Nemzeti Média- és Hírközlési Hatóság

Testing the QoS of Internet services in Hungary

The software and hardware based measurement system of NMHH

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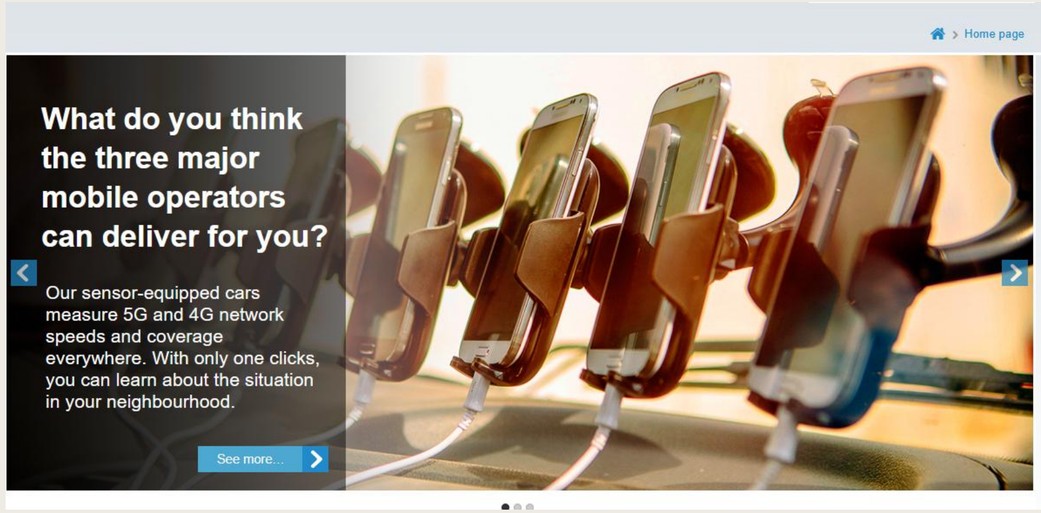
The broadband measurement system of NMHH

Internet measurement system and website – **szelessav.net**



- Launched in 2015.
- For promoting the broadband Internet in Hungary.
- Helping the users in the usage of internet: knowledge base, advices for troubleshoot problems with internet access (Why is my speed slow?)
- Empowering users with public measurement facilities: checking internet access quality, comparing to the offered QoS values (software + hardware tool).
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- Mobile internet measurements carried out with professional tools: QoS and coverage.
- Aggregated measurement results on the website: software- and hardware based QoS and mobile QoS and coverage measurements on maps and in tabular forms: to compare the real QoS of Internet services and generate competition among the ISPs.

