ETSI TR 103 467 V1.1.1 (2018-06)

**Speech and multimedia Transmission Quality (STQ);
Quality of Service aspects for IoT;
Discussion of QoS aspects of services related
to the IoT ecosystem**

Reference

DTR/STQ-00213m

Keywords

3G, data, GSM, IoT, M2M, network, QoS, service

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Copyright Notification

Contents

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

The Internet of Things (IoT) is a term which describes a sphere where a wide variety of physical devices connect and exchange data with other devices or with central entities using packet switched data transfer over mobile or fixed networks. The present document deals with the resulting ecosphere from a Quality of Service. i.e. end user, service-oriented point of view. The central question is about the necessity of new or additional QoS metrics beyond the portfolio which has been already defined for IP protocol based packet switched networks. The present document provides a taxonomy for IoT applications and creates a relation between standard QoS metrics and their application to the IoT world.

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The conventional definition of QoS assumes usage, and respective perception of quality aspects, from a human perspective as these are the end users of network services. In an IoT context, these end users are machines. However, the main metrics which define the quality a communication network delivers, are basically the same. For instance, an IoT device may also need a certain data rate or a given maximum transfer delay to fulfil its purpose optimally.

However, IoT devices have some specific properties which derive from their functional purpose. It cannot be taken as granted that the current standardized QoS parameter inventory covers all angles of quality which are relevant for IoT. The present document provides a systematic approach to describe QoS requirements of IoT devices, and answers the question if additional QoS parameters are needed to capture the specific properties of mobile networks dedicated to the IoT.

1 Scope

The present document discusses Quality of Service (QoS) aspects of services related to the Internet of Things (IoT) ecosystem from an end-to-end perspective; a strict end-user, service-oriented point of view. Here, end-to-end is understood as "from a service user/terminal/provider to a service user/terminal/provider".

The discussion deals with two questions. The first question is if the existing framework for QoS parameter definitions and methodologies is sufficient to also include the IoT angle of view. The second question is if the existing portfolio of QoS parameters needs extensions or adaptations.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

IoT	Internet of Things
QoE	Quality of Experience
QoS	Quality of Service

4 Taxonomy of IoT use cases

IoT subsumes - linked implicitly or explicitly to respective devices - a large and quite diverse number of applications.

It is useful to apply a taxonomy, i.e. a classification scheme, as a step on a systematic approach to answer the question if additional QoS parameters are needed for IoT.

In this context, it is also important to keep in mind that while the 'actor' in an IoT use case may not be a human, the underlying use case or functional target is still driven by human needs. The 'thing' which is the primary actor may therefore be just an agent or representative of a human interest.

Therefore, the term QoE coined for directly human-related cases, where the E stands for direct subjective assessment of the experience made with a given level of QoS, transforms into a metric describing the degree of fulfilment of the underlying need.

The proposed axes of a taxonomy are:

- Degree of real-timeliness: Which response times (as an order of magnitude) are typically required to fulfil the target?
- Degree of interactivity: Actually this can be a sub-category of real-timeliness. Range would be from completely one-way to fully transactional/dialogue based.
- Data rate requirements.
- Data volume: What is the typical amount of data to be transferred in the course of a typical transaction?
- Mobility: Is this application requiring mobility functions of the underlying network?
- Power supply: Is this application critical with respect to power supply, e.g. needs to run on limited supply, such as a battery that needs to last a certain amount of time without replacement?
- Coverage: Is it likely that the device is located in places where network coverage may be critical (e.g. deep in-house or in strongly shielded housings).

5 Classification of selected IoT application examples

5.1 Introduction

With the taxonomy outlined in the previous clause, a number of IoT applications have been selected, and are classified along this taxonomy.

5.2 Voice-controlled interfaces to shopping platforms

This is essentially an extension of voice control. A local node triggers a range of actions which range from controlling local functionality (e.g. playing music), to initiating product purchases.

Table 1

Basic type	Voice control; transfer of recorded voice to a central server.
QoS parameters class	Packet data transfer; service availability, data rate, latency.
Degree of real-timeliness	High. Fast response to voice commands is essential to the function of this service.
Degree of interactivity	Different type: response either by actions (voice control), or dialogue-style when the system asks back.
Data rate requirements	Low to medium; typically 100 kbit/s (audio). It is of course imaginable that additional information such as camera feeds may be added.
Data volume	Between some seconds of audio in case there is local pre-processing (e.g. activation sequences), or full-time audio transmission while active.
Mobility	Typically low (services used through devices at home) but may also be used in mobile scenarios (e.g. while driving).
Power supply	Assumed uncritical (indoor, line voltage supply; perhaps a matter of convenience when used in mobile scenarios).
Coverage	Medium.

