



Internet related performance measurements

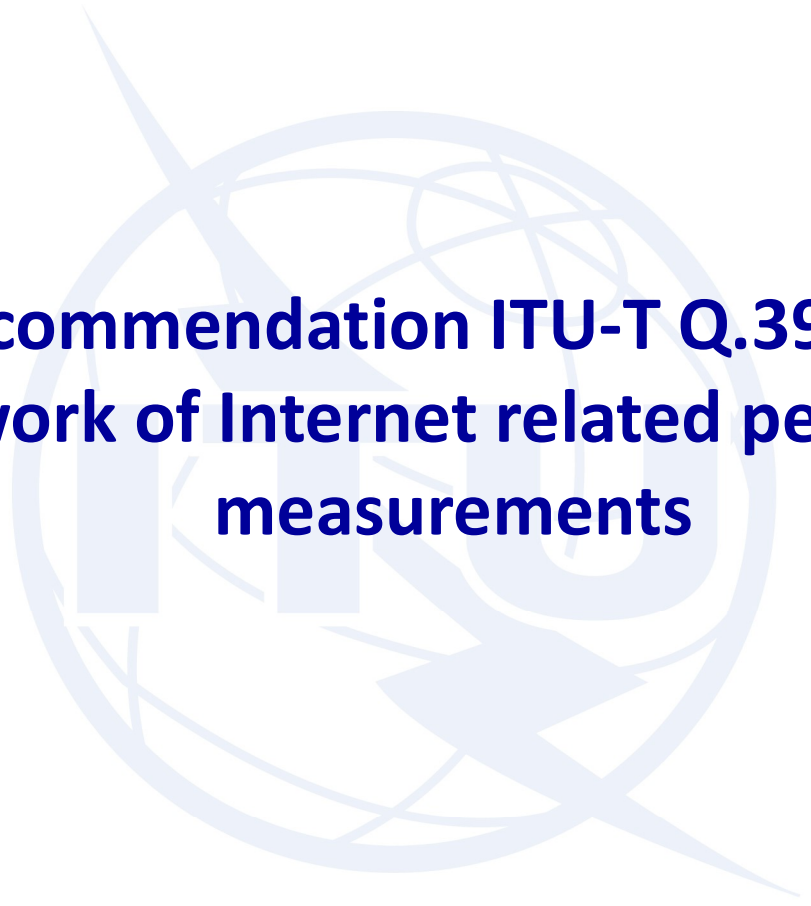
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Content

- **General info about performance measurements**
- **Recommendation ITU-T Q.3960 Framework of Internet related performance measurements**
- **Draft Recommendation ITU-T Q.3961: Testing methodologies of Internet related performance measurements including e2e bit rate within the fixed and mobile operator's networks**
- **Draft Recommendation ITU-T Q.SP-RT-NP "Signalling procedures of the probes to be used for remote testing of network parameters"**
- **Further standardisation developments**

General info about internet performance measurements

- The project internet performance measurements is a joint project between ITU-SG11, ETSI TC INT and the Austrian Regulator RTR. The documents are based on the approaches being taken in OECD (Organization for Economic Co-operation and Development) countries to measure broadband and the BEREC “Net Neutrality Regulatory Assessment Methodology”
- Published Recommendations and Standards
 - Recommendation ITU-T Q.3960: Framework of Internet related performance measurements
- In development:
 - Draft Recommendation ITU-T Q.3961: Testing methodologies of Internet related performance measurements including e2e bit rate within the fixed and mobile operator’s networks
 - Draft Recommendation ITU-T Q.SP-RT-NP “Signalling procedures of the probes to be used for remote testing of network parameters”