Measurement components of the system : Browser based measurement tool

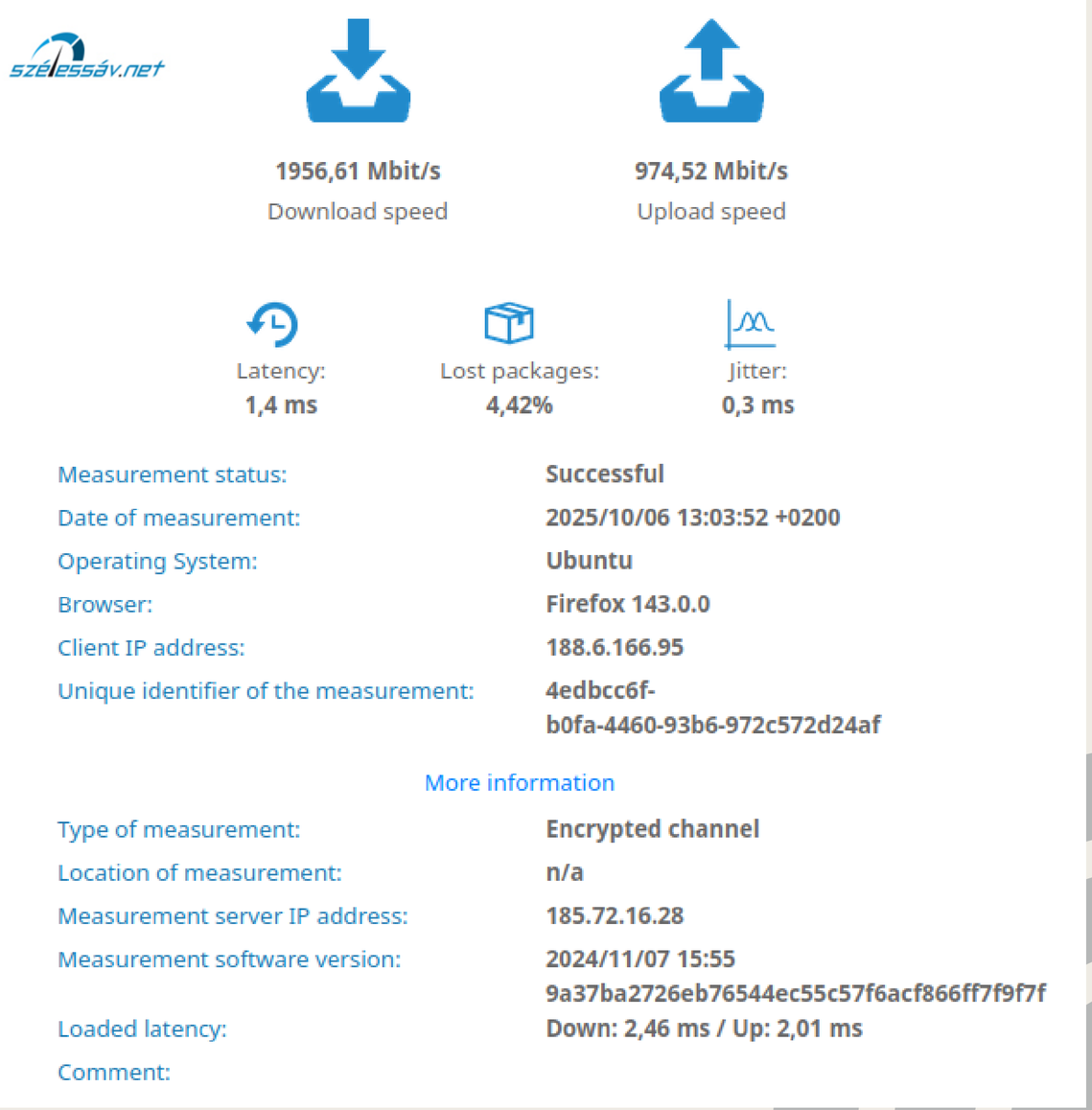
Browser based ,multithreaded measurement method (using websocket)

Measurement server located in the BIX (Internet Exchange point of Budapest): independent from the service providers, neutral, uniform reference for all users.

Measured QoS parameters : download speed, upload speed (over 1 Gbps), latency, jitter, packet loss, + loaded latency (Loaded latency is measured when there is traffic on the link : i. e. someone from your family downloads a big file meanwhile you play online at home).

Report generation (to send the result to the ISP)

Continues development: measuring higher speed and new QoS parameters. In the future we plan to measure speed with additional protocols (like QUIC).



Measurement components of the system: hardware boxes at customer’s premise

Hardware based measurements on fixed line internet access

Internet users in Hungary can apply for hardware measurement probes (hardware box or probe) free of charge.

The probes are based on commercial routers with own developed firmware, and measuring software with configurable scripts. The probe is installed at the customer’s premise between the network termination point and the user device.
These probes perform measurements automatically at times when no other data traffic can affect the test results.

Automatic, regular active measurements (24/7), controlled from the measurement centre at NMHH.

Measurement server is located at neutral reference point (in BIX).

Measured parameters: speed (up to 1 Gbps), latency, jitter, packet loss, port scan.

