ECC Report 195

Monitoring of Quality of Retail Internet Access Service – Pre-selected Minimum set of technical parameters and measurement methods. Best Practices

**21-22 November 2012**

Approved for public consultation

# Executive summary

The purpose of this report is to provide information about best practices in monitoring the quality of Retail Internet Access Service and recommend converged or harmonized Minimum set of methods to achieve this goal.

The Internet has become increasingly important and the number of applications based on the Internet rises continuously. Along with the growing popularity of the Internet and the growing demands of these applications, the number of complaints about the quality of the Internet Access Service increases as well. Although there are many different tariffs and classes offered by the Internet Access Service Providers, information about the quality of Internet Access Service are given rarely, or the information cannot be compared with any other offer, so no transparent and informed choice can be done by the user. If unified data format for quality of service would exist, end users could make informed choice and a reduction of complaints would be expected.

The Universal Service Directive Article 22 requires Member States to “ensure that national regulatory authorities are […] able to require undertakings […] to publish comparable, adequate and up-to-date information for end-users on the quality of their services […]”. The same article says that “regulatory authorities may specify […] the quality of service parameters to be measured” and later on “authorities are able to set minimum quality of service requirements”. For those reasons, facilitating international comparability and supporting national regulatory authorities in the selection of information to be published are very important actions. This report summarizes the measurements best practices by Member States at present and recommends converging actions towards a more consistent future practice.

Possible parameters, measurement configurations and other aspects relevant for the evaluation of quality of service of Internet Access Service are discussed. With reference to previous experiences by Member States, a Minimum set of standardized parameters is selected to become the base for evaluating of the quality of Internet Access Service. The measurement configurations to be considered can be divided into in-net measurements and over-the-top measurements. The in-net measurements cover the area of influence of the internet service provider, while over-the-top measurements show a view closer to the end user perception. Termination units are assessed before an appropriate form of presentation of the results is considered. In addition, complementary measurement methods mirroring the perception of the end user are presented.

The main conclusions of the report are:

Which parameters, how and where should be measured are essential aspects for receiving comparable information of the quality of Internet Access Services; the presentation form including the observed values and units have to be harmonized.

Parameters about Transmission speed, Delay, Delay variation, Packet Loss Ratio and Packet Error Ratio are necessary for evaluating the quality of Retail Internet Access Service.

Additionally to those technical parameters, NRA’s are free to observe and evaluate more technical or/and administrative parameters.

Measurements within the ISP-leg are the most comparable, but a better figure of the performance experienced by the end user can be achieved using end-to-end/over-the-top measurements.

**TABLE OF CONTENTS**

[0 Executive summary 2](#_Toc342559656)

[1 Introduction 6](#_Toc342559657)

[2 The Aim of the Report 7](#_Toc342559658)

[3 Problem Description and Policy Objectives 9](#_Toc342559659)

[4 Definitions of Parameters 11](#_Toc342559660)

[5 Minimum Set of QoS Technical Parameters and Observation Values 17](#_Toc342559661)

[6 Determination of the Values and Measured Units of Parameters 24](#_Toc342559662)

[7 Measurement Methods 27](#_Toc342559663)

[7.1 Scenarios 27](#_Toc342559664)

[7.1.1 QoS Evaluation of the ISP Leg 28](#_Toc342559665)

[7.1.2 QoS evaluation of the access to a national IXP 29](#_Toc342559666)

[7.1.3 QoS evaluation of the access to international IXP 30](#_Toc342559667)

[7.1.4 Conclusions of the Scenario chapter 31](#_Toc342559668)

[7.2 Measurements Applications and Termination Units 33](#_Toc342559669)

[7.3 Sampling Access Lines and Measurement Moments 36](#_Toc342559670)

[7.3.1 Selecting Access Lines for Each Speed Range under Study 37](#_Toc342559671)

[7.3.2 Selecting the Measurement Moments 37](#_Toc342559672)

[7.3.3 Final Remarks on Sampling and Accuracy of the Measured Values 38](#_Toc342559673)

[7.4 Specification of the Test File 38](#_Toc342559674)

[8 Presentation of the Values to the End Users 39](#_Toc342559675)

[8.1 Publishing of Consolidated Information on QoS Values 39](#_Toc342559676)

[8.2 Form of QoS Measurement Results (values) Publication 39](#_Toc342559677)

[8.3 Other Aspects of QoS Information Publishing 41](#_Toc342559678)

[9 Complementary Measurement Methods 42](#_Toc342559679)

[9.1 Distributed Measurements 43](#_Toc342559680)

[9.2 Subjective Evaluation – Global User’s Level of Satisfaction 45](#_Toc342559681)

[10 Conclusions and Recommendations 47](#_Toc342559682)

[ANNEX 1: Responses to A Questionnaire on QoS Frameworks and Practices in Case of Retail Internet Access SENT ON SEPT. 2011 49](#_Toc342559683)

[ANNEX 2: The information about estimated (planned) values publication for new Internet Access offers and for estimated (planned) values publication 72](#_Toc342559684)

