

QoS Made Easy

Smart Measurement and Metrics

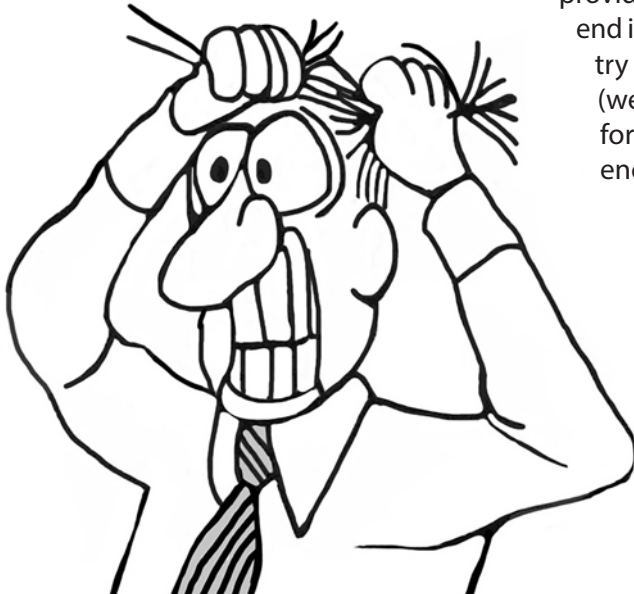


A good user experience?

When smartphone users surf the Internet, watch YouTube™ videos, listen to music on Spotify™, or just make phone calls, they expect it to work without problems.

However, if loading a page takes forever, if video streaming freezes, or if there are long delays when making a call or the call is aborted, the user experience suffers.

The problem: Mobile customers usually don't know and don't care if the cause is a bad mobile connection—and the problem therefore in the realm of the provider—or if the server at the other end is overloaded because many users try to access the same web resource (website, video, etc.). What counts for them is the end-to-end experience.



Measurable parameters (KPI)

The user experience is expressed in parameters called KPI, KQI or QoS..

Each service (such as telephony, web browsing or video streaming) has its own KPI.

With Voice-over-IP, telephony also uses standard data transmission protocols.

Data packets of certain VoIP types, such as VoLTE, can be given preferential treatment to improve quality.

Mobile radio technology generations

Mobile radio access technologies are categorized by generations: 2G, 3G, 4G, 5G etc. Each main generation has multiple subtechnologies that are the result of evolving main technologies.

The most obvious difference between these technologies is the maximum achievable data rate.

Mobile radio generations, technologies and services

	2G	3G	4G	5G
Standards	GSM, CDMA, EDGE, GPRS	UMTS, CDMA2000, HSDPA, EVDO	LTE Advanced, WiMax	3GPP Rel. 15
Voice transmission	circuit switched	circuit switched	packet switched	packet switched
Data transmission	circuit switched	packet switched	packet switched	packet switched
Data rate	up to 473 kbit/s	up to 42,2 Mbit/s	up to 1 Gbit/s	up to 7,5 Gbit/s
Services	text messaging, text-based email	web browsing, email, audio and video streaming	HQ video streaming, VoIP	virtual and augmented reality (VR/AR), Internet of Things, autonomous driving etc.

The maximum data rate

The achievable maximum data rate is influenced by various factors:

- The available radio access technology
- The ramp-up phase, i.e. the time until the maximum data rate is reached. As a consequence, the maximum data rate is not reached with small data volumes
- The number of concurrent users in a mobile radio cell
- Signal level and connection quality

Together, these factors determine what sort of quality users can expect when using a particular type of service on their mobile devices. They also give an indication whether an increase in technical performance leads to a perceptible increase in quality at all.

This means:

A service used in a stable 3G network may result in a better user experience than the same service used in a less stable 4G network.

Service type and throughput

Data throughput is defined as the amount of data transmitted per time unit (kbit/s, Mbit/s). Different services have different demands on the data rate that is necessary for smooth operation.

The table on the right shows some typical values for various services.

However, these values can only give a rough indication of the throughput values necessary for a good user experience for a given service.

