# Approaches being taken in OECD countries to measure broadband performance

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# Main points

- This presentation examines the approaches to network speed tests in OECD countries. In June 2014, the OECD published a report focusing on access network speed tests

# Testing methodologies (1)

- The OECD *Communications Outlook 2013* (OECD, 2013) It compared three kinds of speed indicators developed by
  - Akamai,
  - Measurement Lab (M-Lab)
  - Ookla
- It was also found that for the two sources that relied on voluntary speed tests by users (M-Lab and Ookla), there were large differences

# Testing methodologies (2)

- Accordingly, the OECD organised two workshops on broadband metrics, held in Washington in 2011 and in London in 2012 respectively, which considered measurement of advertised and actual performance

# Testing methodologies (3)

As a result of the discussions in the workshops and the WP-CISP, two approaches for methodologies were agreed:

- Adopt the best currently available datasets
- Work towards the longer-term goal of achieving a dataset based on common methodologies of measuring actual broadband speeds

# Testing methodologies (4)

In Denmark, Greece and Sweden, EAM is implemented by the **adoption** of the measurement platforms of Ookla or M-Lab.

In Austria the Internet speed is measured by its original M-Lab platform.

In the United States, the project also requested that the measured ISPs put “on-net” servers in operation for reference.

# How is performance measured? – Technical issues (1)

Apart from the “user side” factors some technical configuration can affect measured performance.

- One of the examples is a client’s configuration of Transmission Control Protocol (TCP), which is used for HTTP sessions to download data from the Internet. **Among the parameters related to such configurations, the size of a Receive Window (RWIN) determines how much data a server can send to a client without waiting for a confirming message** from the client computer that indicates it properly received these data.

# How is performance measured? – Technical issues (2)

- Theoretically, the maximum speed with which data is transferred by TCP is decided by the following formula:

*Maximum Speed (bit/s) = RWIN (bit) / Round Trip Time (seconds)*

- The Round Trip Time (RTT) or latency means how long it takes for data to go to the server and return to the client. The issue is that some previous versions of desktop operating systems have small size of RWIN as their default settings (e.g. maximum of 64 KB in Windows XP)

# How is performance measured? – Technical issues (3)

In addition to the RWIN function, TCP has a complicated mechanism to adjust a data transfer rate so that reliability and speed are well balanced. At the beginning of a connection the speed starts at a low level, followed by an increase to a higher level and then slows down again if it is too fast for the receiving side or some error occurs.

In order to increase reliability in terms of these issues a period of 30 seconds was chosen by a measuring firm SamKnows, using the M-Lab platform, for projects it undertook in the United Kingdom, the United States and the European Union.

# Jitter measurements

Jitter means how stable latency is and packet loss means how much data is lost or broken in the course of a transmission.

There is some variation on latency measurement such as whether ICMP or UDP is used and how many times a packet is sent and this can differ across projects.

# Measurement approaches

- End-user Application Measurement (EAM)
- End-user Device Measurement (EDM)
- Project Self Measurement (PSM)

# Measurement approaches

- End-user Application Measurement (EAM): Daily use of an end-user's computer or mobile phone is employed for measurement with an application or browser under the user’s control.

# Measurement approaches

- End-user Device Measurement (EDM): Tests are done by specific devices which are installed by end users for measurement

# Measurement approaches

Project Self Measurement (PSM): The measurements are done by the ISPs themselves with controlled methodology