[ANNEX 3: List of references 73](#_Toc342559685)

**LIST OF ABBREVIATIONS AND DEFINITIONS**

|  |  |
| --- | --- |
| **Abbreviation** | **Explanation** |
| **Active method** | Intrusive, measurement method possibly influencing the normal service provision |
| **ASP** | Application Service Provider |
| **BEREC** | Body of European Regulators for Electronic Communications |
| **CAP** | Content or Application Provider |
| **DHCP** | Dynamic Host Configuration Protocol | |
| **DNS** | Domain Name System | |
| **DSL** | Digital Subscriber Line | |
| **ETSI** | European Telecommunications Standards Institute | |
| **ETSI EG** | ETSI Guide | |
| **ETSI ES** | ETSI Standard | |
| **ETSI TS** | ETSI Technical Specification | |
| **IAS** | Retail Internet Access Service | |
| **IP** | Internet Protocol | |
| **IPDV** | IP Packet Delay Variation (Delay variation) | |
| **IPER** | IP Packet Error Ratio | |
| **IPLR** | IP Packet Loss Ratio | |
| **IPTD** | IP Packet Transfer Delay | |
| **ISP** | Internet Access Service Provider | |
| **ITU-R** | ITU Radiocommunication sector | |
| **ITU-T** | International Telecommunication Union – Telecommunications Standardization Sector | |
| **IXP** | Internet Exchange Point | |
| **MO** | Measuring Organization, i.e. NRA, other competent national institutions or an independent organization measuring or determining the measurement methods | |
| **MOS** | Mean Opinion Score | |
| **NRA** | National Regulatory Authority | |
| **NTP** | Network Termination Point | |
| **NTU** | Network Termination Unit | |
| **Passive method** | Not intrusive, measurement method not influencing the normal service provision | |
| **QoS** | Quality of Service | |
| **TCP** | Transmission Control Protocol | |
| **UDP** | User Datagram Protocol | |
| **USD** | Universal Service Directive (2002/22/EC) amended by the 2009/136/EC Citizen’s Rights Directive | |
| **VOI** | Voice over Internet | |
| **WG NaN** | Working Group Numbering and Networks (within the CEPT) | |
| **WG NaN PT TRIS** | Project Team on Technical Regulatory Issues | |

# Introduction

There is no doubt that publicly available, easily comparable and adequate information about the Quality of Service of the Retail Internet Access Services (IAS) provided would contribute to the well informed choice of the potential end user between numerous Internet Access offers available. While this in turn will contribute to positive experience end user will perceive while consuming Internet Access Service. These reasons are of crucial importance in the overall context of the broadband promotion.

At the moment end users are faced with difficulties if they decide to buy IAS since it is quite challenging to compare in an objective way the technical characteristics (mainly Transmission speed) of the different offers of the different Internet Access Service Providers (ISPs). There are three main reasons explaining this problem:

1. ISPs are measuring (if at all) different sets of Quality of Service (QoS) parameters;
2. Not harmonized definitions and methodologies applied for the measurement of the QoS parameters give non comparable values among different ISPs even in case of similar QoS parameters;
3. Consolidated information regarding QoS values from different ISPs is available just in few countries across Europe.

A survey based on a questionnaire (see Annex 1) shows that many National Regulatory Authorities (NRAs) (or other competent national institutions), have established their own QoS measurement methods and tools to evaluate QoS parameters of IAS. It is still a common practice that within the same country different ISPs and NRAs (or other competent national institutions) measure QoS applying different methods, measurements are performed between different points in the networks, etc. That implies that users cannot compare IAS provided by different ISPs in order to make an informed choice.

Apart from that there is also no common approach among NRAs (or other competent national institutions) on measurement methods, what implies that offers from ISPs from different countries cannot be compared. This makes price and quality of service benchmarks between countries less reliable.

The 2002/22/EC Universal Service Directive amended by the 2009/136/EC Citizen’s Rights Directive (USD) contains some tools to empower customers in order to make a more informed choice of ISP and subscription. In this report are explored the different options and the technical impacts on how NRAs (or other competent national institutions) in practice can apply these provisions and at the same time address the three problematic areas identified above.

It should be noted as well that for policy and regulatory aspects in European Union (EU), Body of European Regulators for Electronic Communications (BEREC)[[1]](#footnote-1) performed some studies on QoS in the context of the Network Neutrality. This is also an attempt to clarify quality aspects related to the regulatory domain. Whereas BEREC analysis starts the exercise from the policy and regulatory analysis points of view, the present report is rather pragmatically gathering experience from on-going projects running in different countries, trying to converge them and reflecting on new generally accepted useful approaches. Both approaches should be seen as complementary to achieve enhancements in the single EU communications market.

# The Aim of the Report

The overall aim of the present report is to accommodate NRA’s (or other competent national institutions) with the practical application of the EU’s regulations on the QoS in order to allow their citizens to make a more objective choice of ISP and type of IAS, not only based on the price, but also on the performance of the connection. For that purpose, the report summarizes and accommodates the experiences and capacities of the NRA’s (or other competent national institutions) dealing with quality of the IAS problematic through formulating the best practices from the field.

