

# CERTIFICATE

**P3 communications GmbH**

hereby certifies that



**Crnogorski Telekom**

Moskovska 29, Podgorica, Montenegro

achieved „**Best in Test**“ with a  
Total Score of **746 of 1000**

in the **Mobile Benchmark Montenegro 06/2015**.

(Score 294 of 400 in Telephony, Score 452 of 600 in Data Services)

**P3** | communications



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## Measurement Setup

|                                 | Voice   | Data   |
|---------------------------------|---|--|
| <b>Device</b>                   | Samsung Galaxy S5 Cat6 (SM-G900F)<br>LTE / HSPA+ DC / HSUPA 5.76<br>P3 attenuation solution                                       | Samsung Galaxy S5 Cat6 (SM-G901F)<br>LTE / HSPA+ DC / HSUPA 5.76<br>P3 attenuation solution  |
| <b>Test Cases</b>               | Mobile-to-Mobile<br>4Gpref (MRAB) to 3G pref (MRAB)<br>90 sec call duration 140 sec call window<br>multiRAB 1:1 traffic injection | HTTP DL stress test 10s<br>HTTP DL user experience 3MB<br>HTTP UL stress test 10s<br>HTTP UL user experience 1MB<br>Web Browsing-ETSI Ref. Page, 3 live websites<br>YouTube SD Video-30s clip<br>YouTube HD Video-30s clip |
| <b>Mobility and Route Types</b> | 100% Drivetest<br>47% in Big cities and 53% in small cities and on transfer   |  |
| <b>Samples</b>                  | 4Gpref to 3Gpref: ~3100 per Operator  | 4Gpref ~ 950 per Operator and Service  |
| <b>Dates</b>                    | <b>8 days of measurement: May 26th - June 4th</b>   |  |

## Testing Route



## Score Points and Breakdown

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

| Module       | Infrastructure                    | Max.         | Telekom    | Operator 2 | Operator 3 |
|--------------|-----------------------------------|--------------|------------|------------|------------|
| <b>Voice</b> | <b>Total</b>                      | <b>400</b>   | <b>294</b> | <b>295</b> | <b>324</b> |
|              | big cities                        | 260          | 73,1%      | 74,4%      | 84,6%      |
|              | small cities and connecting roads | 140          | 75,0%      | 70,7%      | 74,3%      |
| <b>Data</b>  | <b>Total</b>                      | <b>600</b>   | <b>452</b> | <b>357</b> | <b>350</b> |
|              | big cities                        | 390          | 82,8%      | 65,6%      | 68,2%      |
|              | small cities                      | 90           | 81,1%      | 73,3%      | 56,7%      |
|              | connecting roads                  | 120          | 46,7%      | 30,0%      | 27,5%      |
| <b>TOTAL</b> |                                   | <b>1.000</b> | <b>746</b> | <b>652</b> | <b>674</b> |

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>big cities</b>       | Web Browsing  | 136,5 | 90,1%   | 69,7%      | 73,0%      |
|                         | File Download | 78,0  | 80,5%   | 66,8%      | 73,0%      |
|                         | File Upload   | 78,0  | 73,4%   | 60,1%      | 40,9%      |
|                         | YouTube       | 97,5  | 81,7%   | 63,0%      | 79,2%      |
| <b>small cities</b>     | Web Browsing  | 31,5  | 91,2%   | 79,6%      | 60,1%      |
|                         | File Download | 18,0  | 81,1%   | 73,9%      | 57,6%      |
|                         | File Upload   | 18,0  | 72,1%   | 59,5%      | 35,7%      |
|                         | YouTube       | 22,5  | 76,1%   | 73,2%      | 69,8%      |
| <b>connecting roads</b> | Web Browsing  | 42,0  | 55,6%   | 33,5%      | 35,5%      |
|                         | File Download | 24,0  | 48,5%   | 25,9%      | 26,3%      |
|                         | File Upload   | 24,0  | 38,6%   | 26,0%      | 11,1%      |
|                         | YouTube       | 30,0  | 37,8%   | 30,5%      | 31,0%      |

## 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      | Telekom | Operator 2 | Operator 3 |
|--|--------------------|-----------|---------|------------|------------|
| <b>big cities</b>                        | Qualified          | [%]       | 95,8%   | 96,5%      | 97,9%      |
|  | Call Setup Time    | [s]       | 5,7     | 6,1        | 5,3        |
|  | AVG Speech Quality | [MOS-LQO] | 3,3     | 3,3        | 3,4        |
|  |                    |           |         |            |            |
| <b>small cities and connecting roads</b> | Qualified          | [%]       | 92,8%   | 91,8%      | 92,8%      |
|  | Call Setup Time    | [s]       | 5,5     | 6,2        | 5,7        |
|  | AVG Speech Quality | [MOS-LQO] | 3,2     | 3,2        | 3,2        |