# List of current official measurement projects in OECD area, basics

U/C/P: Under consideration or planned

| Country or organization | Client type | Mobile (1) | Purposes (2) | Measured metrics (3) | Geographical and topological location of servers | Number of clients | TCP Peak Capacity (4) |
|---|---|---|---|---|---|---|---|
| Austria | EAM | Yes | Consumer protection,<br>Competition enhancement,<br>Network development (information on network quality),<br>Net neutrality (planned) | DATA,LT,JT,PL (DNSR and WEB are planned) | Immediate proximity to the Vienna Internet exchange (VIX) | Approx. 27 000 clients, 300 000 tests, (current value, on-going measurements) | Yes |
| Czech | PSM-ISP | U/C/P (mobile only) | Consumer protection<br>Network development(5) | Signal level calculation and measurement (Reference signal received power, Signal-to-interference-plus-noise ratio)<br>DATA is planned. | Czech territory | Czech territory, defined network of 100 × 100 m squares | |
| Chile | PSM-ISP | Yes | Quality of services indicators | DATA, DNSR and Aggregation rate. (parameters informed by operators, not necessarily verified by SUBTEL) | Depending on ISP<br>(Example: domestic on-net and off-net servers as well as an US server, statistics reported for each) | Depending on ISP | |
| Denmark | EAM | U/C/P | Consumer protection | DATA, LT | The Danish Internet Exchange (DIX'en) in Lyngby | 125 000 tests done in September 2013, Approx. 4000 test each day. | Yes (Ookla) |

# List of current official measurement projects in OECD area, basics

ACCESS NETWORK SPEED TESTS

| Country or organization | Client type | Mobile (1) | Purposes (2) | Measured metrics (3) | Geographical and topological location of servers | Number of clients | TCP Peak Capacity (4) |
|---|---|---|---|---|---|---|---|
| France | PSM | Yes | Verification of license obligations, consumer protection, competition enhancement, network development | Voice quality, SMS, MMS, data rates (DL and UL), web surfing, video service quality | off-net (dedicated to the study) for data rate measurement | Measures in 2000 different locations (for a total of about 20.000 tests for each operator) | |
| Germany | EAM and PSM | Yes for PSM | Consumer protection<br>Net neutrality | Platform measurement: DATA, DNSR, WEB, LT, HTTP response time<br>End user measurement: DATA | Off net with a direct connection to domestic points of interchange between the networks of different operators | Approx. 550 thousands end-users and 26 points of platform measurement | Yes |
| Greece | EAM | No | Consumer protection Competition enhancement, Net neutrality | DATA, LT, JT, PL, ISP's restriction on certain services such as P2P and video streaming | Nearest available M-Lab server | Approx. 10000 users | |
| Italy | PSM and EAM (fixed), PSM (mobile) | Yes | Consumer protection.<br>The results can be used as evidence in cases where promised speed is not realized and thus the user wishes to exercise the right of withdrawal of contract (only applied to fixed services) | DATA, LT, PL, error rate. Only for mobile: WEB, web failure rate, JT | Domestic points of interchange between the networks of different operators (Rome and Milan) | Fixed: 21 points for PSM, 25 535 end user software downloads for EAM<br>Mobile: 1013 points in 20 cities | |

# List of current official measurement projects in OECD area, basics

ACCESS NETWORK SPEED TESTS

| Country or organization | Client type | Mobile (1) | Purposes (2) | Measured metrics (3) | Geographical and topological location of servers | Number of clients | TCP Peak Capacity (4) |
|---|---|---|---|---|---|---|---|
| Korea | EAM for fixed, PSM for mobile | Yes | Consumer protection<br>Network development | Fixed : DATA, WEB<br>Mobile: WEB, Rates of "successful" download and upload that were faster than certain speed, web loading time, (calling quality) | ISP on-net server | 200 points for mobile PSM, 2000 users from each ISP for fixed EAM | |
| Mexico | EAM | Yes | N/A | DATA, LT | Mexico city | (Approx. 1 million tests per month) | |
| New Zealand | EDM | No | Consumer protection<br>Competition enhancement | DATA, WEB (onshore and offshore), LT, JT, PL, DNSR | Auckland and Wellington in the country, Sydney in Australia, Dallas in the US | N/A | |
| Norway | EAM | Yes | Consumer protection | DATA, LT | Norwegian Internet exchange | (Approx. 8000 tests done in September 2013, if the tests for ISPs with more than 40 tests are counted) | Yes (Ookla) |
| Portugal | EAM | No | Consumer protection<br>Market supervision<br>Net neutrality | DATA, LT, traffic shaping | | | |
| Spain | PSM-ISP | Yes | Consumer protection | DATA, successful log-in ratio (probability of successful connections to the ISP for Internet browsing), unsuccessful data transmission ratio (probability of file transmissions without error) | Accordance with Section 5.2 of ETSI 2005 (ideally the server should be as near as possible to the gateway of the measured ISP to the access network but final choice has to be made by that ISP) | More than 210 clients (probes) deployed for each measured service. 5.6 million tests per year performed in total. | |