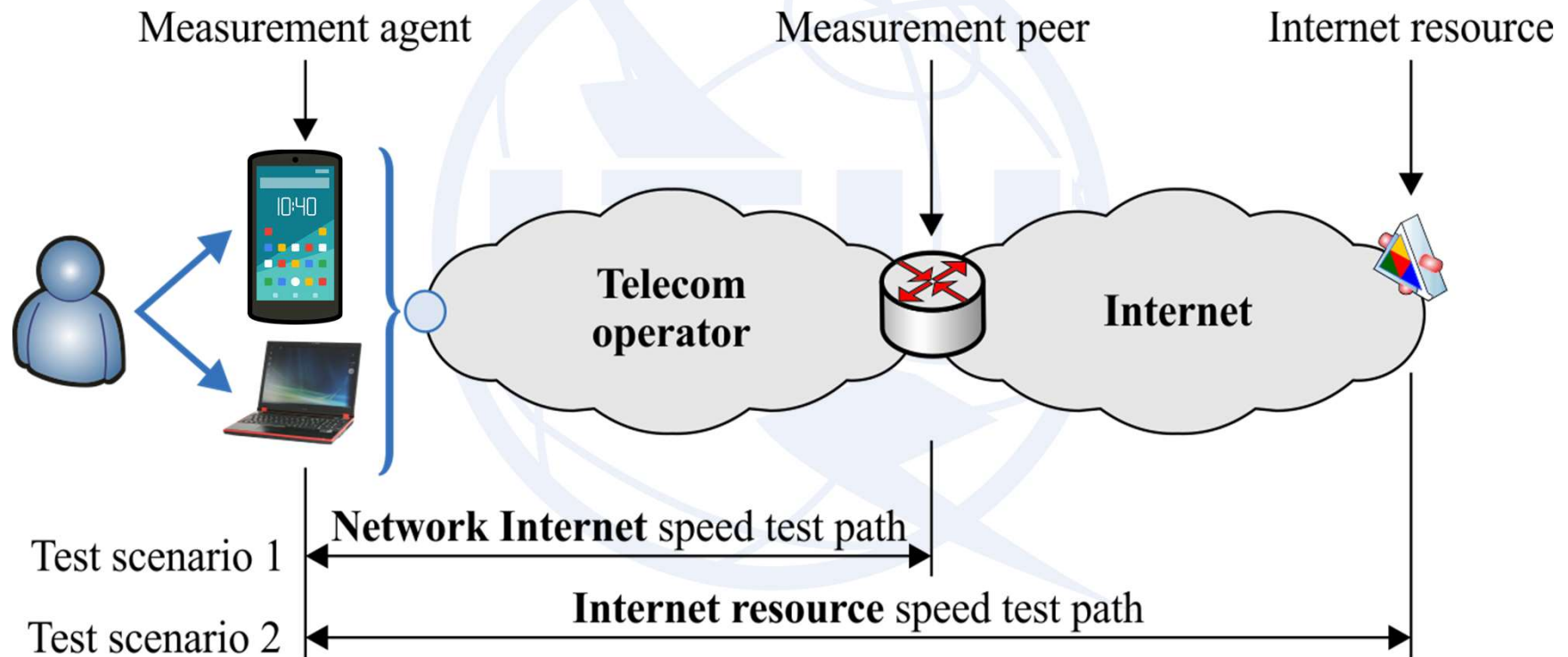


Recommendation ITU-T Q.3960
Framework of Internet related performance
measurements

ITU-T Q.3960: Framework of Internet related performance measurements

- This Recommendation describes the framework for Internet related performance measurements
 - which can be established at the national or international level and
 - can be used for measuring Internet related performance measurements from the customer to a particular Internet resource

ITU-T Q.3960: Framework of Internet related performance measurements



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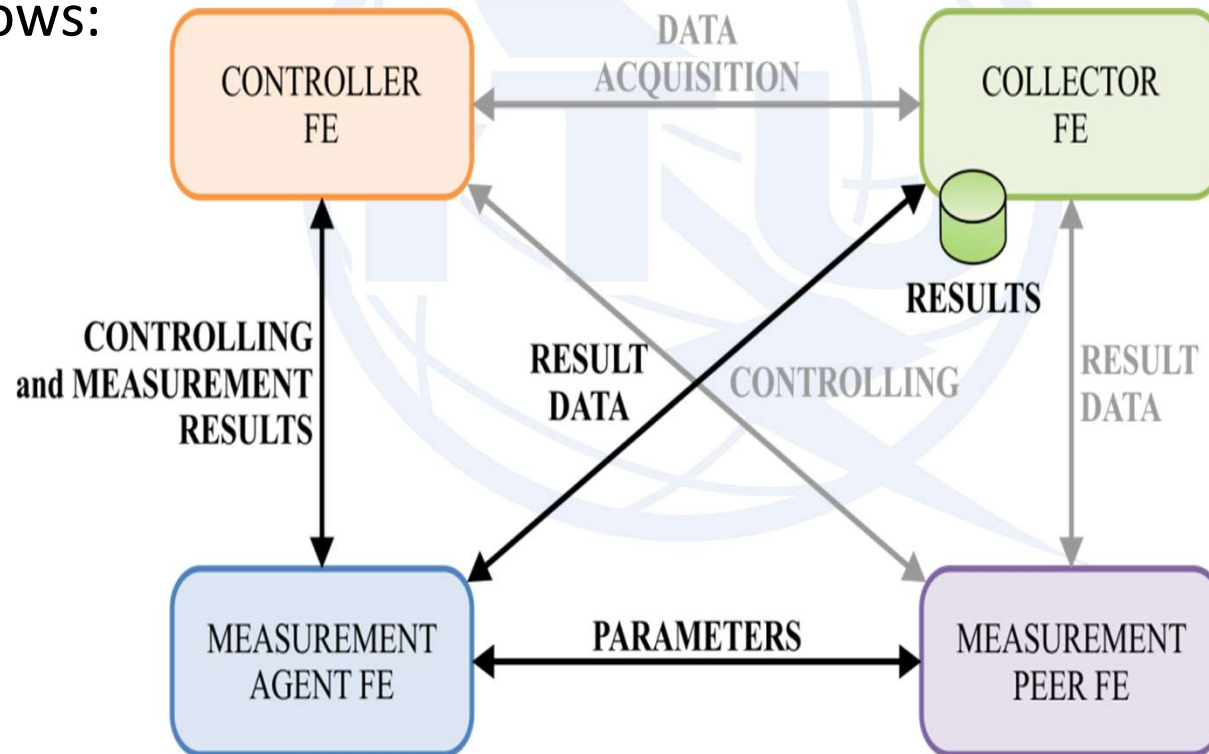
**Draft Recommendation ITU-T Q.3961:
Testing methodologies of Internet related
performance measurements including e2e bit
rate within the fixed and mobile operator's
networks**

Draft Recommendation ITU-T Q.3961
Testing methodologies of Internet related performance
measurements including e2e bit rate within the fixed and mobile
operator's networks

- This Recommendation describes the testing procedures of data transmission speed within the fixed and mobile operator's networks
- The proposed methodology is based on the concept of the ITU-T Q.3960 "Framework of Internet related performance measurements" (2016).
- The documents are based on the approaches being taken in OECD countries to measure broadband and the BEREC "Net Neutrality REgulatory Assessment Methodology"

