

# Audit Report

**P3 communications GmbH**

Has been tasked by

**Vodafone Czech Republic a. s.**

náměstí Junkových 2

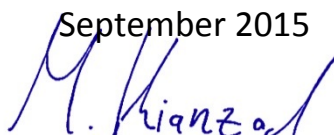
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to measure the performance of its voice and data services on smartphones in comparison to other GSM/UMTS/LTE mobile radio networks in the Czech Republic.

The logo consists of the letters 'P3' in a bold, sans-serif font. The 'P' is a solid grey color, while the '3' is a lighter grey color.

Maziar Kianzad  
*Head of Network Testing  
& Benchmarking*

September 2015

A handwritten signature in blue ink that reads 'M. Kianzad'.

## Measurement Setup

	Voice	Data
<b>Device</b>	Samsung Galaxy S5 LTE cat4 (SM-G900F) LTE / HSPA+ DC / HSUPA 5.76 Antenuatr book	4G Preferred CA Samsung Galaxy Note4 LTE cat6 (SM-N910F) LTE / HSPA+ DC / HSUPA 5.76 Antenuatr book
<b>Test Cases</b>	Mobile-to-Mobile Set1 4Gpref (MRAB) to 3G pref (MRAB) Set2 3Gpref to 4G pref  70 sec call duration 115 sec call window multiRAB 1:1 traffic injection	HTTP DL stress test 10s HTTP UL stress test 10s Web Browsing-ETSI Ref. Page, Live websites YouTube SD Video-30s clip YouTube HD Video-30s clip One car 4G pref. and one 3G pref.
<b>Mobility and Route Types</b>	100% Drivetest 80% in Cities and 20% on Transfer Major and Small cities and connecting roads	
<b>Samples</b>	M2M: ~ 2000 per Operator	Data 3G ~ 455 per Operator Data 4G ~ 480 per Operator Data 4G CA ~ 1100 per Operator
<b>Dates</b>	16 measurement days September 8th - September 26th, 2015	

## Testing Route



## 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) for the geographical categories “Big Cities” and “Connecting Roads”.

Voice M2M	Kpi Name	Unit	Vodafone	Operator 2	Operator 3
big cities	Qualified	[%]	98,5	97,6	94,6
	Call Setup Time	[s]	8,2	6,2	9,2
	AVG Speech Quality	[MOS-LQO]	3,0	3,5	3,0
small cities and connecting roads	Qualified	[%]	97,0	96,5	91,5
	Call Setup Time	[s]	8,1	7,1	9,4
	AVG Speech Quality	[MOS-LQO]	3,1	3,3	2,9

## 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 categories “Big Cities” and “Connecting Roads”.

Data big cities	Kpi Name	Unit	Vodafone	Operator 2	Operator 3
http Live Page download	Qualified	[%]	97,0	94,1	95,4
	AVG Session Time	[s]	2,9	3,1	3,5
http Static Page download	Qualified	[%]	98,1	97,1	95,3
	AVG Session Time	[s]	1,6	1,8	2,1
http file download 3MB	Qualified	[%]	98,4	97,8	96,7
	AVG Session Time	[s]	2,5	3,5	3,3
	90% faster than	[kbit/s]	5346	3904	3860
	10% faster than	[kbit/s]	36641	29703	28054
http file upload 1MB	Qualified	[%]	98,7	95,6	93,5
	AVG Session Time	[s]	1,7	2,8	2,5
	90% faster than	[kbit/s]	3048	1206	1518
	10% faster than	[kbit/s]	9143	9081	7992
http download FDTT 10s	Qualified	[%]	99,1	98,2	98,0
	AVG throughput	[kbit/s]	26620	19701	17334
	90% faster than	[kbit/s]	5780	4244	3529
	10% faster than	[kbit/s]	53242	41797	36349
http upload FDTT 10s	Qualified	[%]	98,5	96,8	97,7
	AVG throughput	[kbit/s]	16461	12080	11302
	90% faster than	[kbit/s]	2904	1005	1428
	10% faster than	[kbit/s]	26859	24103	19682
Youtube SD	Qualified	[%]	98,7	97,5	98,0
	Start Time	[s]	1,4	1,5	1,8
	Playouts w/o interruptions	[%]	100,0	100,0	99,5
Youtube HD	Qualified	[%]	97,6	96,4	93,2
	Start Time	[s]	1,8	1,9	2,3
	Playouts w/o interruptions	[%]	97,4	96,8	96,7