The report names, but does not discuss, the Administrative quality parameters which could be used for evaluation of IAS.

The term IAS used through the text of the present report considers Internet Access Service supplied on the retail basis to the end user and does not cover the cases when Internet Access Service is provided on the basis of non - standard (not available as ordinary IAS offer) service level agreement between ISP and end user.

The parameters and measurements described by the report are applicable for IAS offers without regards to the technology used to provide IAS[[2]](#footnote-2). Nevertheless the NRA’s (or other competent national institutions) may still find it useful to distinguish between different technologies while publishing the data and (or) performing measurements of the additional technical parameters out of the scope of the Minimum number of technical parameters described in the Chapter 5.

The structure of the report is the following after the generic introductory chapters (1- ‘Introduction’ and 2- ‘Aim of the report’):

**Chapter 3** discusses the problematic and policy objectives related to the evaluation of the IAS. The chapter elaborates on the relevant provisions of the USD aimed to address problematic defined;

**Chapter 4** lists the most relevant quality parameters (Technical, Administrative and parameters which are applicable for Subjective evaluation) which in principle could be used for evaluation of quality of service of the IAS. The chapter provides the definitions of the parameters listed. In case of each parameter chapter provides the definition of parameter established by standardization (if this is the case), identifies the deviations from the standardized approach in definitions established at the national levels.

**Chapter 5** provides the rationale behind the establishment of the Minimum Set of the harmonized Technical parameters; discusses the importance of some Technical parameters against the others and suggests the composition of the Minimum Set.

**Chapter 6** presents the options to determine values to be observed and measurement units of Technical parameters discussed in the Chapter 5.

**Chapter 7** is dedicated to different aspects of the Measurements of the quality of the IAS namely: “In-net” quality evaluation scenarios, sampling and representativeness; issues related to performance of the measurements in terms of frequency, length, etc. The chapter provides proposals for the mentioned aspects of the measurements which could be considered for harmonization purposes and discusses Measurement applications and different Termination units which could be used for QoS measurements.

**Chapter 8** is discussing the practical approach for the presentation of the statistical information about the quality of the Retail Internet Access Service to the end user with the aim to provide him / her with the comparable, up to date and adequate information.

**Chapter 9** is discussing the complementary methods particularly those designated as “over-the-top”. These QoS evaluation methods could be considered as a complementary to the ‘in-net’ ones discussed in the Chapter 7 which are closer to traditional objective test measurements, the network management, planning methods and the specific network technologies. Nevertheless, particularly with the diversity of technologies used and the multitude of applications offered to users, it becomes more important to survey parameters closer to the overall user perception.

**Chapter 10** provides conclusions of the Report.

# Problem Description and Policy Objectives

There are no doubts that Access to the Internet is gaining significant importance among other retail electronic communications services. The number of IAS end users is growing steadily and quickly. Together with this the respective number of complaints regarding the IAS is increasing in some countries. In a few countries quality of IAS is becoming dominating concern of the end users.

Today the end user can choose among numerous IAS offers provided via different technologies by different ISPs (e.g. ADSL, GPON, DOCSIS, GPRS, Edge, LTE, WIMAX, etc.). The ability to make informed choice among those IAS offers determines to the significant extent if the end user would be satisfied with the IAS consumed and is an essential condition for a transparent, fair market operation.

It should be noted as well that IAS are differentiated not only by price, but also by QoS parameters, including technical parameters which are not always easy to understand by a regular end user. Therefore ability to make informed choice referred to above depends on number of factors, including the scope of information about quality parameters available, manner of publication of such information, capacity of the end user to understand the presented characteristics of the IAS.

Article 22 paragraph 1[[3]](#footnote-3) of USD **requires** the Member States to ensure that undertakings providing publicly available electronic communications services (undertakings) “publish comparable, adequate <…> information for end-users on the quality of their services”. In order to reach the objective set forth by the recent provision it is **essential to achieve common understanding in following three areas: what are the QoS parameters to select, how and where they should be measured**. It is obvious that without achieving harmonization of those three issues (firstly on the national level) it is impossible to ensure that QoS parameters measured and published by the undertakings would be comparable and adequate. Subsequently not adequate and not comparable, QoS parameters are not serving their purpose – to provide end user with comparable and adequate information about the services provided.

USD Article 22(1) requires Member States to provide NRAs (or other competent national institutions) with discretion to decide on the matter to require undertakings to make publicly available certain information about the quality of electronic communications services, including IAS, but does not impose such obligation directly. Thereby the decision to consider imposition of that obligation as such should be taken on the national level by each Member State taking into account national circumstances.

An application of obligation foreseen in USD Article 22(1), should address the problem on the market, be adequate and proportional as any other obligation foreseen by the Regulatory Framework of the EU. Absence of publicly available “comparable, adequate and up-to-date information for end-users on the quality of their services” may be considered a problem because it significantly reduces the possibility of the end user to make informed choice.