Draft Recommendation ITU-T Q.3961- Architecture

The testing system is composed of functional entities (FE) as follows:



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Testing procedures (1)

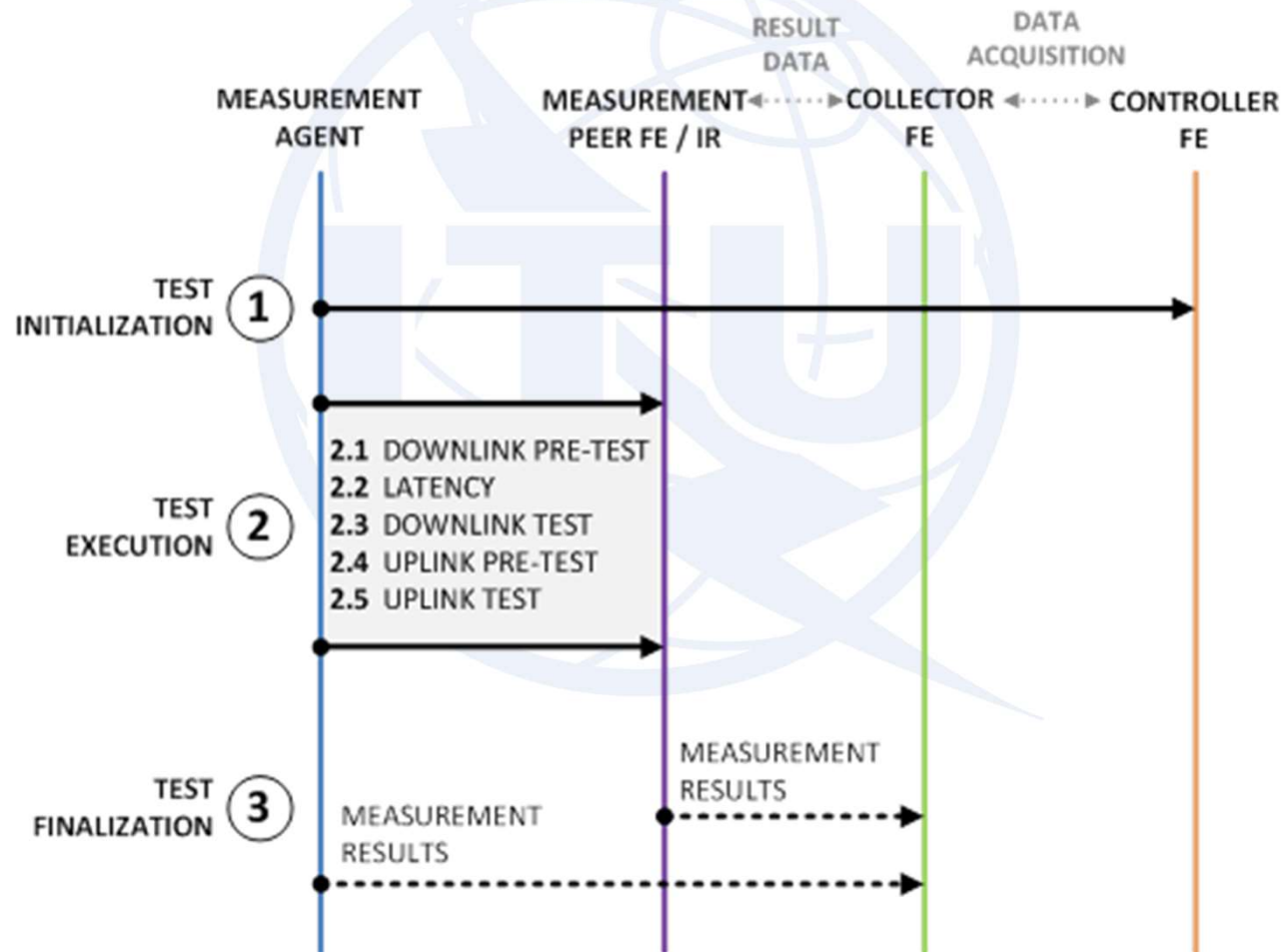
- The Measurement Peer (MP) is determined directly in Controller by geo-locating the Measurement Agent (MA) and determining his closest access to the Internet. In case of executing the Internet resource speed test, the Measurement Peer can be either selected by default or letting the user chose a destination within a list of Internet resources.
- The test consists of seven phases which are carried out one after each other, i.e. phase m starts after phase $m-1$ has finished without any pause in-between. That means that the phases do not overlap.

Testing procedures (2)

- To ensure comparable data transmission speed test conditions in mobile networks, a pre-load should be initiated. With the pre-load, the mobile networks are set in a defined initial state i.e. CELL_DCH in UMTS and connected in LTE.
- If the downlink and uplink pre-tests procedures are not implemented (Phases 2 and 5), the Measurement Agent shall open a TCP uplink and downlink connection. For downlink, the Controller sends a data block of size z . For uplink, the Measurement Agent sends a data block of size z .