Measurement accuracy is tested at NMHH’s laboratory.

Measurement components of the system – mobile drive test system for measuring mobile internet QoS and coverage

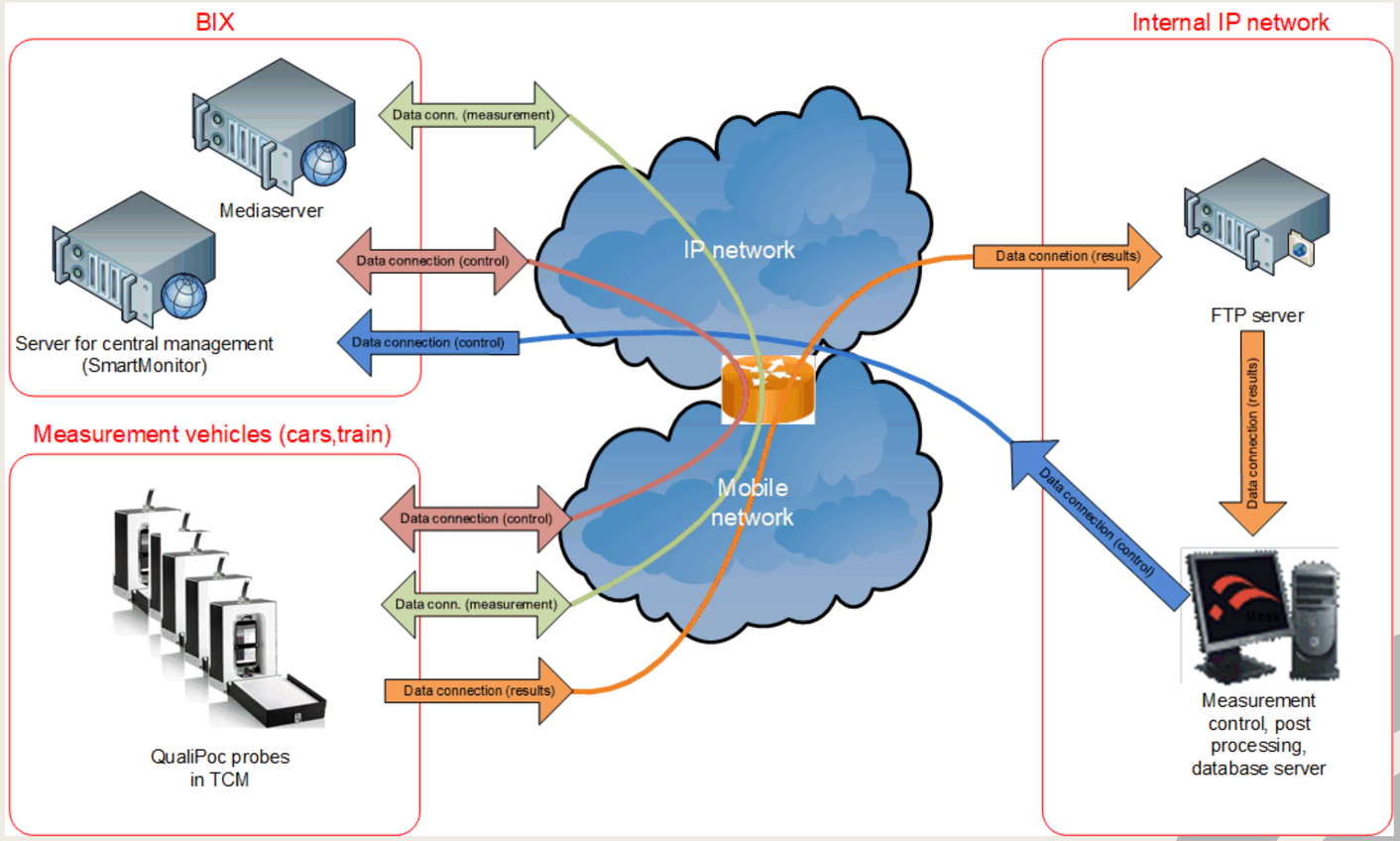
The NMHH converted vehicles used in normal road form into mobile measuring stations in order to be able to carry out accurate measurements.