## 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     | Telekom | Operator 2 | Operator 3 |
|----------------------------|----------------------------|----------|---------|------------|------------|
| <b>http Live Page DL</b>   | Qualified                  | [%]      | 98,2%   | 94,1%      | 95,4%      |
|                            | AVG Session Time           | [s]      | 2,2     | 3,4        | 2,9        |
|                            |                            |          |         |            |            |
| <b>http Static Page DL</b> | Qualified                  | [%]      | 98,1%   | 97,3%      | 93,7%      |
|                            | AVG Session Time           | [s]      | 1,8     | 2,8        | 2,6        |
|                            |                            |          |         |            |            |
| <b>http file DL 3MB</b>    | Qualified                  | [%]      | 98,5%   | 97,5%      | 98,0%      |
|                            | AVG Session Time           | [s]      | 2,4     | 6,3        | 3,0        |
|                            | 90% faster than            | [kbit/s] | 7166    | 3077       | 4538       |
|                            | 10% faster than            | [kbit/s] | 31957   | 10989      | 24742      |
|                            |                            |          |         |            |            |
| <b>http file UL 1MB</b>    | Qualified                  | [%]      | 97,3%   | 97,2%      | 90,8%      |
|                            | AVG Session Time           | [s]      | 2,8     | 7,4        | 4,6        |
|                            | 90% faster than            | [kbit/s] | 1215    | 794        | 769        |
|                            | 10% faster than            | [kbit/s] | 6885    | 2306       | 5634       |
|                            |                            |          |         |            |            |
| <b>http DL FDTT 10s</b>    | Qualified                  | [%]      | 98,7%   | 99,3%      | 98,5%      |
|                            | AVG throughput             | [kbit/s] | 37809   | 8583       | 19745      |
|                            | 90% faster than            | [kbit/s] | 5796    | 3596       | 5336       |
|                            | 10% faster than            | [kbit/s] | 70880   | 13403      | 37628      |
|                            |                            |          |         |            |            |
| <b>http UL FDTT 10s</b>    | Qualified                  | [%]      | 99,2%   | 98,6%      | 93,8%      |
|                            | AVG throughput             | [kbit/s] | 15944   | 1651       | 5302       |
|                            | 90% faster than            | [kbit/s] | 1113    | 706        | 577        |
|                            | 10% faster than            | [kbit/s] | 33908   | 2775       | 13505      |
|                            |                            |          |         |            |            |
| <b>Youtube SD</b>          | Qualified                  | [%]      | 98,1%   | 90,7%      | 98,2%      |
|                            | Start Time                 | [s]      | 1,4     | 2,6        | 1,9        |
|                            | Playouts w/o interruptions | [%]      | 100,0%  | 100,0%     | 99,6%      |
|                            |                            |          |         |            |            |
| <b>Youtube HD</b>          | Qualified                  | [%]      | 96,2%   | 96,5%      | 96,0%      |
|                            | Start Time                 | [s]      | 2,0     | 2,7        | 2,1        |
|                            | Playouts w/o interruptions | [%]      | 98,9%   | 96,3%      | 98,4%      |
|                            |                            |          |         |            |            |

