96,5
	Start Time	[s]	2,0	1,9	1,9	2,6
	Playouts w/o interruptions	[%]	99,9	99,9	100,0	98,9
	AVG Resolution	[p]	1078,6	1079,8	1079,5	1058,8

Data Towns	KPI Name	Unit	Vodafone	Operator 2	Operator 3	Operator 4
HTTP Live Page DL	Qualifier	[%]	98,4	97,1	97,3	89,6
	Time to first Byte	[ms]	572	699	776	733
	KBytes first second	[KB]	504	444	504	372
HTTP Static Page DL	Qualifier	[%]	99,8	98,4	96,8	96,0
	Overall Session Time	[s]	1,3	1,7	1,3	2,4
HTTP file DL 3MB	Qualifier	[%]	100,0	99,7	98,3	99,3
	AVG Session Time	[s]	2,1	3,7	2,3	5,4
	90% faster than	[kbit/s]	5261	2969	6426	1643
	10% faster than	[kbit/s]	51392	50136	61697	28285
HTTP file UL 1MB	Qualifier	[%]	98,0	98,9	98,1	86,8
	AVG Session Time	[s]	1,4	1,5	1,6	2,9
	90% faster than	[kbit/s]	2851	2731	2811	1456
	10% faster than	[kbit/s]	23256	22472	23460	8807
HTTP DL FDTT 7s	Qualifier	[%]	99,8	99,5	98,1	96,5
	AVG throughput	[kbit/s]	36188	27076	49517	15262
	90% faster than	[kbit/s]	5239	2957	7188	2002
	10% faster than	[kbit/s]	78349	66645	96188	34294
HTTP UL FDTT 7s	Qualifier	[%]	98,4	99,7	98,1	88,3
	AVG throughput	[kbit/s]	20263	17867	22710	6537
	90% faster than	[kbit/s]	3280	3055	3440	1542
	10% faster than	[kbit/s]	41776	38590	46562	14391
YouTube	Qualifier	[%]	98,4	97,6	99,4	96,1
	Start Time	[s]	2,4	2,6	2,2	3,0
	Playouts w/o interruptions	[%]	98,4	97,6	99,4	96,1
	AVG Resolution	[p]	1060,8	1059,7	1067,1	984,2

Data Roads	KPI Name	Unit	Vodafone	Operator 2	Operator 3	Operator 4
HTTP Live Page DL	Qualifier	[%]	97,7	95,7	95,0	79,0
	Time to first Byte	[ms]	615	727	823	863
	KBytes first second	[KB]	461	432	453	359
HTTP Static Page DL	Qualifier	[%]	97,9	97,5	95,5	89,9
	Overall Session Time	[s]	1,5	1,8	1,6	2,8
HTTP file DL 3MB	Qualifier	[%]	98,8	99,7	98,0	96,2
	AVG Session Time	[s]	2,8	4,7	3,1	6,8
	90% faster than	[kbit/s]	4041	2076	4230	1510
	10% faster than	[kbit/s]	49444	44079	53192	24010
HTTP file UL 1MB	Qualifier	[%]	96,8	96,1	95,7	74,8
	AVG Session Time	[s]	1,9	1,8	2,2	2,9
	90% faster than	[kbit/s]	1739	2039	1790	1516
	10% faster than	[kbit/s]	19271	19012	19753	8536
HTTP DL FDTT 7s	Qualifier	[%]	98,3	98,1	96,8	92,7
	AVG throughput	[kbit/s]	28284	21918	30908	13186
	90% faster than	[kbit/s]	4373	2725	4786	2267
	10% faster than	[kbit/s]	64511	48959	74850	27169
HTTP UL FDTT 7s	Qualifier	[%]	96,3	94,9	95,6	73,3
	AVG throughput	[kbit/s]	14966	14759	13773	6304
	90% faster than	[kbit/s]	2066	2452	2442	1593
	10% faster than	[kbit/s]	35395	28840	41555	11412
YouTube	Qualifier	[%]	96,5	92,0	93,1	88,5
	Start Time	[s]	2,7	2,9	2,7	3,5
	Playouts w/o interruptions	[%]	97,9	96,9	97,1	97,9
	AVG Resolution	[p]	1050,8	1050,8	1054,3	913,5