The measuring cars continuously travel the country and measure the download and upload speed, latency, radio frequency coverage, and net neutrality on the mobile networks of each service provider using the professional SwissQual measurement system.

The engineers of the NMHH divided the country into 85 micro-regions. The measuring vehicles cover all the small areas with the greatest possible regularity and thoroughness, and then the recorded measurement results are subjected to strict checks. Finally, the verified results are published on the szelessav.net website.

System architecture of mobile measuring system

- Measurement server
  placed in BIX (Budapest Internet Exchange)
  (Neutral measurement reference point)
- Measuring mobile phones in vehicles/backpacks



Measurement methodology of drive tests

The NMHH uses five measuring cars, presently. Ten to twelve settlements are checked daily with a measuring car, and if coverage problems are detected, they go back to measure once more.

The mobile networks of the main operators are measured. The measurements are performed with several mobile phones. We need several mobile phones, because the 4G, and 5G networks of the main mobile operators are tested separately, in parallel, and the reason why NMHH uses well-known mobile phones is to roughly experience what average users experience when using mobile phones.

Speed and delay measurements are made between the measuring car and a measuring server located at IXP of Budapest (BIX).

Measurement methodology of drive tests

The phones have modified, stripped-down firmware so that unnecessary apps don't run in the background and a R&S Swissqual's Qualipoc measurement app runs on the phones to perform the measurements. The modified firmware allows more technical parameters to be read from the phone.

Mobile phones are placed in streamlined boxes on top of the cars. The box does not shield EM radiation. The individual telephones are in air-conditioned modules. The modules ensure a stable and optimal temperature for the measurements (23°C ± 2°C). (The overheating of the phone could cause reduced speed measurement result.)

The devices are controlled remotely, the current testing tasks are sent from the NMHH's measurement center, and they are set to perform measurements only above a given speed at specified intervals in order no to collect data from the same location for minutes if the car gets stuck.

A R&S RF scanner is used for the radio signal strength measurements (coverage).

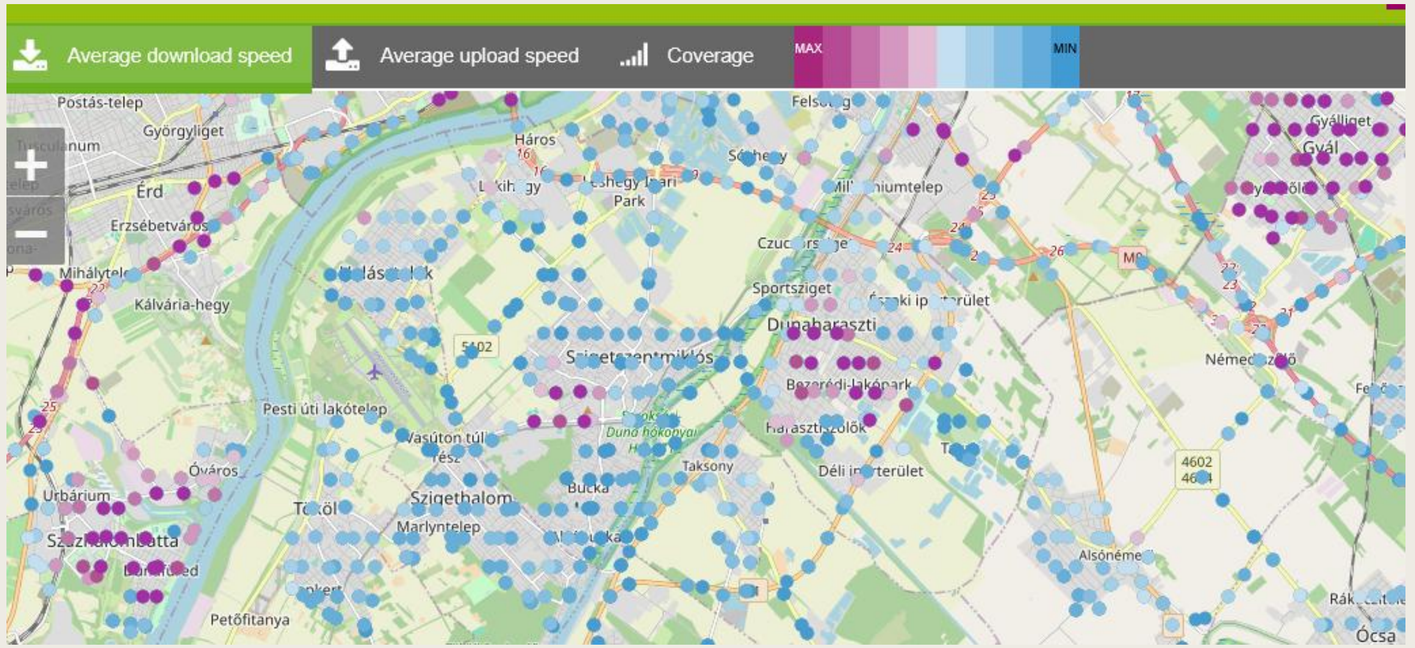
The measurement methodology used for these measurements was agreed with the mobile operators.