While executing its discretion to impose obligation foreseen in USD Article 22(1), NRAs (or other competent national institutions) should take account on the views of interested parties. Scope of the interested parties referred should go beyond the providers of electronic communications services and include organizations and associations representing the interests of end users and ASPs. It is important to consult such organizations and associations because end users and ASPs are precisely the ones that should benefit from the imposition of named obligation. In that context it is important to decide on the scope and form of the information to be published. Chapter 8 of this report discusses that matter in more detail.

In the context of deciding on the publication of QoS information, USD Article 22(2)[[4]](#footnote-4) even more broadens the competence of the NRAs (or other competent national institutions) and additionally provides that NRAs (or other competent national institutions) “may specify, inter alia <…> form and manner of the information to be published <…> in order to ensure that end-users <…> have access to comprehensive, comparable, reliable and user-friendly information”. The recent provision is important in order to harmonize the publication of information by numerous ISPs on quality of IAS they provide, so that published information would be user-friendly and easy to compare.

Summarizing, it may be concluded that, in the context of imposition of the obligation of publication of information on QoS of IAS as such, provisions of the USD Article 22 (1) and (2) establish sufficient legal reference for NRAs (or other competent national institutions) in order to:

* ensure that certain information on the quality of service of the IAS offered would be made publicly available, as well as
* specify the form and manner of the publication of such information.

Both decisions should be based on the national circumstances and considering the views of interested parties.

However the problematic related to implementation of the right of the end user to make informed choice goes beyond simple harmonization in terms of publication of information on quality of IAS on national level. Nevertheless important, harmonized scope of the information published does not ensure that values of quality parameters published could be directly compared. So that to ensure such comparability (1) the quality parameters as such, (2) the definitions of quality parameters and (3) methodologies used to obtain values of such parameters should be harmonized. Only in case when harmonization of all three positions is reached on the national and international levels, quality of service of the IAS can be evaluated in the same manner by all the ISPs and results of such evaluations could be directly compared by the end users. Such harmonization is therefore of crucial importance and ensures the policy objective brought forward by the USD Article 22(1).

With that, the objective USD Article 22 (2) establishes the right of the NRA (or other competent national institutions) to specify the “quality of service parameters to be measured” and suggests that “where appropriate the parameters, definitions and measurements methods set out in Annex III may be used”. The Annex III of USD establishes three quality parameters related to the access to the public communications network and makes reference to ETSI EG 202 057.

The directive does not specify and in any case does not limit the list of parameters or methods which could be applied, however as the first choice for reference on that matter may be presumed to be the ETSI EG 202 057. While the ETSI EG 202 057 defines, among others, end-to-end measurements, it may be presumed therefore that the active measurement method as well as measurements beyond the ISP leg are considered.

# Definitions of Parameters

ETSI and ITU deliverables as ETSI EG 202 057, ETSI TS 102 250, ETSI EG 203 165, ETSI EG 202 765, ITU-T Recommendations Y.1540 and Y.1541 establish a number of user related QoS parameters and its definitions[[5]](#footnote-5).

The aim of this chapter is to present an overview of QoS parameters which are related to the quality of IAS and their definitions from the available references given in standardization deliverables. The purpose of this exercise is to put together all the parameters and their respective definitions from the different references in order to analyse if and how very different approaches are used in defining respective parameters.

Later on those parameters would be used to create the set of parameters to evaluate quality of the IAS.

For the sake of clarity, QoS parameters are grouped in two generic groups: technical and administrative. Subjective QoS parameter Global user satisfaction is placed separately at the end of table. Furthermore technical QoS parameters, representing similar or the same quality characteristics, but named and/or defined in different ways in standardization deliverables are grouped in subgroups. Similarly parameters representing mobile IAS QoS are grouped in separate subgroup of the group of technical parameters.