Data small cities	Kpi Name	Unit	Vodafone	Operator 2	Operator 3
http Live Page download	Qualified	[%]	95,1	88,5	92,2
	AVG Session Time	[s]	3,0	3,3	3,7
http Static Page download	Qualified	[%]	95,8	93,0	94,7
	AVG Session Time	[s]	1,8	2,2	2,4
http file download 3MB	Qualified	[%]	96,6	93,1	96,8
	AVG Session Time	[s]	3,3	5,2	5,0
	90% faster than	[kbit/s]	3520	2715	1971
	10% faster than	[kbit/s]	28202	23369	22770
http file upload 1MB	Qualified	[%]	96,2	89,9	87,8
	AVG Session Time	[s]	1,8	4,1	3,2
	90% faster than	[kbit/s]	2711	892	1169
	10% faster than	[kbit/s]	8312	8753	6987
http download FDTT 10s	Qualified	[%]	98,3	93,7	97,8
	AVG throughput	[kbit/s]	15872	13069	14283
	90% faster than	[kbit/s]	3902	2811	2259
	10% faster than	[kbit/s]	29981	27312	33989
http upload FDTT 10s	Qualified	[%]	97,5	91,4	96,0
	AVG throughput	[kbit/s]	12226	7872	8360
	90% faster than	[kbit/s]	2738	621	573
	10% faster than	[kbit/s]	19306	18719	17606
Youtube SD	Qualified	[%]	96,7	91,8	95,9
	Start Time	[s]	1,5	1,7	2,2
	Playouts w/o interruptions	[%]	100,0	99,5	100,0
Youtube HD	Qualified	[%]	95,0	89,1	87,7
	Start Time	[s]	1,9	2,2	2,5
	Playouts w/o interruptions	[%]	96,1	93,9	94,3

Data connecting roads	Kpi Name	Unit	Vodafone	Operator 2	Operator 3
http Live Page download	Qualified	[%]	91,9	87,0	91,5
	AVG Session Time	[s]	3,1	3,1	3,5
http Static Page download	Qualified	[%]	96,0	92,3	92,0
	AVG Session Time	[s]	1,7	1,9	2,1
http file download 3MB	Qualified	[%]	94,8	93,3	95,6
	AVG Session Time	[s]	3,8	5,2	3,8
	90% faster than	[kbit/s]	3128	2254	3664
	10% faster than	[kbit/s]	29520	28846	25237
http file upload 1MB	Qualified	[%]	95,3	88,4	92,1
	AVG Session Time	[s]	2,2	3,0	2,7
	90% faster than	[kbit/s]	2212	918	1441
	10% faster than	[kbit/s]	7663	8869	7181
http download FDTT 10s	Qualified	[%]	95,0	94,4	95,5
	AVG throughput	[kbit/s]	16398	16891	16519
	90% faster than	[kbit/s]	3285	2832	3930
	10% faster than	[kbit/s]	33960	36678	34053
http upload FDTT 10s	Qualified	[%]	95,4	92,7	95,2
	AVG throughput	[kbit/s]	9670	8404	9289
	90% faster than	[kbit/s]	1532	607	856
	10% faster than	[kbit/s]	19904	18996	17987
Youtube SD	Qualified	[%]	94,6	92,4	91,2
	Start Time	[s]	1,7	1,6	2,0
	Playouts w/o interruptions	[%]	99,1	99,0	99,5
Youtube HD	Qualified	[%]	88,6	86,3	91,3
	Start Time	[s]	2,1	2,2	2,3
	Playouts w/o interruptions	[%]	91,0	99,0	94,3