Aggregated QoS measurement results on website

The measured data uploaded to data processing server automatically after each measurement campaign.

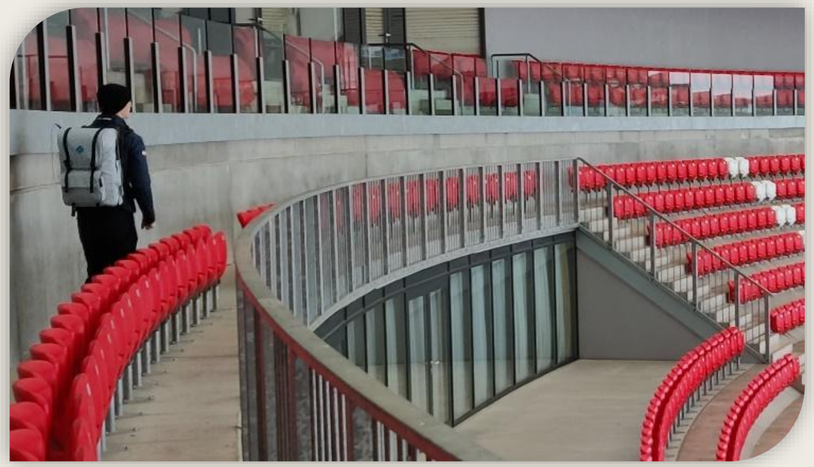
The average of the data generated during 10 sec. will be displayed at the 10th sec. automatically.

If the data speed lower than 128kbps, no visualization.



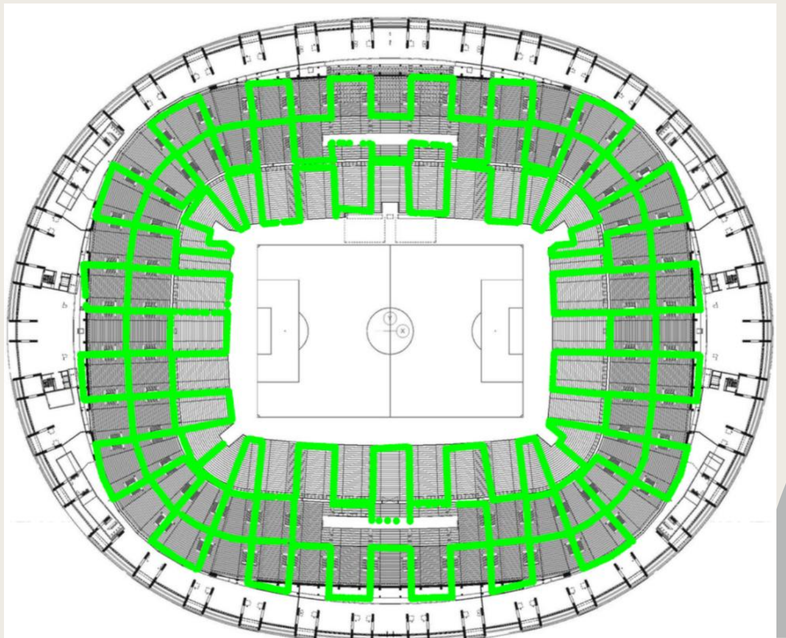
where the car cannot go
where the car cannot go