1. Definitions of QoS parameters which could be considered for IAS

| **Nr.** | **Parameter** | **Definition with reference** | **Notes** |
| --- | --- | --- | --- |
| **Technical parameters** | | | |
| **1.** | **Parameters related to data transmission speed** | | |
| 1.1 | Data transmission speed | The data transmission speed is defined as the data transmission rate that is achieved separately for downloading and uploading specified test files between a remote web site and a user's computer.  (ETSI EG 202 057-04 clause 5.2) | For up- and down-load |
| 1.2 | Mean Data Rate (FTP/HTTP/E-mail) | After a data link has been successfully established, this parameter describes the average data transfer rate measured throughout the entire connect time to the service. The data transfer shall be successfully terminated. (ETSI TS 102 250-2 clauses 6.1.7, 6.8.7, 7.2.8) | This parameter is defined in standardization document dedicated to mobile Internet access services |
| **2.** | **Parameters related to service availability / unavailability** | | |
| 2.1 | Percent IP service unavailability (PIU) | The percentage of total scheduled IP service time (the percentage of Tav intervals) that is (are) categorized as unavailable using the IP service availability function.  (ITU-T Recommendation Y.1540 clause 7.2) |  |
| 2.2 | Service availability | Service availability (time end-users can use the service) is the arithmetic mean from the total number of service availability calculated results during one payment cycle. Service availability during the payment cycle is determined in accordance with the formula:  , where p – Service availability as a percentage; T – Total time of service availability in hours; tk – measurement time in hours; n – the total number of network termination point. | Taken from a national regulation |
| **3.** | **Parameters related to delay** | | |
| 3.1 | IP packet transfer delay (end-to-end) (IPTD) | The end-to-end IP packet transfer delay is the one-way delay between the measurement points at the source host address and destination host address (ITU-T Recommendation Y.1540 clause 6.2.). | IPTD is a network performance parameter. The parameter is open for the different protocols to be used. |
| 3.2 | Delay | Delay means round-trip delay time in milliseconds between packets sending and receiving from the network termination point to the dedicated point.  , where - average Delay in milliseconds at measurement time; t1 - the packet receiving time in milliseconds; t2 - the packet sending time in milliseconds; n - the total number of transmitted packets during the measurement time. | Taken from a national regulation.  This parameter is similar to 3.4, but is open for the use with different protocols. |
| 3.3 | Delay (one way transmission time) | The delay is half the time in milliseconds that is needed for an ICMP Echo Request/Reply (Ping) to a valid IP address. (ETSI EG 202 057-04 clause 5.5). | 3.3 and 3.4 are the same methodology, but 3.3 is half of 3.4 |
| 3.4 | Ping Round Trip Time | The round trip time is the time required for a packet to travel from a source to a destination and back. It is used to measure the delay on a network at a given time. (ETSI TS 102 250-2 clause 6.3.1) | This parameter is defined in standardization document dedicated to mobile Internet access services. |

| **Nr.** | **Parameter** | **Definition with reference** | **Notes** |
| --- | --- | --- | --- |
| **4.** | **Parameters related to delay variation** | | |
| 4.1 | End-to-end  2-point IP packet delay variation | IPDV is defined in ITU-T Recommendation Y.1540 clause 6.2.4and explained in more details in ITU-T Recommendation Y.1541 Annex II: | Network performance parameter |
| 4.2 | Delay variation | Delay variation is determined in accordance with the formula:  , where J – Delay variation in milliseconds;- average Delay in milliseconds at measurement time; n – the total number of transmitted packets during the measurement time; Li -packet Delay in milliseconds. | Taken from a national regulation. |
| **5.** | **Parameters related of losing information/IP packets** | | |
| 5.1 | IP packet loss ratio (IPLR) | IP packet loss ratio is the ratio of total lost IP packet outcomes to total transmitted IP packets in a population of interest. (ITU-T Recommendation Y.1540 clause 6.4) |  |
| 5.2 | Packet Loss Ratio | Packet Loss Ratio means the percentage of lost packets to total number of sent packets. Packet Loss Ratio is determined in accordance with the formula:  , where Z - Packet Loss Ratio as a percentage; n - the total number of transmitted packets during the measurement time; D - number of lost packets during the measurement time. | Taken from a national regulation. |
| 5.3 | Unsuccessful data transmission ratio | The unsuccessful data transmission ratio is defined as the ratio of unsuccessful data transmissions to the total number of data transmission attempts in a specified time period.  A data transmission is successful if a test file is transmitted completely and with no errors. (ETSI EG 202 057-04 clause 5.3) | 5.3 and 5.4 use the same methodology |
| 5.4 | Data Transfer Cut-off Ratio [%] (FTP/HTTP/E-mail) | The data transfer cut-off ratio is the proportion of incomplete data transfers and data transfers that were started successfully. (ETSI TS 102 250-2 clauses 6.1.8, 6.8.8, 7.2.9) | This parameter is defined in standardization document dedicated to mobile IAS. |

| **Nr.** | **Parameter** | **Definition with reference** | **Notes** |
| --- | --- | --- | --- |
| **6.** | **Parameters related to errored IP packets** | | |
| 6.1. | IP packet error ratio (IPER) | IP packet error ratio is the ratio of total errored IP packet outcomes to the total of successful IP packet transfer outcomes plus errored IP packet outcomes in a population of interest. (ITU-T Recommendation Y. 1540 clause 6.3) |  |
| 6.2 | IP Packet error Ratio (IPER) | IP Packet error Ratio (IPER) means the percentage of errored packets to total number of sent packets. Packet Error Ratio is determined in accordance with the formula:  , where IPER - Packet Error Ratio as a percentage; n - the total number of transmitted packets during the measurement time; E - number of errored packets during the measurement time. | Taken from a national regulation. |
| **7.** | **Parameters applicable to Internet access services that are accessed via a login process** | | |
| 7.1 | Login time | The login time is the period starting when the data connection between the Test-PC and the Test-Server has been established and finishing when the login process is successfully completed. ( ETSI EG 202 057-4 clause 5.1) |  |
| 7.2 | Successful log-in ratio | The successful log-in ratio is defined as the ratio of successful log-ins to access the Internet when both the access network and the ISP network are available in full working order. (ETSI EG 202 057-4 clause. 5.4) |  |
| **8.** | **Parameters related to access to DNS services** | | |
| 8.1 | DNS host name resolution failure ratio | The DNS host name resolution failure ratio is the probability that a host name to host address translation of a DNS resolver was not successful. (ETSI TS 102 250-2 clause 5.10) |  |
| 8.2 | DNS host name resolution time | The DNS host name resolution time is the time it takes to perform a host name to host address translation. (ETSI TS 102 250-2 clause 5.11) |  |