# List of current official measurement projects in OECD area, basics

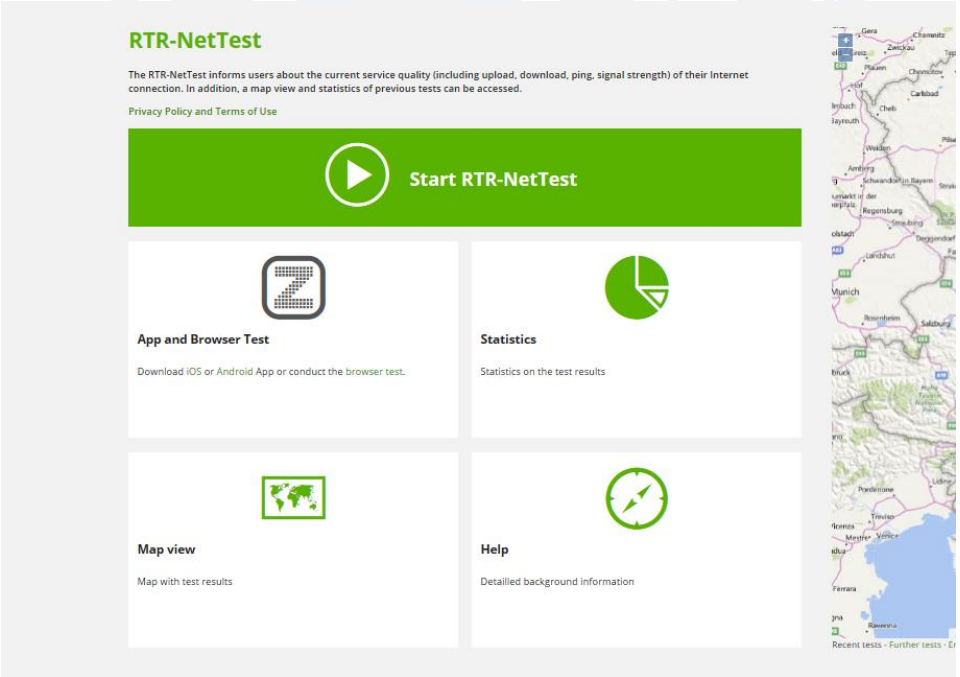
ACCESS NETWORK SPEED TESTS

| Country or organization | Client type | Mobile (1) | Purposes (2) | Measured metrics (3) | Geographical and topological location of servers | Number of clients | TCP Peak Capacity (4) |
|---|---|---|---|---|---|---|---|
| Slovenia | EAM | No | Consumer protection Competition enhancement, Net neutrality | DATA, LT | Server is located in Ljubljana at the web hosting provider with a 1 Gbit/s connectivity to the internet. | Measurement is at the early stage. Currently 220 tests. | |
| Sweden | EAM | Yes | Consumer protection, self-help, ISP-statistics, reports | DATA, LT | 5 locations close to urban centers of Sweden. Stockholm, Malmö, Gothenburg, Sundsvall, Luleå | 100000 users/day, 100 million since launch 2007. | Yes (Ookla) |
| Turkey | PSM-ISP | No | Consumer protection and Competition enhancement | DATA | The cities are categorized into five groups according to internet traffic from high to low. ISPs pick two cities from each category. | Under development | |
| United Kingdom | EDM | No | Consumer protection | DATA, WEB, LT, PL, JT, DNSR | 5 servers located in London and its outskirts | Approx. 2000 devices | Yes |
| United States | Fixed EDM, Mobile EAM | Yes | Consumer protection | DATA, WEB, LT(UDP and ICMP), PL(UDP and ICMP), video streaming, VoIP, DNS R, DNS failures, latency under load, availability of connection, data consumption | Core measurement points: 9 geographically diverse off-net servers placed by M-Lab<br>Secondary points: 121 on-net servers placed by ISPs<br>(Results are based on off-net points only. On-net points are to check differences) | Fixed: Approx. 7000 devices<br>Mobile: (Just started) | Yes |
| European Commission | EDM | No | Network development (Digital Agenda for Europe) | DATA, WEB, LT, PL, DNSR, VoIP | 24 M-Lab test nodes and 11 SamKnows servers in 14 cities across Europe. All are off-net points and located at major peering points or IXPs | Approx. 9000 devices | Yes |

