

# CERTIFICATE

## **P3 communications GmbH**

Am Kraftversorgungsturm 3, D-52070 Aachen, Germany

hereby certifies that



## **Hrvatski Telekom d.d.**

Roberta Frangeša Mihanovića 9, 10110 Zagreb, Croatia

achieved „**Best in Test**“ with a

Total Score of **918 of 1000**

in the **Mobile Benchmark Croatia 10/2017.**

(Score 341 of 400 in Telephony, Score 577 of 600 in Data Services)



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

## 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 52% in Cities, 17% in Towns and 31% on Roads Cities, towns and roads	
<b>Samples</b>	~ 4200 per Operator	~ 1500 per Operator
<b>Dates</b>	<b>9 measurement days</b> <b>28.09.2017 – 07.10.2017</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.	Telekom	Operator 2	Operator 3
<b>Voice</b>	<b>Total</b>	<b>400</b>	<b>341</b>	<b>296</b>	<b>307</b>
	Cities	240	86%	74%	80%
	Towns	80	86%	76%	80%
	Roads	80	84%	70%	65%
<b>Data</b>	<b>Total</b>	<b>600</b>	<b>577</b>	<b>563</b>	<b>518</b>
	Cities	360	97%	96%	91%
	Towns	120	94%	89%	82%
	Roads	120	95%	93%	78%
<b>TOTAL</b>		<b>1.000</b>	<b>918</b>	<b>859</b>	<b>826</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.	Telekom	Operator 2	Operator 3
<b>Cities</b>	Web Browsing	108	97%	95%	88%
	File Download	90	96%	93%	83%
	File Upload	90	96%	97%	97%
	YouTube	72	99%	99%	95%
<b>Towns</b>	Web Browsing	36	96%	91%	81%
	File Download	30	89%	81%	79%
	File Upload	30	96%	94%	82%
	YouTube	24	96%	90%	86%
<b>Roads</b>	Web Browsing	36	96%	95%	75%
	File Download	30	95%	90%	77%
	File Upload	30	96%	92%	82%
	YouTube	24	93%	96%	78%

## 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
<b>Cities</b>	Qualifier	[%]	98,6	99,1	98,7
	Call Setup Time	[s]	4,3	8,9	5,2
	AVG Speech Quality	[MOS-LQO]	3,6	3,1	3,1
<b>Towns</b>	Qualifier	[%]	98,6	99,4	98,6
	Call Setup Time	[s]	4,2	8,4	5,0
	AVG Speech Quality	[MOS-LQO]	3,6	3,1	3,1
<b>Roads</b>	Qualifier	[%]	97,7	97,3	93,8
	Call Setup Time	[s]	4,4	8,6	5,3
	AVG Speech Quality	[MOS-LQO]	3,6	3,2	3,0

## 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
HTTP Live Page DL	Qualifier	[%]	100,0	99,2	98,5
	Time to first Byte	[ms]	452	438	551
	KBytes first second	[KB]	553	518	460
HTTP Static Page DL	Qualifier	[%]	99,8	99,9	99,8
	Overall Session Time	[s]	1,0	1,0	1,2
HTTP file DL 3MB	Qualifier	[%]	100,0	100,0	100,0
	AVG Session Time	[s]	0,8	0,9	1,7
	90% faster than	[kbit/s]	23878	19051	8330
	10% faster than	[kbit/s]	67797	66815	52450
HTTP file UL 1MB	Qualifier	[%]	99,7	100,0	99,7
	AVG Session Time	[s]	0,6	0,7	0,8
	90% faster than	[kbit/s]	11244	9451	8422
	10% faster than	[kbit/s]	25157	22599	27332
HTTP DL FDTT 7s	Qualifier	[%]	100,0	99,9	99,7
	AVG throughput	[kbit/s]	76154	65818	29342
	90% faster than	[kbit/s]	30184	19846	8095
	10% faster than	[kbit/s]	132782	120519	58153
HTTP UL FDTT 7s	Qualifier	[%]	99,6	100,0	100,0
	AVG throughput	[kbit/s]	29135	25063	30979
	90% faster than	[kbit/s]	13716	13450	12295
	10% faster than	[kbit/s]	38212	31597	44016
YouTube	Qualifier	[%]	100,0	100,0	99,5
	Start Time	[s]	1,9	2,0	2,6
	Playouts w/o interruptions	[%]	100,0	100,0	99,7
	AVG Resolution	[p]	1080,0	1078,2	1075,0