| **Nr.** | **Parameter** | **Definition with reference** | **Notes** |
| --- | --- | --- | --- |
| **9.** | **Parameters applicable for mobile Internet access services** | | |
| 9.1 | Service non-accessibility (FTP/HTTP/E-mail) | The service non-accessibility ratio denotes the probability that a subscriber cannot establish a PDP context and access the service successfully. (ETSI TS 102 250-2 clauses 6.1.1,6.8.1, 7.2.2) |  |
| 9.2 | Setup time (FTP/HTTP/E-mail) | The setup time describes the time period needed to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received. (ETSI TS 102 250-2 clauses 6.1.2, 6.8.2, 7.2.3) |  |
| 9.3 | IP-Service access failure ratio (FTP/HTTP/E-mail) | The IP-service access ratio denotes the probability that a subscriber cannot establish an TCP/IP connection to the server of a service successfully. (ETSI TS 102 250-2 clauses 6.1.3, 6.8.3, 7.2.4) |  |
| 9.4 | IP-Service setup time (FTP/HTTP/E-mail) | The IP-service setup time is the time period needed to establish an TCP/IP connection to the server of a service, from sending the initial query to a server to the point of time when the content is sent or received. (ETSI TS 102 250-2 clauses 6.1.4, 6.8.4, 7.2.5) |  |
| 9.5 | Session failure ratio (FTP/HTTP/E-mail) | The session failure ratio is the proportion of uncompleted sessions and sessions that were started successfully. (ETSI TS 102 250-2 clauses 6.1.5, 6.8.5,7.2.6) |  |
| **Administrative / Non-technical parameters** | | | |
| 1. | Supply time for residential Internet access | Supply time for residential Internet Access is the duration from the instant of a valid service order being received by an Internet access provider to the instant a working service is made available for use. (ETSI EG 202 057-1 clause 5.2) |  |
| 2. | Fault report rate per fixed access lines | The number of fault reports per fixed access line. (ETSI EG 202 057-1 clause 5.4) | Applicable for fixed Internet access services only |
| 3. | Fault repair time for fixed access lines | The duration from the instant a fault report has been made to the instant when the service element or service has been restored to normal working order. (ETSI EG 202 057-1 clause 5.5) | Applicable for fixed Internet access services only |

| **Nr.** | **Parameter** | **Definition with reference** | **Notes** |
| --- | --- | --- | --- |
| 4. | Response time for operator services | The duration from the instant when the address information required for setting up a call is received by the network to the instant the human operator answers the calling user to provide the service requested. (ETSI EG 202 057-1 clause 5.6) |  |
| 5. | Frequency of End user complains | The number of complaints logged per customer per data collection period. (ETSI EG 202 057-1, clause 5.9) |  |
| 6. | End User complaints resolution time | The duration from the instant a customer complaint is notified to the published point of contact of a service provider and is not found to be invalid to the instant the cause for the complaint has been resolved. (ETSI EG 202 057-1, clause 5.10) |  |
| 7. | Bill correctness complaints | The proportion of bills resulting in a customer complaint about the correctness of a given bill. (ETSI EG 202 057-1 clause 5.11) |  |
| 8. | Prepaid account credit correctness complaints | The proportion of prepaid accounts resulting in a customer complaint about the correctness of its credit or the charges made.  (ETSI EG 202 057-1 clause 5.12) |  |
| **Subjective evaluation** | | | |
| 1. | Global user satisfaction | Level of satisfaction of the users expressed in MOS (Mean Opinion Scores); see further details in clause 9.2 of the report.  Reference standards are in this case: ITU-R BS.1116-1, ITU‑R BT.500-13, ITU-T P.800, ITU-T P.910 (see clause 9.3) |  |

Although given above administrative parameters are used for an evaluation of IAS, they are limited to the expression of the ISP’s organizational features of the IAS provision e.g. an attitude of ISP’s staff to end users, but do not describe IAS as such from the technical perspective. Taking into account that present document is focusing on evaluation of the IAS from the perspective of technical quality. Administrative parameters are not discussed further in this document.

Further within the report it will be focused only on the technical parameters which are applicable without regards to the underlying technology which is used for the provision of the IAS and applications offered by ASPs.

# Minimum Set of QoS Technical Parameters and Observation Values

As it was discussed in the Chapter 3, Article 22(1) of the USD requires Member States to ensure that undertakings providing publicly available electronic communications services “publish comparable, adequate <…> information for end-users on the quality of their services”.

The ultimate goal of deciding on minimum scope of information to be presented to the end user is that such information should be understandable and the number of technical parameters to be analysed by the end user is kept to minimum. At the same time it is important to ensure that nevertheless the number of values is kept to the scope sufficient to evaluate Quality of Service of IAS.