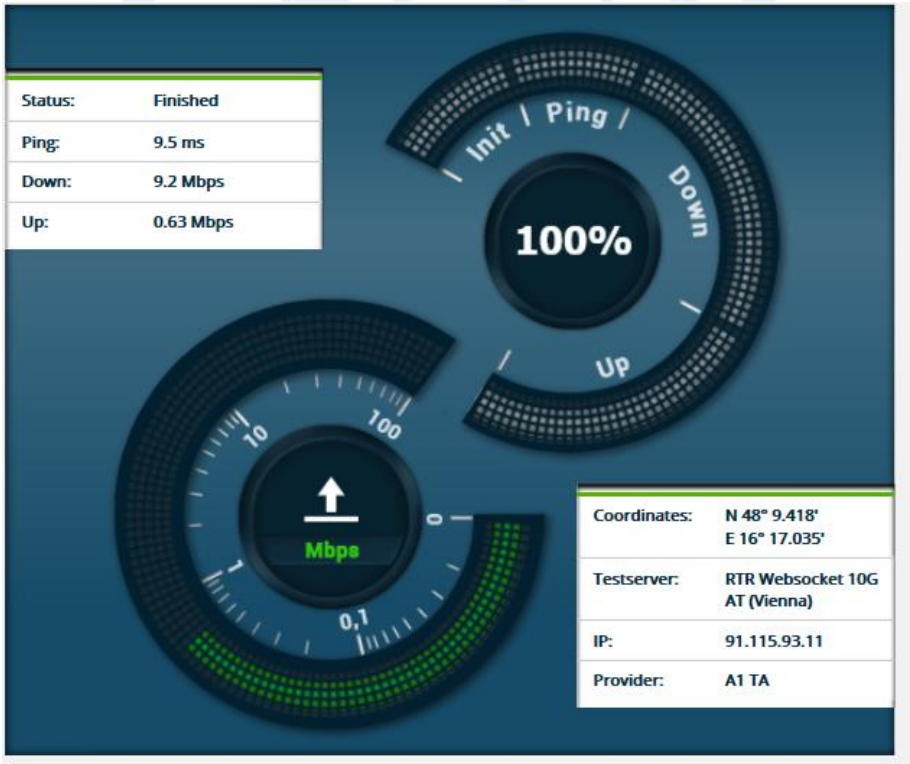
# The M-Lab Implementation in Austria

# RTR Implementation with Web-Browser

- https://www.netztest.at/en/



# RTR Implementation
# Testing procedure



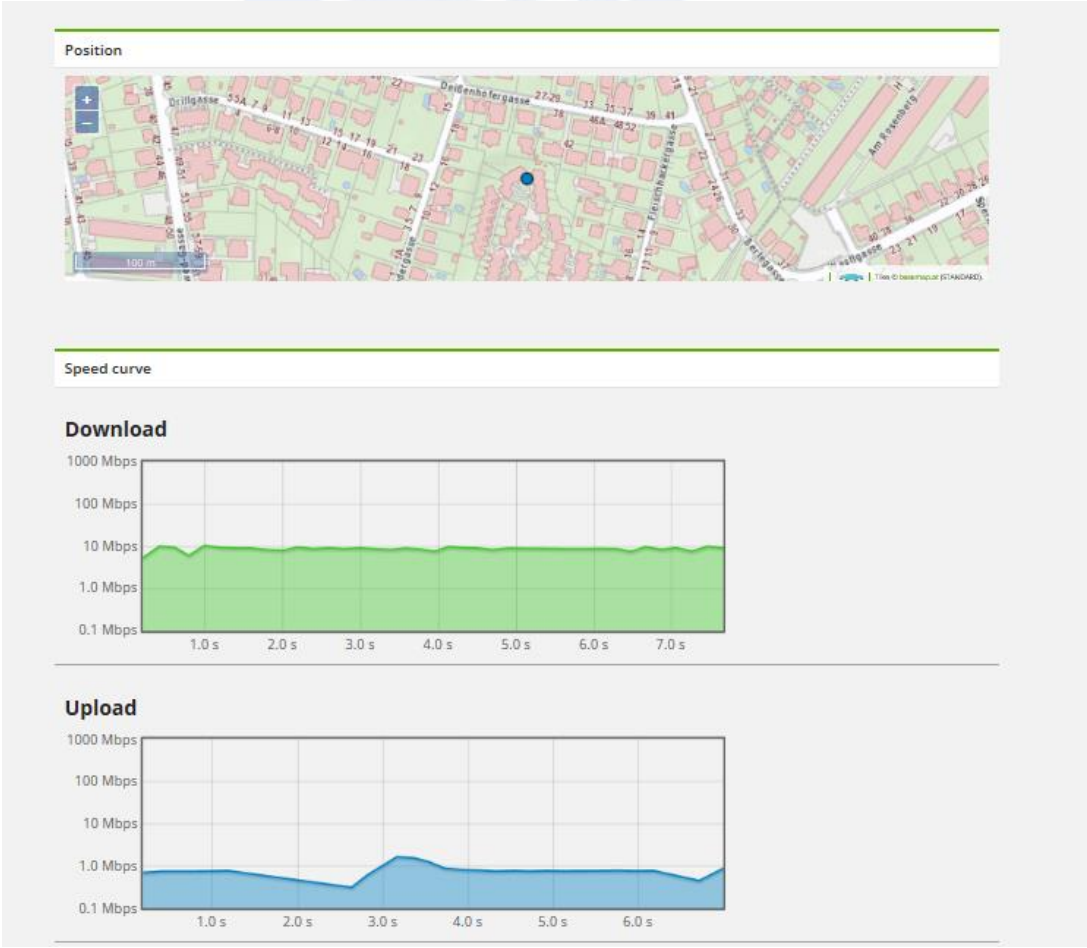
# RTR Implementation Test Results

## History

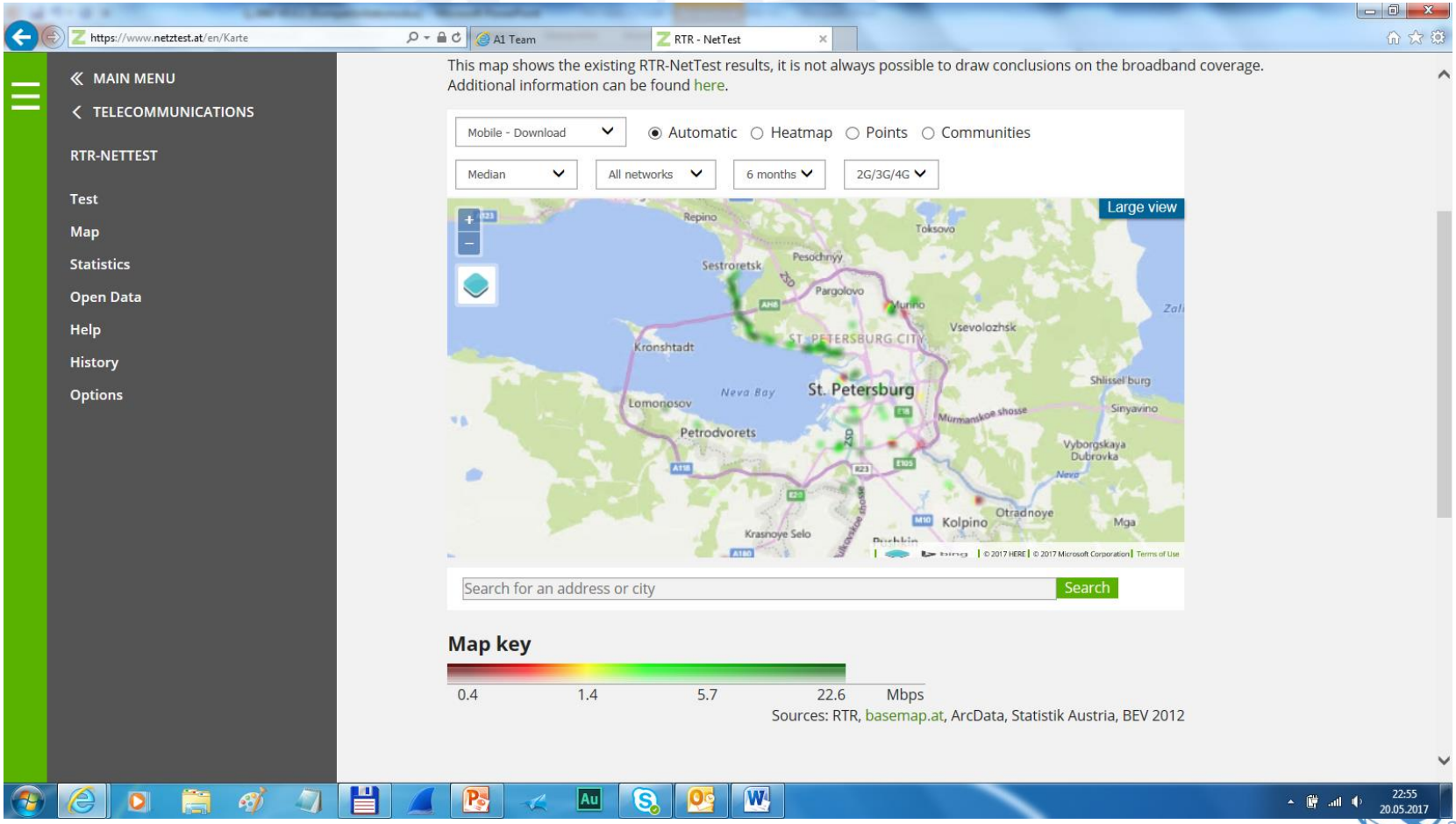
| Measurement result from May 20, 2017 11:12:58 PM ? | |
|---|---|
| Download | 8.8 Mbps |
| Upload | 0.7 Mbps |
| Ping | 9.5 ms |

| Detailed results | |
|---|---|
| Test time | May 20, 2017 11:12:58 PM |
| Timezone | UTC+2h |
| Download speed | 8.8 Mbps |
| Upload speed | 0.7 Mbps |
| Ping | 9.5 ms |
| Network type | BROWSER |
| Location | N 48°9.418' E 16°17.035' (BROWSER, +/- 67 m) |
| Country of location | AT |
| Country of AS | AT |
| Country of IP | AT |
| ZIP code | 1230 |
| Community | Wien |
| District | Wien Liesing |