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Testing execution Workflow



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Testing execution Workflow

Phase 1: Initialization

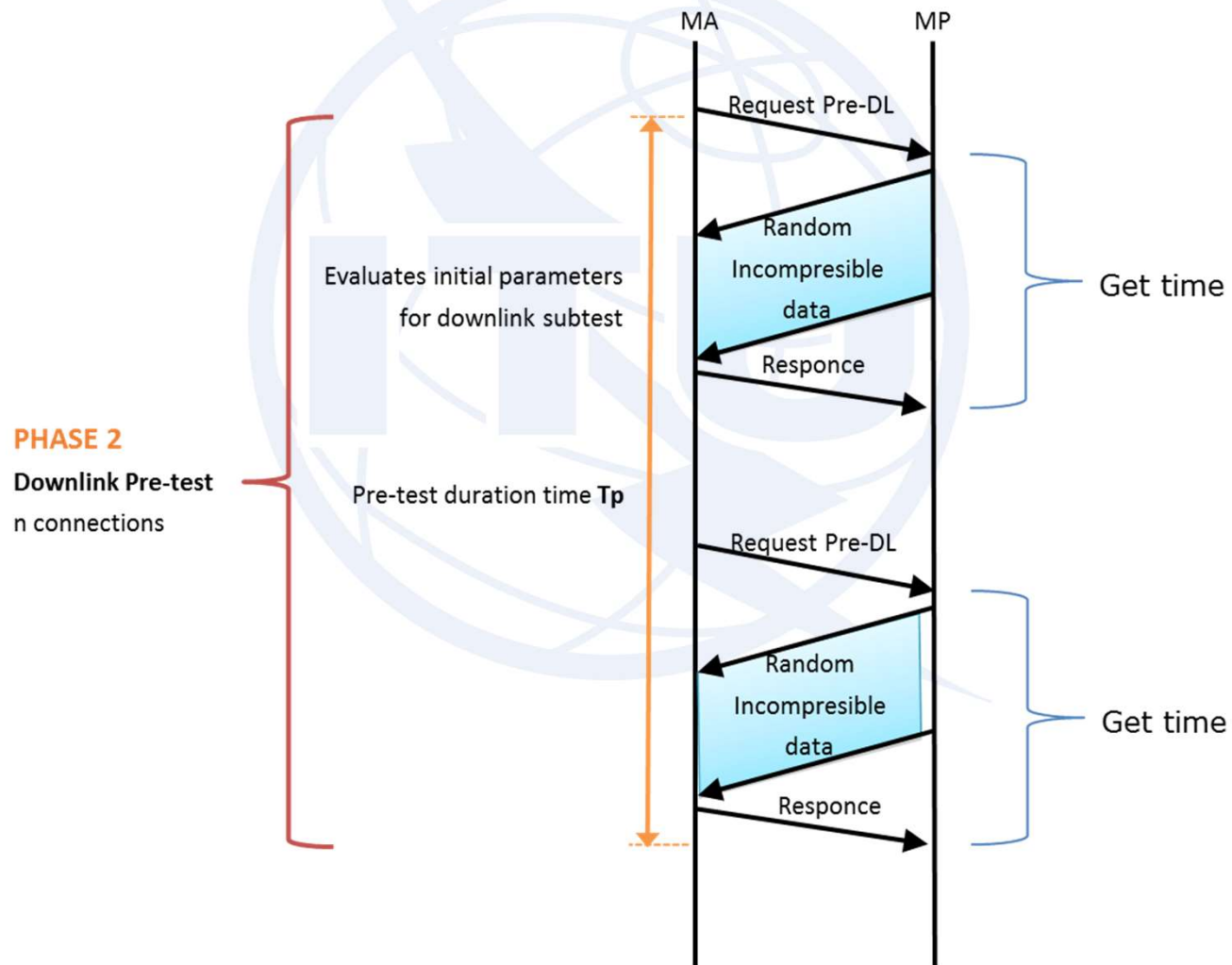
- **In Phase 1: Initialization** the Measurement Agent tries to connect to the Controller with TCP. In order to pass through certain firewalls, which might block unencrypted data transmissions, HTTPS might be necessary. The data streams themselves are optionally unencrypted.



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Testing execution Workflow

Phase 2: Downlink pre-test



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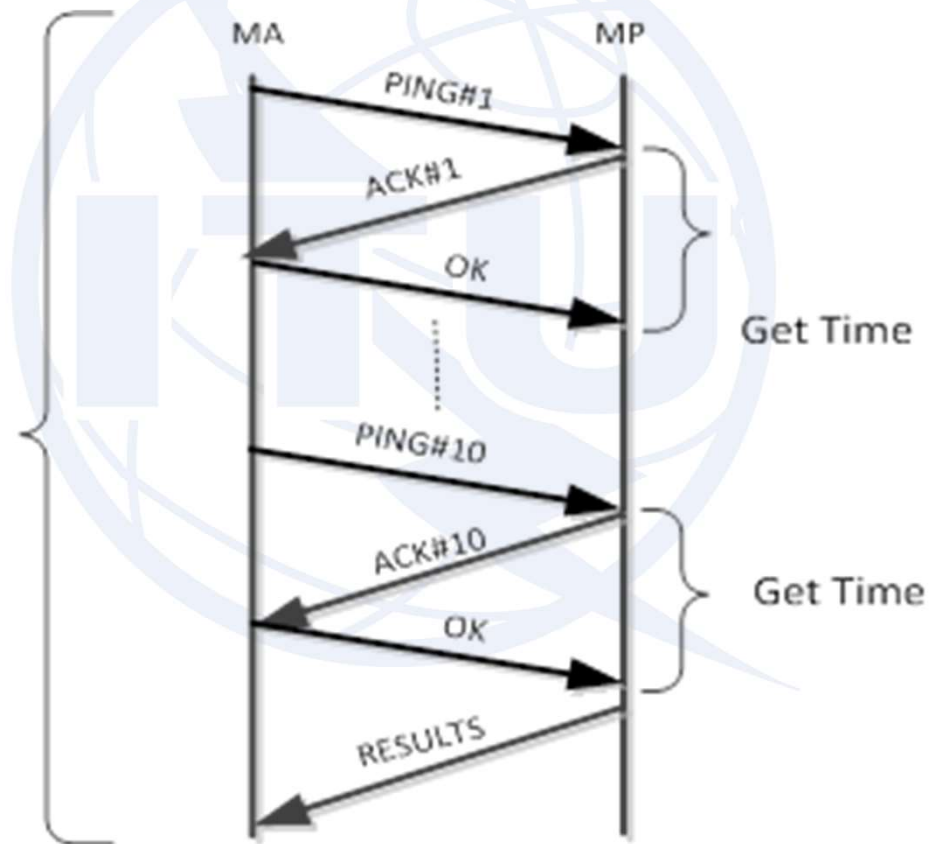
Testing execution Workflow