In Table 1 technical quality parameters, which could be used to evaluate technical characteristics of the IAS, are listed. However it is relatively long and may be considered hardly understandable for “non-professional” end user. At the same time many NRAs (or other competent national institutions) agree that it is not necessary to publish the complete list of existing parameters in order to provide the relevant information on QoS to end-users. Again there is no common approach among NRAs (or other competent national institutions) on what set of parameters would be the best to fit the purpose.

The present report presumes therefore that for the general evaluation of the IAS there is no need to evaluate all technical parameters. Present chapter is discussing the list of minimum necessary technical parameters which values could be considered to make available for the information of the end user so that general technical characteristics of the IAS could be evaluated.

While considering such composition of parameters, attention should be given to those technical parameters which are important for the most popular Internet applications. In order to help choosing the most relevant parameters, it is shown the Table 2 with the relation between some technical parameters and the most relevant services provided over the Internet.

1. Relevance of Technical parameters for the evaluation of typical IAS

| **Service/Application** | **Data transmission speed** | | **Delay** | **Delay variation** | **Packet loss** | **Packet error** |
| --- | --- | --- | --- | --- | --- | --- |
| **Downstream** | **Upstream** |
| Browse (text) | ++ | - | ++ | - | +++ | +++ |
| Browse (media) | +++ | - | ++ | + | +++ | +++ |
| Download file | +++ | - | + | - | +++ | +++ |
| Transactions | - | - | ++ | - | +++ | +++ |
| Streaming media | +++ | - | + | - | + | + |
| VoIP | + | + | +++ | +++ | + | + |
| Gaming | + | + | +++ | ++ | +++ | +++ |

- : not relevant +: slightly relevant ++: relevant +++: strongly relevant

Source: Based on ETSI EG 202 057-4, ITU-T Rec. Y.1541 and ITU-T Rec. G.1010

Taking into account the information provided in the table there may be concluded that only some of the technical parameters distinguished in the Table 1 should be selected. The selected parameters should be defined on the bases of international standards, while the presentation of the values should primarily be made for non-professional clients (common end users).

Table 3 below provides which technical parameters could be selected for the general evaluation of the IAS. Conclusions of the Table 3 are made in two steps. Firstly, table contains analysis of each group of technical parameters listed in the Table 1 and, secondly, in case certain group is deemed to be relevant, table provides arguments based on which it is suggested to include certain parameters from the certain group into the Set of parameters for general evaluation of the IAS.

1. Arguments for (non) inclusion of technical parameters into the composition of the Set for general evaluation of the IAS

