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Mobile Network Testing

FROM THE FROG'S-EYE TO THE BIRD'S-EYE VIEW AND BACK

Making mobile network scores comparable

Excerpt of News
Magazine 222/20 from
Rohde & Schwarz

MOBILE NETWORK TESTING

Assessing mobile networks and their performance has long been a subject of interest to network operators and regulatory authorities, as well as to trade media and T&M equipment manufacturers such as Rohde&Schwarz. Up to now, network scores have been difficult to compare due to a lack of uniform measurement methods. A new ETSI method solves this problem.

There are many assessment methods currently available, based on different interfaces for acquiring measured values and in many cases developed over time. This makes comparison virtually impossible. ETSI, the leading standardization body for mobile communications, therefore launched a project more than two years ago to tackle this issue, analyze existing methods, merge them and adapt them to standardized measurements and KPIs. The final report, TR 103 559 "Best practices for robust network QoS benchmark testing and scoring", was published in August 2019. Along with general rules for conducting test campaigns, it covers the underlying services, measurements and KPIs and provides detailed descriptions of individual measured values, as well as their weighting and combination to arrive at an overall network performance score.

The report is a joint effort of network operators, T&M service providers, infrastructure manufacturers and measuring equipment manufacturers. As a contributor to the method, Rohde&Schwarz is already determining the network performance score in its SmartAnalytics analysis platform.

User perception as a rating scale

Due to the rapid increase in the data transport capacity of mobile networks, users now see smartphones as the primary means of access to digital services and all types of applications; therefore, they are also considered the primary means of access for measuring equipment. These services and applications are based on established transport protocols, but the load profiles in the network and the requirements for satisfactory quality vary greatly, depending on the application. Users have different quality expectations for uploading a photo to a social media network than for watching a soccer match in a livestream video.

Despite their high transport capacity, today's networks still fall far short of being perfect transport media. Interruptions occur or the data throughput needed by an application cannot be ensured or cannot be ensured continuously. The transmission time also leads to a time offset between the sending and receiving of data. Many applications adapt to changing channel conditions and attempt to minimize the negative impact on perceived quality, for example by temporary data decimation or buffering to bridge interruptions in transmission.

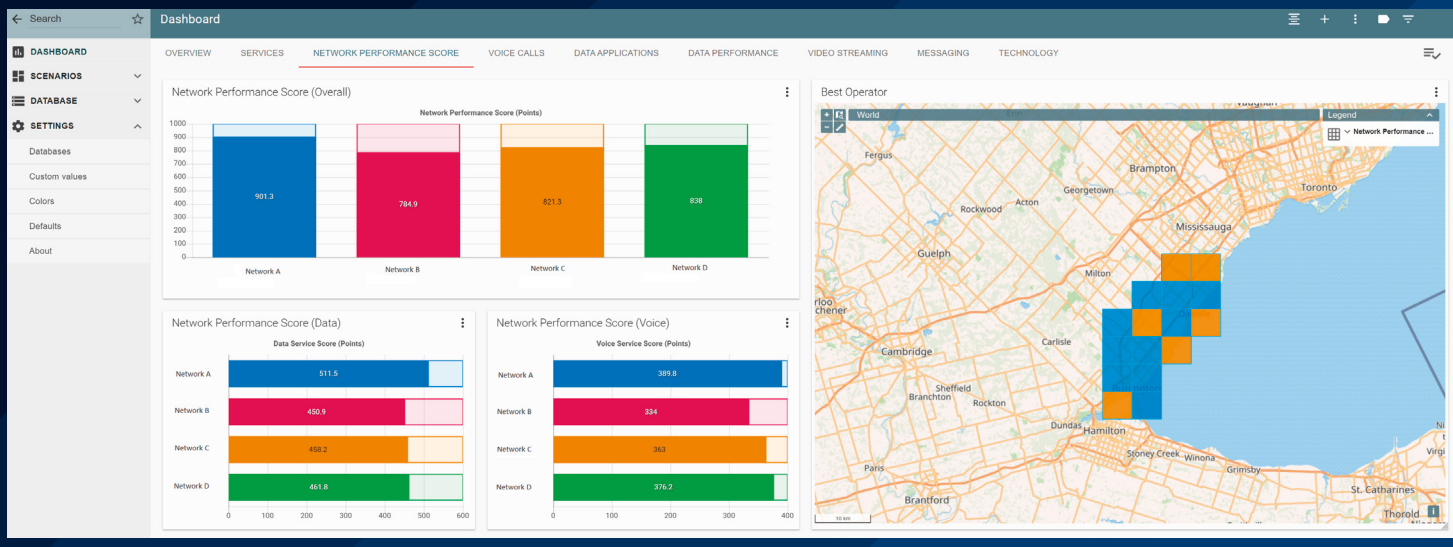

Fig. 1: With the SmartAnalytics reporting tool, network operators or independent testers can assess network quality according to various criteria and, in particular, calculate an overall network score in line with ETSI TR 103 559.