# RTR Implementation Test Results Diagramm

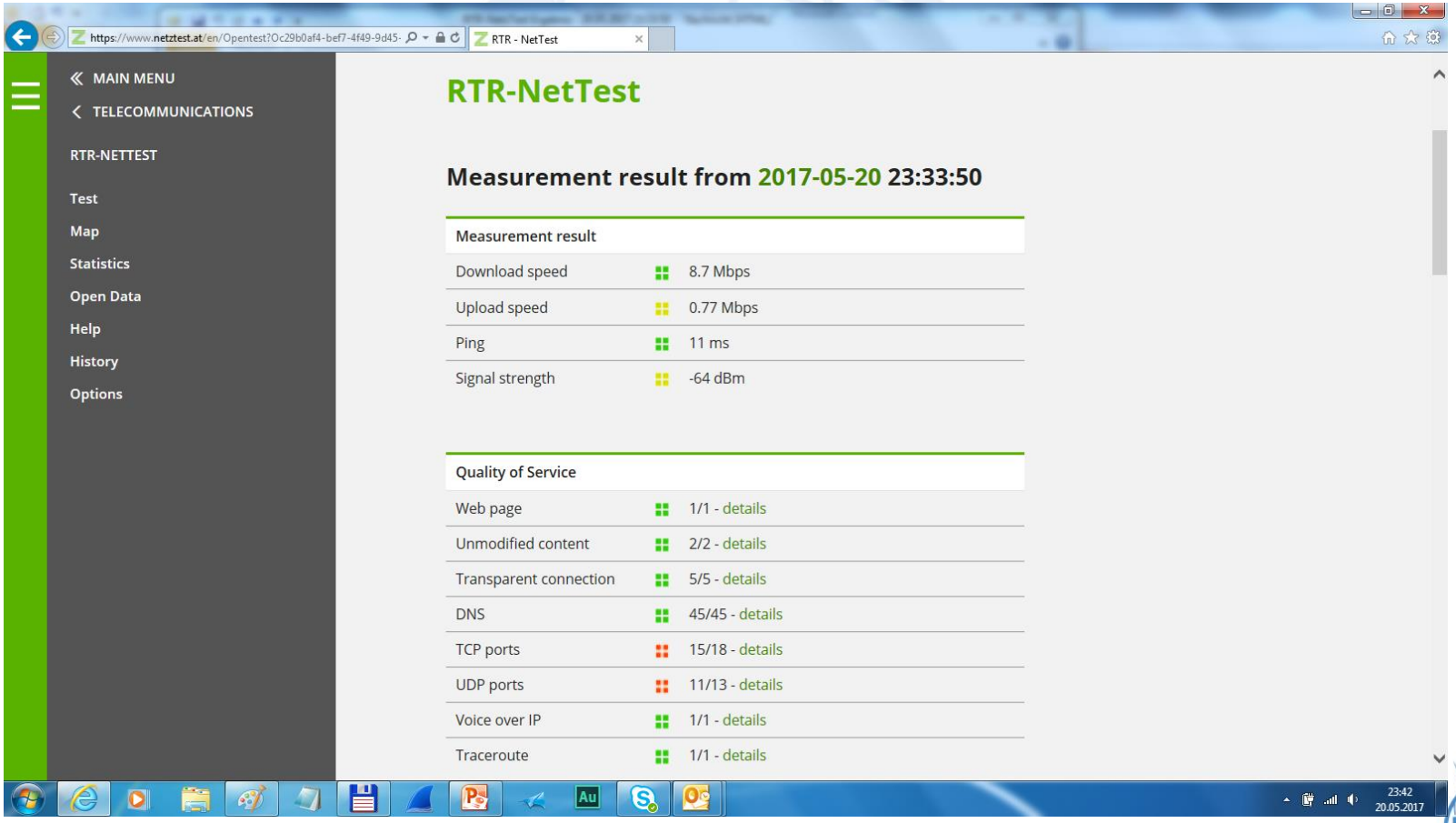


# RTR Implementation – Map



# RTR Implementation, additional QoS Features with Android

https://www.netztest.at/de/Opentest?Oa60cedba-6a54-4daf-ab45-5eec6b1ee041
https://www.netztest.at/de/Opentest?O0ff0ada5-f251-4d13-8e7a-b961d39f45d1



# RTR Implementation
# additional QoS Features with Android
# VoIP Details

| | |
|---|---|
| Voice over IP | 1/1 - details |
| | VoIP (Voice over IP) is a technology for the delivery of voice across IP based networks. |
| | Simulated VoIP call with a duration of 5000 ms. - details |