| Data small cities          | Kpi Name                   | Unit     | Telekom | Operator 2 | Operator 3 |
|----------------------------|----------------------------|----------|---------|------------|------------|
| <b>http Live Page DL</b>   | Qualified                  | [%]      | 98,6%   | 96,3%      | 91,8%      |
|                            | AVG Session Time           | [s]      | 2,3     | 3,0        | 3,2        |
| <b>http Static Page DL</b> | Qualified                  | [%]      | 98,7%   | 98,0%      | 93,0%      |
|                            | AVG Session Time           | [s]      | 2,0     | 2,4        | 2,6        |
| <b>http file DL 3MB</b>    | Qualified                  | [%]      | 99,0%   | 99,3%      | 94,1%      |
|                            | AVG Session Time           | [s]      | 2,8     | 5,3        | 3,8        |
|                            | 90% faster than            | [kbit/s] | 6222    | 4744       | 3439       |
|                            | 10% faster than            | [kbit/s] | 32832   | 12862      | 25157      |
| <b>http file UL 1MB</b>    | Qualified                  | [%]      | 97,1%   | 95,6%      | 88,5%      |
|                            | AVG Session Time           | [s]      | 3,3     | 6,2        | 6,2        |
|                            | 90% faster than            | [kbit/s] | 1113    | 845        | 654        |
|                            | 10% faster than            | [kbit/s] | 6897    | 2362       | 5284       |
| <b>http DL FDTT 10s</b>    | Qualified                  | [%]      | 98,7%   | 99,3%      | 96,1%      |
|                            | AVG throughput             | [kbit/s] | 36731   | 11394      | 14495      |
|                            | 90% faster than            | [kbit/s] | 5809    | 6117       | 3679       |
|                            | 10% faster than            | [kbit/s] | 77488   | 17721      | 28996      |
| <b>http UL FDTT 10s</b>    | Qualified                  | [%]      | 98,7%   | 99,3%      | 95,1%      |
|                            | AVG throughput             | [kbit/s] | 15521   | 2102       | 3381       |
|                            | 90% faster than            | [kbit/s] | 1091    | 862        | 520        |
|                            | 10% faster than            | [kbit/s] | 37929   | 2830       | 13259      |
| <b>Youtube SD</b>          | Qualified                  | [%]      | 98,7%   | 92,9%      | 95,8%      |
|                            | Start Time                 | [s]      | 1,5     | 2,3        | 2,1        |
|                            | Playouts w/o interruptions | [%]      | 100,0%  | 99,3%      | 99,6%      |
| <b>Youtube HD</b>          | Qualified                  | [%]      | 93,3%   | 96,9%      | 93,3%      |
|                            | Start Time                 | [s]      | 1,8     | 2,2        | 2,5        |
|                            | Playouts w/o interruptions | [%]      | 99,0%   | 99,3%      | 99,6%      |

| Data connecting routes     | Kpi Name                   | Unit     | Telekom | Operator 2 | Operator 3 |
|----------------------------|----------------------------|----------|---------|------------|------------|
| <b>http Live Page DL</b>   | Qualified                  | [%]      | 82,4%   | 71,6%      | 77,4%      |
|                            | AVG Session Time           | [s]      | 2,8     | 3,2        | 3,6        |
|                            |                            |          |         |            |            |
| <b>http Static Page DL</b> | Qualified                  | [%]      | 87,1%   | 71,1%      | 76,0%      |
|                            | AVG Session Time           | [s]      | 2,6     | 2,6        | 3,1        |
|                            |                            |          |         |            |            |
| <b>http file DL 3MB</b>    | Qualified                  | [%]      | 82,2%   | 71,1%      | 74,2%      |
|                            | AVG Session Time           | [s]      | 7,4     | 6,1        | 6,0        |
|                            | 90% faster than            | [kbit/s] | 1728    | 3280       | 2492       |
|                            | 10% faster than            | [kbit/s] | 30496   | 12018      | 16937      |
|                            |                            |          |         |            |            |
| <b>http file UL 1MB</b>    | Qualified                  | [%]      | 79,8%   | 68,7%      | 61,9%      |
|                            | AVG Session Time           | [s]      | 5,2     | 7,2        | 7,3        |
|                            | 90% faster than            | [kbit/s] | 895     | 669        | 557        |
|                            | 10% faster than            | [kbit/s] | 6372    | 2375       | 4676       |
|                            |                            |          |         |            |            |
| <b>http DL FDTT 10s</b>    | Qualified                  | [%]      | 87,7%   | 83,5%      | 80,3%      |
|                            | AVG throughput             | [kbit/s] | 19867   | 7889       | 10325      |
|                            | 90% faster than            | [kbit/s] | 1596    | 198        | 1264       |
|                            | 10% faster than            | [kbit/s] | 64151   | 15645      | 25964      |
|                            |                            |          |         |            |            |
| <b>http UL FDTT 10s</b>    | Qualified                  | [%]      | 85,1%   | 88,3%      | 74,7%      |
|                            | AVG throughput             | [kbit/s] | 6926    | 1573       | 1905       |
|                            | 90% faster than            | [kbit/s] | 397     | 97         | 264        |
|                            | 10% faster than            | [kbit/s] | 26244   | 2816       | 4055       |
|                            |                            |          |         |            |            |
| <b>Youtube SD</b>          | Qualified                  | [%]      | 82,5%   | 68,4%      | 76,1%      |
|                            | Start Time                 | [s]      | 1,9     | 2,8        | 2,4        |
|                            | Playouts w/o interruptions | [%]      | 98,3%   | 99,2%      | 100%       |
|                            |                            |          |         |            |            |
| <b>Youtube HD</b>          | Qualified                  | [%]      | 73,3%   | 74,1%      | 68,8%      |
|                            | Start Time                 | [s]      | 2,6     | 2,4        | 3,1        |
|                            | Playouts w/o interruptions | [%]      | 95,5%   | 95,6%      | 95,5%      |