Phase 2: Downlink pre-test

- In Phase 2, the Measurement Agent opens n connections to the assigned Measurement Peer. Within each connection, the Measurement Agent requests and the Measurement Peer sends a data block of size z . While the duration of the pre-test has not exceeded T_p , the Measurement Agent requests a data block of double size compared to the last iteration step. The transfer of the last data block will be finished even if the duration has already exceeded T_p . At the end of the pre-test, all connections are left optionally open for further use.

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Testing execution Workflow
Phase 3: Latency test

Phase 3
Latency
Subtest



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Testing execution Workflow

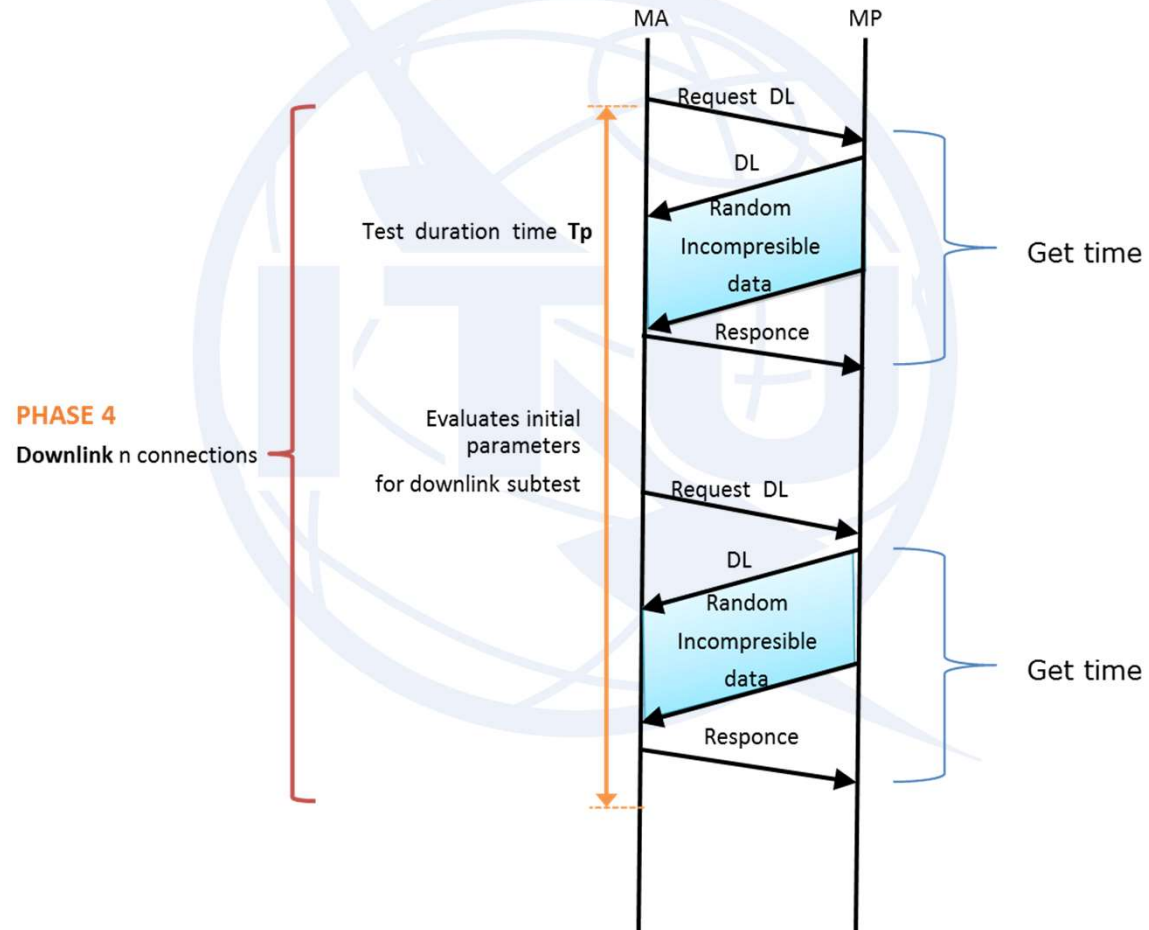
Phase 3: Latency test

- During the Phase 3, the Measurement Agent sends p “pings” in short intervals to the Measurement Peer to test the latency of the connection.
- The Measurement Agent measures the time between sending and receiving the return message, while the Measurement Peer additionally measures the time between sending its return message and the Measurement Agent’s reception response. The Measurement Agent stores all measurements.