**Successful**
It is possible to receive voice packets.

**Details**

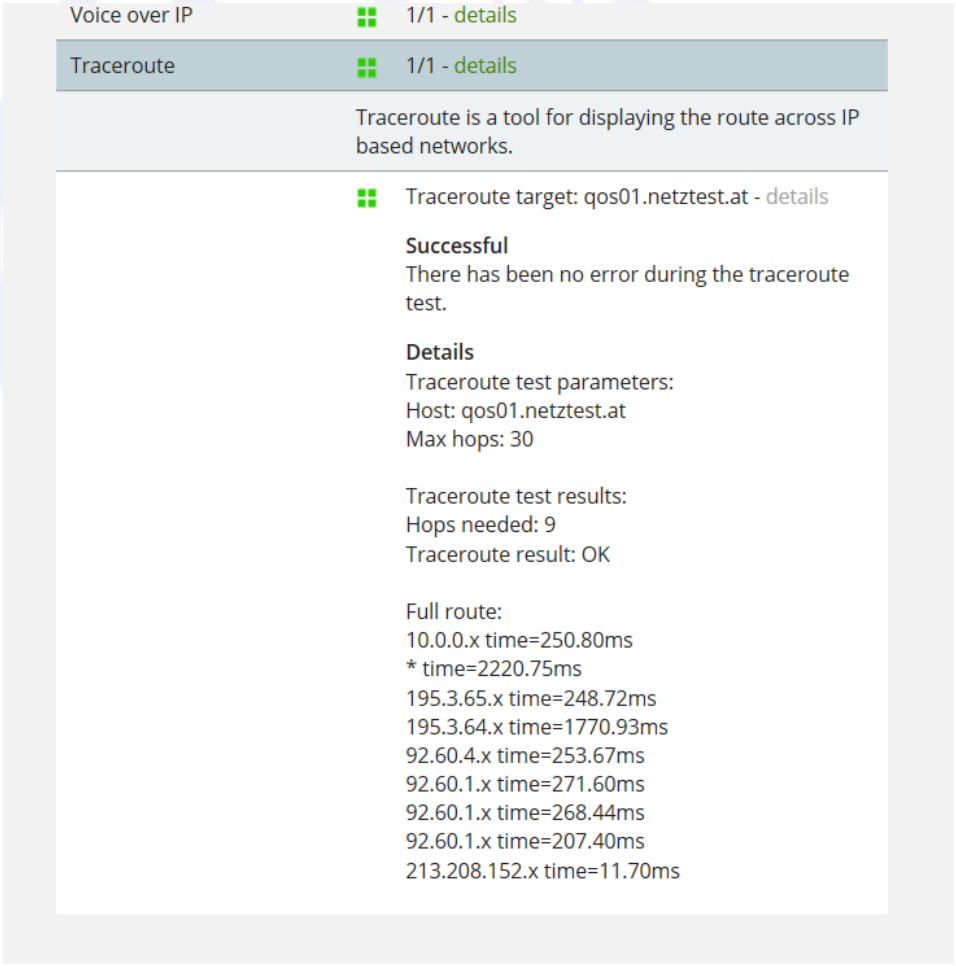
TEST PARAMETERS
Sample rate: 8000, bits per sample: 8
Call duration: 5000 ms
Packet interval: 20 ms
Payload type: PCMA
Target port: 5060

TEST RESULTS

Incoming voice stream:
max. jitter: 8.1 ms
mean jitter: 3.02 ms
max. delta: 86.94 ms
packets sent: 250
packets received: 250
packet lost percentage: 0.0%
sequence errors: 0
shortest / longest sequence: 250 / 250

Outgoing voice stream:
max. jitter: 8.7 ms
mean jitter: 3.42 ms
max. delta: 87.39 ms
packets sent: 250

# RTR Implementation additional QoS Features with Android Trace Route Details



# Thank you!

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