5.3 Metering

Table 2

Basic type	Transfer of measurement data such as energy consumption, calorimetric information, etc.
QoS parameters class	Packet data transfer; service availability, data rate, latency.
Degree of real-timeliness	Low to medium (in the case data is used to manage energy distribution).
Degree of interactivity	None or low (in case of control elements such as management of energy consumption).
Data rate requirements	Low, assumed < 10 kbit/s.
Data volume	Small (a few kBytes).
Mobility	None or low (connected to fixed-location assets).
Power supply	Critical or uncritical depending on the degree the IoT device is integrated.
Coverage	Can be critical (deep in-house placement).

5.4 Predictive maintenance/telemetry

Table 3

Basic type	Transfer of status data of machines/components.
QoS parameters class	Packet data transfer; service availability, data rate, latency.
Degree of real-timeliness	Low to medium.
Degree of interactivity	None or low (in case there is a back channel with some kind of status indication).
Data rate requirements	Low, assumed < 10 kbit/s.
Data volume	Small (< kBytes).
Mobility	None to high depending on the type of asset.
Power supply	Assumed to be uncritical as IoT device is typically part of asset at design time; otherwise may be an issue.
Coverage	Can be critical (stationary deep in-house placement); in mobile applications assumed to be uncritical (asset assumed to be in radio coverage frequently enough).

5.5 Bicycle locator

Table 4

Basic type	Periodic transfer of location data on a permanent basis or after activation after the vehicle is recognized as missing/stolen.
QoS parameters class	Packet data transfer; service availability, data rate, latency.
Degree of real-timeliness	Low (frequency ~1/hour or less will fulfil the purpose).
Degree of interactivity	None or low (in case there is a back channel with some kind of status indication).
Data rate requirements	Low, assumed < 10 kbit/s.
Data volume	Small (< kBytes).
Mobility	High.
Power supply	Assumed to be critical, the devices needs to be ready to function over several years.
Coverage	Medium (if the vehicle is inside buildings there will be no GPS coverage anyway but transmitting last known position can be helpful).

5.6 Bio sensors (e-health)

Table 5

Basic type	Transfer of sensor data from various sensors (e.g. heart rate, blood pressure, blood oxygen saturation, blood sugar, etc.).
QoS parameters class	Packet data transfer; service availability, data rate, latency.
Degree of real-timeliness	Low to medium.
Degree of interactivity	None (there may be alarming of wearers to critical conditions, but it is assumed that other devices e.g. smartphones will be used in that case).
Data rate requirements	Low, assumed < 10 kbit/s.
Data volume	Small (< kBytes).
Mobility	Usually high (same as wearer).
Power supply	High, convenience will require long run time on battery, (expected 0,5 years run time or better before replacement).
Coverage	Assumed to be uncritical in typical cases (wearer assumed to be in radio coverage frequently enough) but there may be cases where tight monitoring is important.

6 IoT with local concentrator nodes

IoT does not necessarily mean that each device has its own direct connection to respective infrastructure. There are cases where a multitude of local devices exist, for instance in cars or trains. These devices can be connected - via short-range means such as Bluetooth of WiFi, or even through a wired backbone - to a local node which manages the actual connection to remote IoT infrastructure.

In that case, local use cases are the same but the requirements for mobile networks are more likely to be similar to traditional packet data connections. Performance requirements, typically for throughput and latency, are then determined by the aggregated requirements of local devices and their use cases.

7 Methodology

With current IoT network concepts it can be safely assumed that measurements will have to use IoT-specific devices, i.e. standard modems or smartphones are unlikely to be capable of acting sufficiently similar.

Apart from that, it is assumed that basic upload and/or download scenarios, or control using respective building blocks, can be used, so use case parameters are within the space respective standard tests are providing (data volume and/or time window and frequency of transactions).

8 Conclusion

After thorough consideration, it can be concluded that IoT does not require a qualitative change in current methodologies or extension of the current portfolio of QoS parameters. The underlying service for IoT is packet data transfer, perhaps combined with telephony-style transfer of audio at the most; so existing QoS parameters and testing methods are sufficient.

Also, the degrees of freedom of such tests (test case parameters) will be sufficient.

There are two aspects which may constitute border cases between technical requirements and QoS.

One would be the ability of IoT devices to run with low energy requirements (operate long-term with a given battery capacity). The other one is the ability to operate under poor radio coverage conditions and, as a possible improvement for this situation, to be able to use multiple networks by design.

It may be argued that these aspects, as they relate to the usefulness of an IoT solution to fulfil a given purpose, may also be understood as QoS or QoE property. However, this would be covered by existing QoS parameters from the service independent category (e.g. Radio Network Unavailability).