4G/5G backpack based mobile Internet and coverage measurements at hot spots



Where the car cannot go :

- Football arenas
- Factories (e.g. logistical centres)
- Universities
- Bike paths
- Etc.



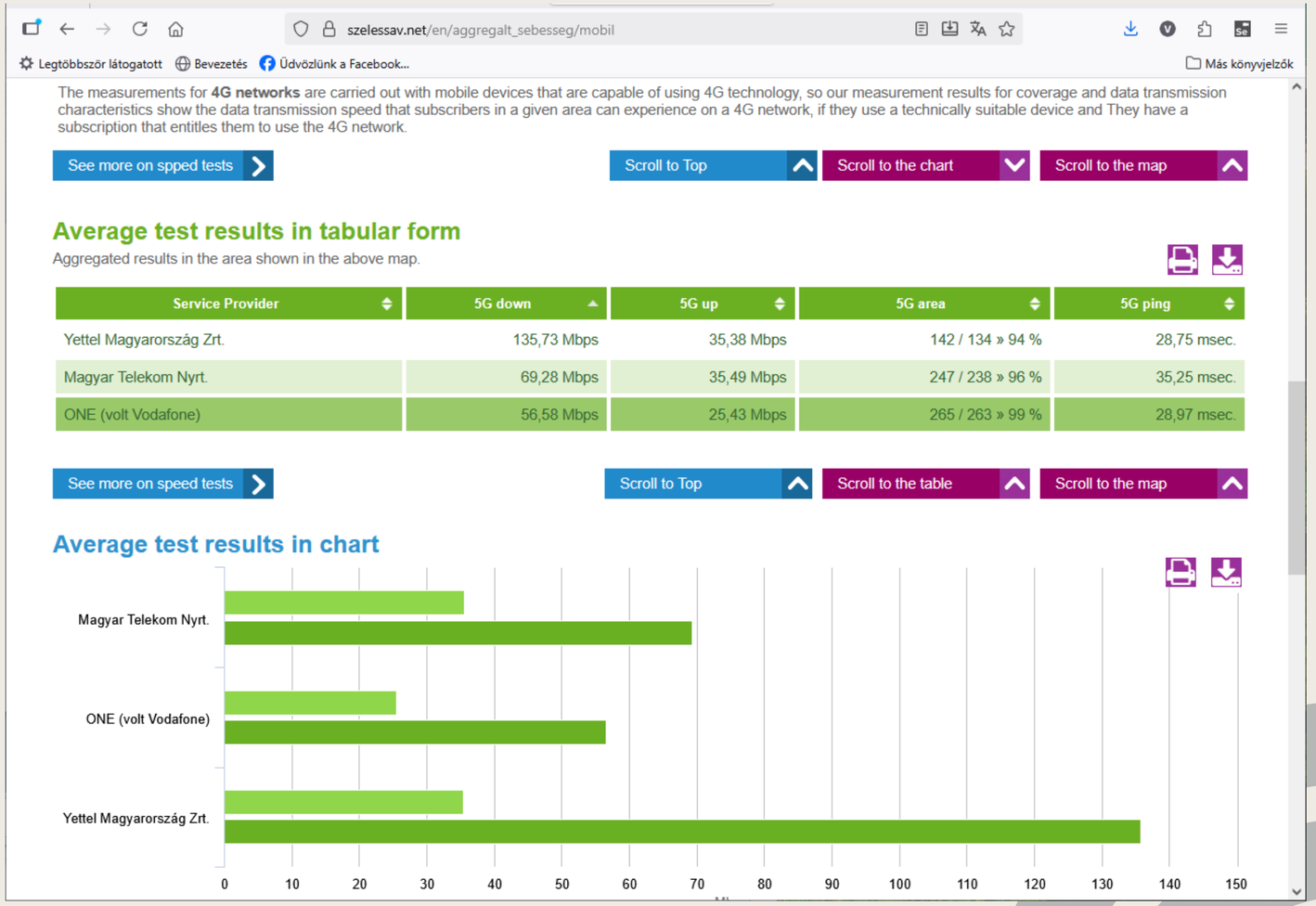
Mobile QoS measurement results in tabular form