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Workflow

Phase 4: Downlink subtest Testing execution



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Workflow

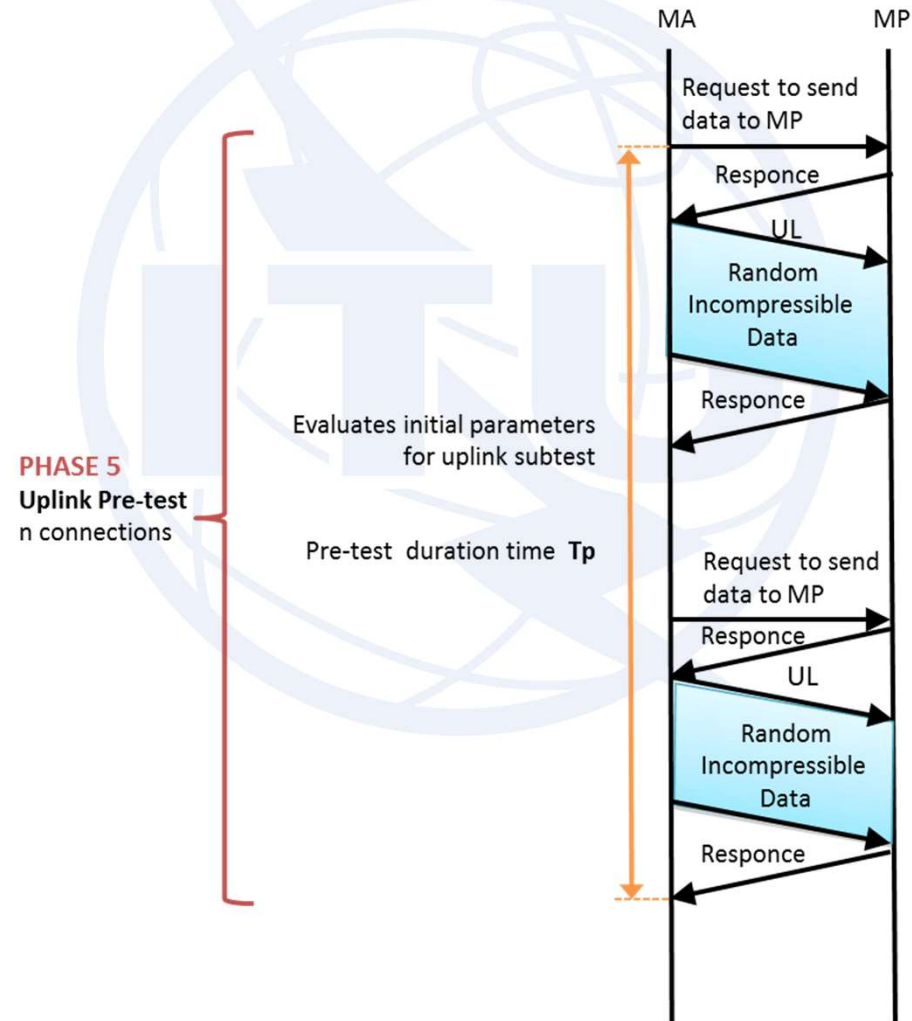
Phase 4: Downlink subtest Testing execution

- Within each of the n connections opened during phase 2, the Measurement Agent simultaneously requests and the Measurement Peer continuously sends data streams consisting of fixed-size chunks of size s (randomly pre-generated data with high entropy).
- All transmissions start at the same time, which is denoted as relative time 0. For each connection the Measurement Agent records the elapsed time and the amount of data received.

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Workflow

Phase 5: Uplink pre-test



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Workflow

Phase 5: Uplink pre-test

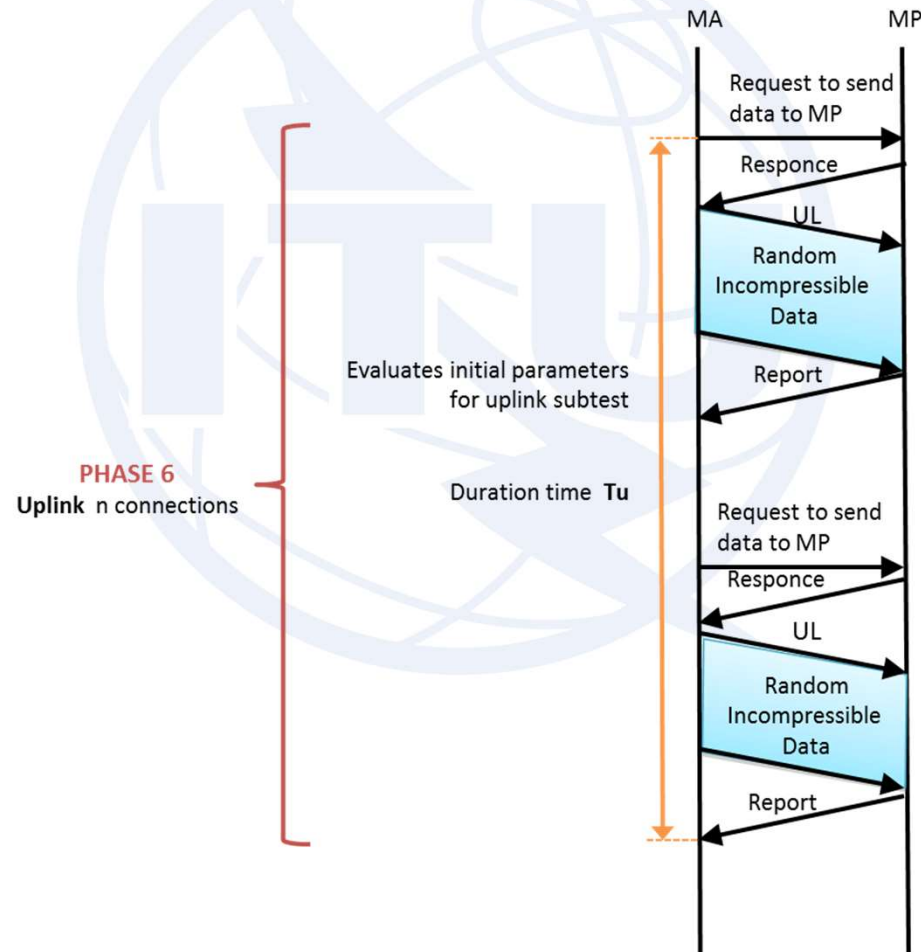
- In Phase 5, the Measurement Agent opens n connections to the assigned Measurement Peer. Within each connection, the Measurement Agent sends a data block of size z (randomly pre-generated data with high entropy). While the duration of the pre-test has not exceeded T_p , the Measurement Agent sends a data block of double size compared to the last iteration step. The transfer of the last data block will be finished even if the duration has already exceeded T_p . At the end of the pre-test, the connections are left open for further use.