Data Towns	KPI Name	Unit	Telekom	Operator 2	Operator 3
HTTP Live Page DL	Qualifier	[%]	99,7	98,5	98,2
	Time to first Byte	[ms]	449	460	709
	KBytes first second	[KB]	551	502	445
HTTP Static Page DL	Qualifier	[%]	100,0	99,5	99,3
	Overall Session Time	[s]	1,0	1,0	1,7
HTTP file DL 3MB	Qualifier	[%]	99,7	99,3	99,3
	AVG Session Time	[s]	1,1	1,9	2,5
	90% faster than	[kbit/s]	13816	6232	4908
	10% faster than	[kbit/s]	62016	55376	49251
HTTP file UL 1MB	Qualifier	[%]	100,0	99,7	99,6
	AVG Session Time	[s]	0,7	0,7	1,6
	90% faster than	[kbit/s]	8816	8476	2021
	10% faster than	[kbit/s]	24465	21924	25277
HTTP DL FDTT 7s	Qualifier	[%]	100,0	99,3	100,0
	AVG throughput	[kbit/s]	55527	41768	27137
	90% faster than	[kbit/s]	12366	7354	5014
	10% faster than	[kbit/s]	122731	94763	57422
HTTP UL FDTT 7s	Qualifier	[%]	99,7	99,7	98,3
	AVG throughput	[kbit/s]	25162	22518	23769
	90% faster than	[kbit/s]	9566	10508	2720
	10% faster than	[kbit/s]	38066	30914	42750
YouTube	Qualifier	[%]	99,3	98,3	98,9
	Start Time	[s]	2,0	2,6	3,0
	Playouts w/o interruptions	[%]	100,0	99,7	97,8
	AVG Resolution	[p]	1077,3	1066,0	1054,5

Data Roads	KPI Name	Unit	Telekom	Operator 2	Operator 3
HTTP Live Page DL	Qualifier	[%]	99,1	98,7	96,4
	Time to first Byte	[ms]	459	458	877
	KBytes first second	[KB]	543	498	406
HTTP Static Page DL	Qualifier	[%]	99,5	99,4	95,8
	Overall Session Time	[s]	1,0	1,1	2,0
HTTP file DL 3MB	Qualifier	[%]	99,8	99,5	97,1
	AVG Session Time	[s]	1,6	2,1	3,7
	90% faster than	[kbit/s]	8419	4804	3203
	10% faster than	[kbit/s]	58196	57035	56220
HTTP file UL 1MB	Qualifier	[%]	99,5	99,8	98,7
	AVG Session Time	[s]	1,0	1,1	2,4
	90% faster than	[kbit/s]	5822	3609	1475
	10% faster than	[kbit/s]	23399	21704	26152
HTTP DL FDTT 7s	Qualifier	[%]	99,5	100,0	96,2
	AVG throughput	[kbit/s]	43494	36776	27699
	90% faster than	[kbit/s]	11133	7296	4206
	10% faster than	[kbit/s]	87563	76156	62009
HTTP UL FDTT 7s	Qualifier	[%]	99,1	99,8	97,4
	AVG throughput	[kbit/s]	22513	20336	18825
	90% faster than	[kbit/s]	6178	3668	1621
	10% faster than	[kbit/s]	34824	31546	43637
YouTube	Qualifier	[%]	97,8	99,0	95,8
	Start Time	[s]	2,0	2,5	3,3
	Playouts w/o interruptions	[%]	99,8	100,0	95,1
	AVG Resolution	[p]	1077,8	1067,2	1038,4