

CERTIFICATE

P3 communications GmbH

Am Kraftversorgungsturm 3, D-52070 Aachen, Germany

hereby certifies that



Crnogorski Telekom A.D.

Moskovska 29, 81000 Podgorica, Montenegro

achieved „**Best in Test**“ with a
Total Score of **713 of 1000**

in the **Mobile Benchmark Montenegro 09/2017.**

(Score 243 of 400 in Telephony, Score 470 of 600 in Data Services)



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Head of Network Testing
& Benchmarking
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Measurement Setup

	Voice	Data
Device	Samsung Galaxy S7 cat9	Samsung Galaxy S7 cat9 Sony Xperia XZ cat9
Test Cases	Mobile-to-Mobile (M2M) Side1 (4G preferred) to Side2 (4G preferred) Side1 (4G preferred) to Side2 (4G preferred) 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 55% in Cities, 17% in Towns and 28% on Roads Cities, towns and roads small country approach	
Samples	~ 3100 per Operator	~ 1060 per Operator
Dates	8 measurement days 11.09.2017 – 20.09.2017	

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”.

Module	Infrastructure	Max.	Telekom	Operator 2	Operator 3
Voice	Total	400	243	280	227
	Overall	400	61%	70%	57%
Data	Total	600	470	408	402
	Overall	600	78%	68%	67%
TOTAL		1.000	713	688	630

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 Service Group

Data	Service Group	Max.	Telekom	Operator 2	Operator 3
Overall	Web Browsing	180	78%	70%	68%
	File Download	150	76%	68%	64%
	File Upload	150	80%	65%	67%
	YouTube	120	80%	68%	70%

Voice KPI Overview

The following table indicates the achieved values of all networks under test in each of the relevant Telephony Key Performance Indicators (KPIs).

Voice M2M	Kpi Name	Unit	Telekom	Operator 2	Operator 3
Overall	Qualifier	[%]	95,5	97,0	95,0
	Call Setup Time	[s]	6,8	5,4	7,4
	AVG Speech Quality	[MOS-LQO]	3,4	3,0	3,5

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).

Data Overall	Kpi Name	Unit	Telekom	Operator 2	Operator 3
HTTP live page DL	Qualifier	[%]	96,5	95,7	94,6
	Time to first Byte	[ms]	495	578	510
	KBytes first secons	[KB]	405	439	459
HTTP static page DL	Qualifier	[%]	97,0	96,9	94,9
	Overall Session Time	[s]	1,1	2,0	1,4
HTTP file DL 3MB	Qualifier	[%]	97,0	97,4	96,0
	AVG Session Time	[s]	1,3	2,7	2,0
	90% faster than	[kbit/s]	13886	5212	8249
	10% faster than	[kbit/s]	57776	38647	44118
Data Overall	Kpi Name	Unit	Telekom	Operator 2	Operator 3
HTTP file UL 1MB	Qualifier	[%]	96,8	95,5	95,3
	AVG Session Time	[s]	0,9	1,7	1,7
	90% faster than	[kbit/s]	6274	1607	2993
	10% faster than	[kbit/s]	23055	16632	15094
HTTP DL FDTT 7s	Qualifier	[%]	97,3	97,3	95,1
	AVG throughput	[kbit/s]	52441	30403	31403
	90% faster than	[kbit/s]	17387	6942	10571
	10% faster than	[kbit/s]	97472	53597	52768
HTTP UL FDTT 7s	Qualifier	[%]	97,1	96,1	97,1
	AVG throughput	[kbit/s]	28017	28891	14644
	90% faster than	[kbit/s]	7372	1761	5935
	10% faster than	[kbit/s]	44325	45559	22968
YouTube	Qualifier	[%]	95,9	93,7	93,4
	Start Time	[s]	2,1	2,4	2,1
	Playouts w/o interruptions	[%]	99,4	98,7	99,5
	AVG Resolution	[p]	1076,2	1065,9	1075,6