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Workflow

Phase 6: Uplink subtest



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Workflow

Phase 6: Uplink subtest

- Within each of the n connections opened during phase 5, the Measurement Agent continuously sends data streams.
- All transmissions start at the same time, which is denoted as relative time 0. For each connection, the Measurement Peer gives feedback to the Measurement Agent by sending the elapsed time and the amount of data received.

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Workflow

Phase 7: Finalization

- After finishing all tests, the Measurement Agent sends the collected data to the Collector. As option the MP can also send the data about the measurement to the collector. Both datasets could be compared by the Collector to check the quality and integrity of the result. All tests, successful or unsuccessful, are stored by the Collector.

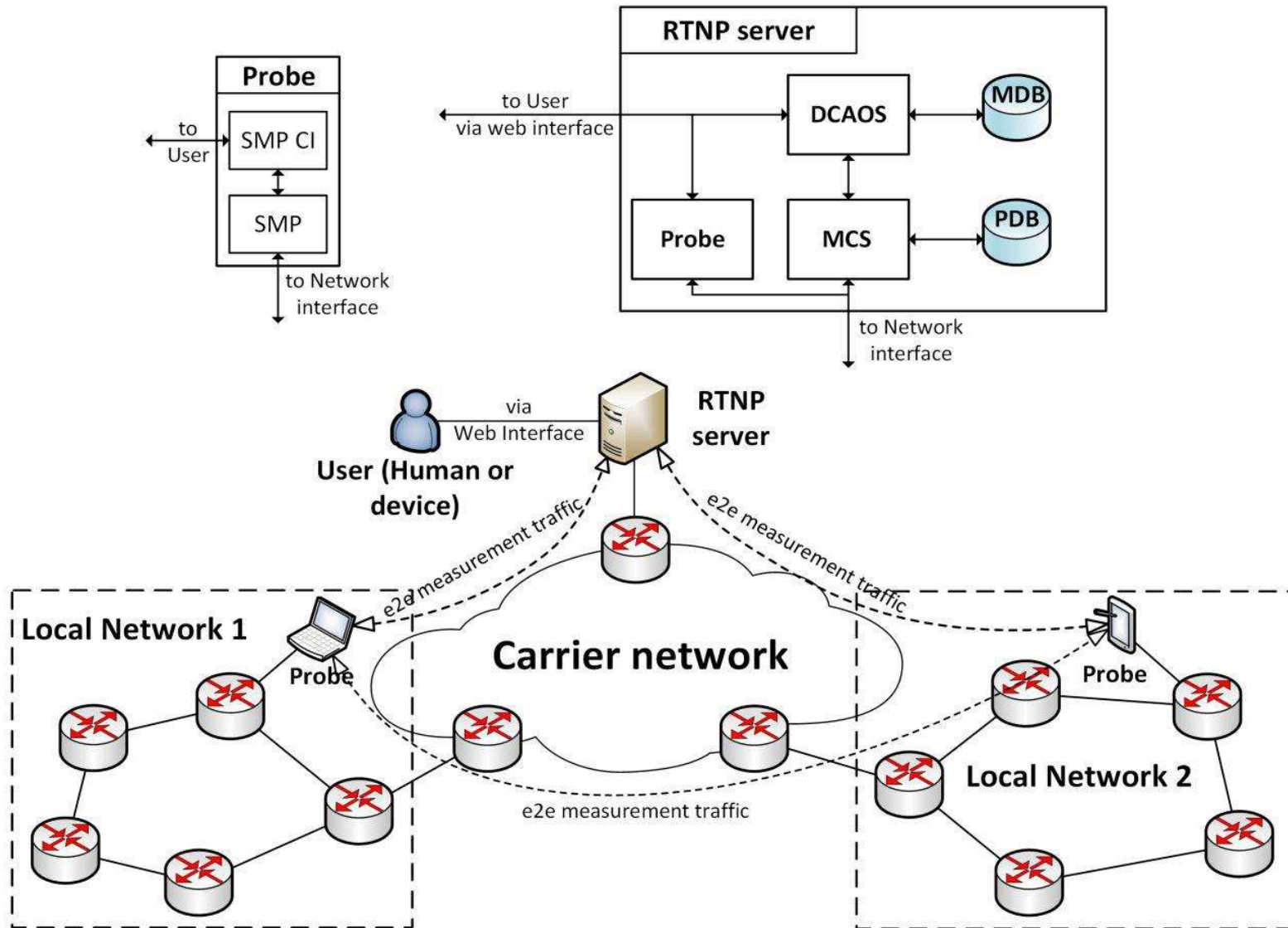
Draft Recommendation ITU-T Q.SP-RT-NP
**“Signalling procedures of the probes to be used
for remote testing of network parameters”**