Service	Data Rate
Video streaming	1 - 10 Mbit/s
Web browsing	100-200 kbit/s
Music streaming	100 kbit/s
IP Telephony	30-100 kbit/s
Video Telephony	1 Mbit/s
Text Messaging	1-10 kbit/s
Mail	100 kbit/s

Data test KPI

Data service tests can be categorized as follows:

Data Test Type	Service Characteristics	KPI
Upload/ Download	Testing the maximum achievable data rate	<ul style="list-style-type: none">■ Throughput■ Connection failure rate■ Duration of data transfer■ Drop rate
Web browsing	Many small elements are loaded partly in parallel, partly one after the other	<ul style="list-style-type: none">■ Loading time■ Drop rate
Video streaming	For video streaming, a constant minimum data rate is more important than temporary peaks	<ul style="list-style-type: none">■ Frequency of „freezing“■ Drop rate■ Time to playback

Telephony KPI

A typical test scenario for telephony involves two devices, in which the first device calls the second one. Once the connection is successfully established (the call setup time is registered), the connection is held for the predefined time and then terminated.

The most important KPIs for telephony are:

- **Voice quality**, measured, for example, using the internationally standardized ITU-T P.863 (“POLQA”) method
- **Stability of the connection**: how long can the connection be maintained?
- **Delay between speaking and listening** – also called latency or delay – especially for over-the-top VoIP services like Skype™ or WhatsApp™

Data packets of VoIP services that are part of the standardized network technology (e.g. VoLTE for 4G), are prioritized.

Voice data packets of over-the-top (OTT) services, however, are regarded as standard data packets. The probability of delays is therefore higher.

If a delay is longer than approx. ½ second, participants might unintentionally interrupt each other, because they assume the other party is making a pause. This can result in a very poor quality of experience.

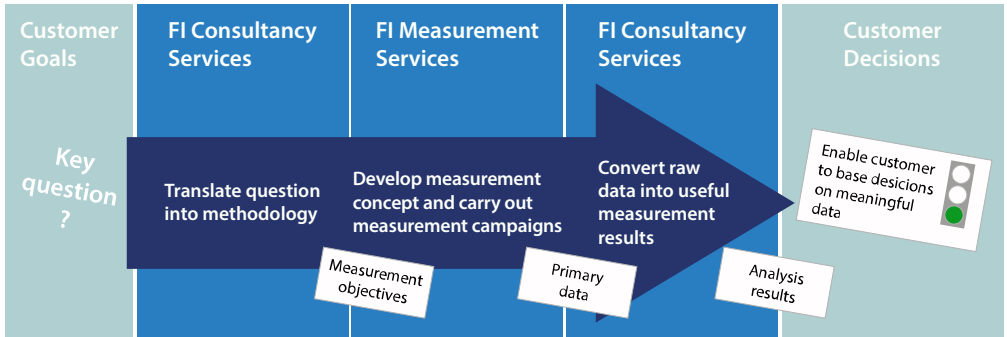
QoS is business value

User experience is a key success factor for mobile network providers and industries whose business model largely depends on a well-performing mobile network (for example, music or video streaming services).

For these stakeholders, it is therefore important to obtain meaningful data that shows where investment in the mobile network (or other components) is necessary to optimize the user experience and guarantee the service quality promised to customers.

If companies invest with the objective to increase the performance of the mobile network, this data provides information how investment can be made with the best cost-benefit ratio.

Ideally, a set of well-chosen QoS performance indicators describes the customer's benefits and therefore the business value of a mobile network. Additionally, this data serves as a basis for determining how services are communicated to the customer or what a fair use policy would have to look like.



Measuring the user experience

At this point, it is important to keep in mind that the quality as perceived by a user is influenced by factors that network operators cannot completely control. As a mere transport medium, the mobile network itself is not to blame if for example the server that delivers a website or video is overloaded.

However, the average user is generally not interested in the root causes of poor performance. A network operator will therefore use end-to-end measurements with realistic use cases combined with diagnostic tests to identify the origin of problems.

In order to measure the user experience, it is necessary to consider the entire utilization action. For a telephony service, for example, this includes the complete process from establishing a connection after the user has entered a phone number until the end of the call.

Combinations of end-to-end tests and diagnostic procedures are also used by other stakeholders, e.g. companies that purchase mobile services from network operators or corporate customers with devices for employees. KPI and targets for such services are defined in Service Level Agreements (SLA).

Our measurement systems

The whole range from smartphone-only to multi-channel measurement

All Focus Infocom measurement systems master end-to-end service tests with standardized KPI.

Where KPI do not exist or where they are not sufficient, we will develop suitable parameters with the aim of describing the user experience as realistically as possible. This can also be done in close cooperation with our clients for individual use cases.

With our unique SAM (Smart App Manager) technology, we also provide a platform that allows us to control, measure and evaluate the activities of smartphone apps such as Facebook™, WhatsApp™, Spotify™, or YouTube™, using KPI that can be freely defined.





Get in touch!

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