Network operators therefore have a strong interest in assessing the performance of their networks from the user perspective and finding out how they can increase it as efficiently as possible. However, technical parameters such as data rate, latency or packet losses are less useful for determining performance than performance-oriented criteria of actual applications, such as phone calls or the voice and video quality of a livestream, as well as simple values such as how long it takes to send an image or successfully load a website.

To obtain meaningful information about the overall performance of a network, the ETSI method proposes a weighted sum of quasi-perceptual quality measurements for typical applications.

What determines the performance of a network from the user perspective?

Data services account for the lion's share of the transmitted data volume, and users spend significantly more time on data applications than on phone calls. These circumstances should be reflected in the overall score. However, data services also differ both technically and in frequency of use.

To properly take all aspects into account, the behavior of a typical user is simulated. For this purpose, automatic mobile test systems establish connections in actual networks with normal smartphones and run a series of data applications in addition to making test phone calls. This includes downloading files, accessing livestream videos, browsing websites, performing load tests and sending media content to a social media network. In this way, from a technical perspective, the various situations are mapped. File downloading emulates data traffic with an individual server in the network (e.g. downloading apps, emails or social media content), while web browsing emulates communications with many different servers over parallel IP connections (along with conventional browsing, most apps also communicate with multiple servers at the same time). The video stream requires a virtually continuous data flow, uploading images to a social media network represents sending data to a network server, and a load test (data transmission over parallel connections from and to a high-performance data server) checks the maximum achievable data rate.

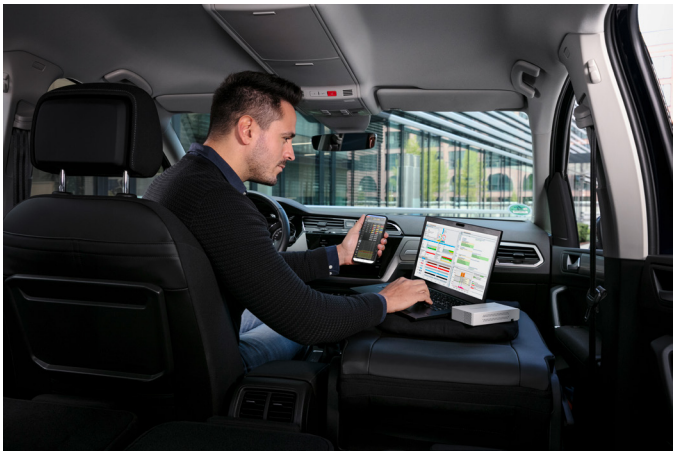

Fig. 2: A fleet of test vehicles and testers on foot spend several weeks collecting seamless data concerning the quality of a network.

Various aspects are tested and scored for each of these cases, including phone calls:

- Does the application start running at all or within a predefined time window, and is the connection maintained over the total time?
- How long does the start phase take (e.g. call setup or start of video playback)?
- What is the quality during the application, or how long does it take to complete the task (e.g. uploading an image)?

All of these aspects contribute to the overall score with suitable weighting.

A large number of field measurements – typically several thousand throughout the entire network – are required in order to obtain a statistically reliable score. Automated test systems in vehicles as well as portable systems are used for this (Fig. 2).

Benefits for network operators and users

Nationwide benchmark measurements have a fairly strong public impact, especially in Europe, and are decision factors for many users. Periodic network ratings by consumer magazines are often reported on popular news portals. Catchy quality KPIs are naturally an advantage. To obtain them, the previously described quality measurements are performed in various environments. This includes differentiated scoring for urban and rural areas as well as highways, trains or highly frequented places such as railway stations, stadiums and airports. The weighted scores are combined to calculate the quality score for the overall network. The quality scores for individual aspects, such as coverage along major highways, can be indicated individually. This makes it easy for readers to decide which network operator has the network that best meets their needs.

However, this is only the publicly visible benefit of an integral scoring method. It also gives network operators a tool to improve their networks in the regions and for the applications that provide the most benefits for their customers. Network operators get a quick overview of the performance of their networks and can take targeted measures to remedy any deficiencies.

Along with regional assessment, other criteria can also be used as a basis for scoring, such as technology (e.g. 2G/3G versus 4G) or network performance after installation of new hardware or software. With a clearly defined scoring system, all changes to the network and their impact on the perceived quality can be directly checked and quantified.

Rohde&Schwarz uses the method described by ETSI to calculate the network performance score as a key entry element in the SmartAnalytics analysis and reporting tool, which can be used to evaluate the data collected during a test campaign. Extensive filter and analysis functions allow efficient navigation of the measurement data down to the lowest detail level of communications between devices and the network. The integrated view of the network performance score also shows potential room for improvement for the selected region or application and enables effective focusing on problematic situations in the network.