Draft Recommendation ITU-T Q.SP-RT-NP “Signaling procedures of the probes to be used for remote testing of network parameters”

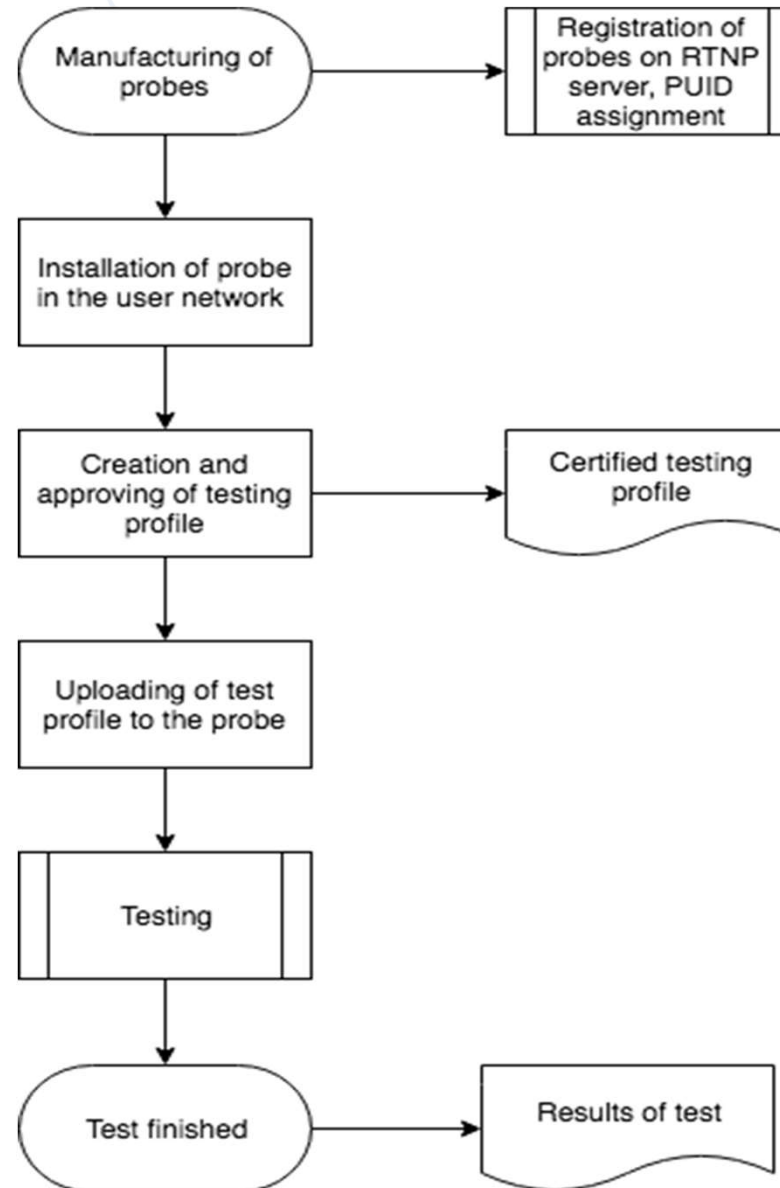
- This Draft Recommendation defines requirements for high level signaling procedures intended for use in controlling probes used for remote testing of network parameters.
- These procedures enable a probe to function as a “black box” recording all events on the subscriber side, and suitable for a trusted system in resolving disputes between various ICT stakeholders
- The proposed methodology is based on the concept of the ITU-T Q.3960 “Framework of Internet related performance measurements” (2016) and ETSI TR 101 667.
- To address the implementational issues we closely collaborate with industry (e.g. Rostelecom, R&S).



System architecture



General logic of the testing using probes



Testing profiles

Testing profile for passive mode

- Round trip time, ms
- Jitter, ms
- Packet loss ratio, lost packets / received packets
- Internet speed measurement, Mbit / sec

Testing profile for active mode

- Application layer protocols
- Ports
- Traffic distribution between IP addresses
- Uplink / downlink ratio, Mbit / sec
- Average packet size, KB
- Average packet rate, packets / sec





Further standardisation developments

Planned Internet related performance QoS Test methods

- The following Internet related performance QoS Test methods should be standardized:
 - Website downloads test - The website test downloads a reference web page (mobile Kepler page by ETSI)
 - Unmodified Content - This test downloads a test web resource (e.g. image) and checks if it was modified during transport.
 - Transparent Connection Test - This test checks if a request is modified by a proxy or other middlebox.
 - The DNS Test- DNS is a fundamental Internet service. It is used to translate domain names to IP addresses. Depending on the test it is checked if the service is available, if the answers are correct and how fast the server responds.
 - The TCP Test - TCP is an important connection oriented Internet protocol. It is used for example for web pages or e-mail.
 - The UDP Test - UDP is an important connectionless Internet protocol. It is used for real-time communications, e.g. for VoIP and video.
 - The VoIP Test - VoIP (Voice over IP) is a technology for the delivery of voice across IP based networks.