## Voice KPI Description

Voice M2M	Kpi Name	Unit	Description
	Qualified	[%]	Share of qualified calls out of the overall number of attempts.  A call is qualified if - call setup successful within 15s AND - call not dropped AND - no "mute call" <sup>1</sup>
	Call Setup Time	[s]	Average of Call Setup Times from all qualified calls
	AVG Speech Quality	[MOS-LQO]	Average of Speech Quality per speech sample from all qualified calls

<sup>1</sup> definition of "mute call" : (2 or more consecutive MOS less than 1.6) OR (3 or more MOS less than 1.6) in a 70s call

## Data KPI Description

Data	Kpi Name	Unit	Description
http Live Page download	Qualified	[%]	Share of qualified sessions out of the overall number of attempts.  A session is qualified if page successfully loaded within 10s of the user initiating the session
	AVG Session Time	[s]	Average of the duration of all qualified sessions
http Static Page download	Qualified	[%]	Share of qualified sessions out of the overall number of attempts.  A session is qualified if page successfully loaded within 10s of the user initiating the session
	AVG Session Time	[s]	Average of the duration of all qualified sessions

<b>http file download 3MB</b>	Qualified	[%]	Share of qualified sessions out of the overall number of attempts. A session is qualified if average data rate of file DL exceeds 384kbit/s
	AVG Session Time	[s]	Average of the duration of all qualified sessions
	90% faster than	[kbit/s]	10th percentile of the data rate of all qualified sessions
	10% faster than	[kbit/s]	90th percentile of the data rate of all qualified sessions
<b>http file upload 1MB</b>	Qualified	[%]	Share of qualified sessions out of the overall number of attempts. A session is qualified if average data rate of file UL exceeds 384kbit/s
	AVG Session Time	[s]	Average of the duration of all qualified sessions
	90% faster than	[kbit/s]	10th percentile of the data rate of all qualified sessions
	10% faster than	[kbit/s]	90th percentile of the data rate of all qualified sessions
<b>http download FDDT 10s</b>	Qualified	[%]	Share of qualified sessions out of the overall number of attempts. A session is qualified if average data rate of session exceeds 128kbit/s
	AVG throughput	[kbit/s]	Average of the data rate of all qualified sessions
	90% faster than	[kbit/s]	10th percentile of the data rate of all qualified sessions
	10% faster than	[kbit/s]	90th percentile of the data rate of all qualified sessions
<b>http upload FDDT 10s</b>	Qualified	[%]	Share of qualified sessions out of the overall number of attempts. A session is qualified if average data rate of session exceeds 64kbit/s
	AVG throughput	[kbit/s]	Average of the data rate of all qualified sessions
	90% faster than	[kbit/s]	10th percentile of the data rate of all qualified sessions
	10% faster than	[kbit/s]	90th percentile of the data rate of all qualified sessions



<b>Youtube SD</b>	Qualified	[%]	<p>Share of qualified sessions out of the overall number of attempts.</p> <p>A session is qualified, if</p> <ul style="list-style-type: none"> <li>- video is started within 33s AND</li> <li>- no single interruption &gt;8s occurs AND</li> <li>- the sum of all interruptions does not exceed 15s AND</li> <li>- no more than 10 individual interruptions occur</li> </ul>
	Start Time	[s]	Average taken from all qualified sessions of the time it takes from the user requesting the catalog page, spanning the selection, requesting and buffering of the video until the video starts playing
	Playouts w/o interruptions	[%]	Share of qualified sessions which played without any interruptions
<b>Youtube HD</b>	Qualified	[%]	<p>Share of qualified sessions out of the overall number of attempts.</p> <p>A session is qualified, if</p> <ul style="list-style-type: none"> <li>- video is started within 33s AND</li> <li>- no single interruption &gt;8s occurs AND</li> <li>- the sum of all interruptions does not exceed 15s AND</li> <li>- no more than 10 individual interruptions occur</li> </ul>
	Start Time	[s]	Average taken from all qualified sessions of the time it takes from the user requesting the catalog page, spanning the selection, requesting and buffering of the video until the video starts playing
	Playouts w/o interruptions	[%]	Share of qualified sessions which played without any interruptions