Dr. Jens Berger

A closer look at the scoring method

The method for calculating and scoring individual services and combining them to obtain an overall score has intentionally been kept simple and clear. The basic principle is weighted addition of point scores for individual aspects of the applications, such as accessibility and the quality or duration of the application.

Various statistical KPIs are calculated for this. Average values of individual parameters have only limited relevance to user perception and are often influenced by high individual values. The performance deficits of a network can be grasped better with percentile values, which specifically capture the share of problematic tests, or by testing compliance with tolerable thresholds, because user perception is ultimately determined by negative experiences.

The individual KPIs determined from a large number of individual measurements are first converted from technical units (e.g. milliseconds or kbit/s) to a neutral points scale. This is based on a simplified model of human perception with saturation areas at the lower and upper ends of the scale (Fig. 3). The abstracted KPIs obtained in this way can now be directly compared with each other and summed to obtain higher-level quality values.

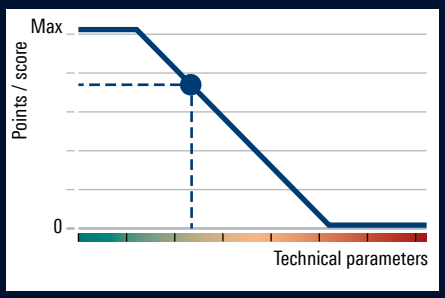

Fig. 3: Conversion of technical measured values into dimensionless points with saturation areas provides a simple simulation of human perception.

Point scoring can be performed for individual geographic regions and with regard to other meaningful categories, for example locations of particular importance, transportation, etc. The point scores for each category are then weighted (taking into account typical aspects, such as population density or data volume at specific locations) and further combined to determine the performance of the entire network.

The aim is to get an overview of the overall performance of the network from this total score (Fig. 4) and to effectively localize weak spots. The uniform points scale makes it possible to easily and verifiably identify problematic regions, applications and even individual KPIs. Maximum achievable scores can be determined for each region and category, and even for each individual parameter. If the score is significantly lower than the maximum, there is a problem at this location or with this service. At the same time, this method also makes potential room for improvement directly visible.

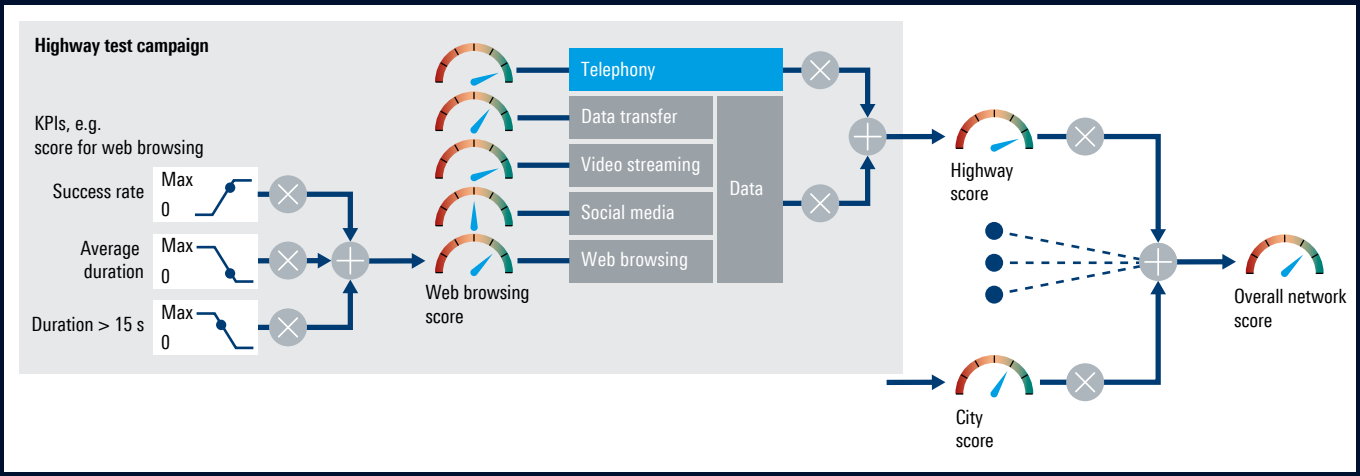

Fig. 4: The ETSI measurement method for obtaining an overall network performance score evaluates a series of typical applications such as web browsing and video streaming, adds the weighted values to obtain individual scores, and adds the weighted individual scores to obtain an overall network score.

Rohde & Schwarz
The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

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PD 3609.9905.32 | Version 02.00 | August 2023 (nk)

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PD 3609.9905.32 02.00 PDP 1 en