The results measured with our measuring system are accepted by the service providers because we have agreed on the measurement method with them.

The current average speed of the best service for the entire country is 80Mbps download, 30Mbps upload for 4G, while 135Mbps download and 35 Mbps upload for 5G. The latency response times are around 30ms in all cases, which is because 5G is non-standalone and still uses the 4G system to send network control information. The situation will improve when it can operate with its own 5G network architecture.

Currently, based on our measurement results, one of the service providers is running an advertising series that they are the fastest.

Presumably, the published results will generate competition among mobile operators, which will result in them improving their networks and making them more capable of standalone 5G.



Why we could experience lower speed and higher latency than we could expect from a 5G connection theoretically?

Reasons for it:

- Non-standalone 5G : the mobile network combines 4G and 5G technology, The standalone 5G system architecture has not yet been built.
- Very high speed is achievable only areas, where 3500 MHz carrier network is available for the 5G.

Shifting to measuring more meaningful QoE metrics: Network Performance Score (NPS)

The shift to a Network Performance Score moves from technical metrics to a single, user-centric score that reflects the end-user's actual Quality of Experience (QoE) for common applications.

In August 2019 the ETSI released the technical report TR 103 559 which defines best practices for mobile network QoS benchmark testing.

The goal of the benchmarking is to determine the best provider or operator for a designated area with respect of the services accessed with a mobile phone. The tests conducted are telephony, video streaming, data throughput and more interactive applications such as browsing, social media and messaging. This goal is achieved by executing benchmarking tests in designated test areas that represent or actually cover a major part of the users of mobile services. The results collected in the various areas are individually and collectively weighted and summarized into an overall score.

This score provides a holistic view of network quality by integrating key QoE factors like service availability, wait times, and media quality, helping operators identify areas for improvement to boost subscriber satisfaction.

By focusing on what truly matters to the user, operators can enhance satisfaction.

We are gradually introducing the NPS measurements

Summary

NMHH operates a website to increase user awareness and empower Internet users with public measurement capabilities.

The public QoS measurement capability includes browser-based tool and hardware box-based measurements that can be deployed at customer’s site. The 24/7 test box measurements allow monitoring of changes in QOS characteristics over time. Users can compare the measured QoS characteristics with the values offered by the service provider.

NMHH carries out professional mobile Internet and coverage measurement using sensor equiped cars (measuring along the roads) and backpack based system (measuring at hot spots: like stadiums, pedestrian zones etc.)

The published results can generate competition among mobile operators, which could result in developing theirs network architectures (towards standalone 5G).

In addition to data speed, other QoS characteristics are becoming increasingly important from user experience perspective.

We are shifting from measuring technical QoS metrics to an overall score that reflects the end-user's actual Quality of Experience (QoE) for common applications.

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Thank you for your attention !