| **Group of parameters** | **Arguments** | **Set for general evaluation of the IAS** |
| --- | --- | --- |
| Parameters related to **data transmission speed** | Why the group **is** selected as relevant:   * Most relevant for the user and easy to understand; * Present in nearly every IAS offer; * Influences almost any application over the internet; * May be measured on the Network level and can be compared with values obtained on Application level.   Which parameter and Why is selected:   * Parameter 1.1 from Table 4.1 because it is technology neutral, while 1.2 is adjusted to the mobile IAS; * Already widely in use by many NRAs (or other competent national institutions), ASPs, independent entities, equipment (e.g. servers) providers, ISPs. | Data transmission speed.  It is suggested to rename Data transmission speed as **Transmission speed** with the aim of seeking simplicity of the presentation of the information to the end-user.  Definition: the data transmission rate that is achieved separately for downloading and uploading specified test files between a remote web site and a user's computer.  (ETSI EG 202 057-04 clause 5.2) |
| Parameters related to the service **Unavailability** | Why the group **is not** selected as a relevant:   * In general the term Unavailability as such is understandable from the end users perspective and may be considered to be of huge relevance for the end user; * However the definition of the parameter provided in the standardization document (2.1 of the Table 4.1) does not represent the Unavailability as the end user may normally understand it; * The availability of the service as perceived by the user is also covered by a series of administrative parameters which do not form the scope of this document (e.g. fault repair time, fault report rate, frequency of end user complaints, end user complaint’s resolution time) * Measurement methodology described may be considered complicated from the ISP’s perspective; * Therefore in order to ensure that Unavailability would be represented in a way as end user perceives it, new definition and new measurement methodology should be developed and put in place; * It may be concluded therefore that it is not reasonable to include the parameter 2.1 as it is described in standardization due to the reasons above. |  |
| Parameters related to **Delay** | Why the group **is** selected as relevant:   * Relevant for the user and easy to understand; * Influences many application over the internet, e.g. crucial for most of the time sensitive applications; * However for some of the applications it is typically compensated by advanced traffic management techniques and (or) by the applications itself; * In most of the cases, may be measured on the Network level and can be compared with values obtained on Application level; * Already widely in use by many NRAs (or other competent national institutions), operators and by many web based speed meters.   Which parameter and Why is selected:   * To include the parameter 3.3; * For 3.3 and 3.4 ICMP protocol is defined for the evaluation on delay End user himself (herself) cannot easily perform measurements of 3.1 and 3.2, while 3.3 and 3.4 are easy to understand and use for end users themselves, e.g. to be able to make the Ping test; * Definitions of 3.1 and 3.2 are open for the different protocols (e.g. TCP/UDP) to be used and therefore can better express real quality of IAS perceived by the end user; * At the same time 3.1, 3.3 and 3.4 are well standardized. While 3.3 and 3.4 are already widely in use by many web based speed meters; * Delay measured as a round trip (Parameters 3.2, 3.3 and 3.4) express both upload and download delays by only one value, which is important to keep the information simple and short. However it is not precise enough and more detailed information about delay could be achieved by measuring and presenting separately upload and download delays | IP packet transfer delay (end-to-end) (IPTD)  It is suggested to use the term **Delay** when presented to the end users with the aim of seeking simplicity of the presentation of the information to the end-user.  Definition: The delay is half the time in milliseconds that is needed for an ICMP Echo Request/Reply (Ping) to a valid IP address. (ETSI EG 202 057-04 clause 5.5). |
| Parametersrelatedto **Delay variation** | Why the group **is** selected as relevant:   * Influences some popular application over the Internet, e.g. VoIP, on-line gaming; * For some of the applications it is typically compensated by advanced traffic management techniques and (or) by the applications run on the Application level; * In most of the cases, may be measured on the network level and can be compared with values obtained on Application level; * Already widely in use by many NRAs, operators and by many web based speed meters.   Which parameter and Why is selected:   * To include the parameter 4.1; * 4.1 is well standardized and is already widely in use by many NRAs and operators. | End-to-end 2-point IP packet delay variation.  It is suggested to use the term **Delay variation** when presented to the end users with the aim of seeking simplicity of the presentation of the information to the end-user.  Definition: defined in ITU-T Recommendation Y.1540 clause 6.2.4 and explained in more details in ITU-T Recommendation Y.1541 Annex II |
| Parameters related of **losing information / IP packets** | Why the group **is** selected as relevant:   * For some popular applications this parameter is crucially important, e.g. VoI. The IP packets can be dropped, e.g. due to the small buffer size or bad radio connection (in case of the mobile IAS), nevertheless at the same time values of the Transmission speed, Delay and Delay variation parameters discussed above could be sufficiently good; * Directly influences few popular application over the Internet, e.g. most for UDP based applications without the compensation techniques used on the Application level; * In some cases it may be compensated (until the certain break down value is reached) by the applications run on the Application level; * In most of the cases, may be measured on the Network level and can be compared with values obtained on Application level.   Which parameter and Why is selected:   * To include the parameter 5.1; * 5.3 and 5.4 are using similar methodology and are calculating the loss of the files instead of the loose of the IP packets as it is the case of 5.1 and 5.2. For the relevant Internet applications the loss of IP packets is the threshold and not the file; * 5.1 and 5.2 are defined in the similar manner, therefore it is suggested to use the definition provided in standardization, which is 5.1. | IP packet loss ratio (IPLR)  It is suggested to use the term **Packet Loss Ratio** with the aim of seeking simplicity of the presentation of the information to the end-user.  Definition: Packet Loss Ratio is the ratio of total lost IP packet outcomes to total transmitted IP packets in a population of interest. (ITU-T Recommendation Y.1540 clause 6.4) |
| Parameters related to **errored IP packets** | Why the group **is** selected as relevant:   * For the general evaluation on the IAS above parameters may not be considered enough in all the instances, because quality decrease experienced due to the reasons related to the errored packets may occur in case values of above parameters are good enough; * In case of TCP errored IP packets will be compensated (until the certain break down value is reached) by the packet resending technique; * Directly influences few popular application over the Internet which are UDP based applications without the compensation techniques used on the Application level; * In most of the cases, may be measured on the Network level and can be compared with values obtained on Application level.   Which parameter and Why is selected:   * To include the parameter 6.1; * 6.1 and 6.2 are defined in the similar manner, therefore it is suggested to use the definition provided in standardization, which is 6.1. | IP packet error ratio (IPER)  It is suggested to use the term **Packet Error Ratio** with the aim of seeking simplicity of the presentation of the information to the end-user.  Definition: the ratio of total errored IP packet outcomes to the total of successful IP packet transfer outcomes plus errored IP packet outcomes in a population of interest.  (ITU-T Recommendation Y. 1540 clause 6.3) |
| **Parameters applicable to Internet access services that are accessed via a login process** | Why the group is **not** selected as relevant:   * Is not technology neutral, since it is applicable just for the few cases of the Internet Access offers which requires log in process, e.g. Dial-up; * Even for the Internet Access Service to which log in is required, this parameter does not influence to the significant extent the perception of the Internet Access Service quality. |  |
| Parameters related to **access to DNS services** | Why the group is **not** selected as relevant:   * Parameter expresses the technical network performance, but does not directly represents the quality of the Internet applications as such, i.e. shows the performance of the used DNS server which is not about the IAS itself; * Therefore the parameter is more relevant for the network operator to supervise certain performance of the network rather than represent the quality of the IAS. |  |
| **Parameters applicable for mobile Internet access services** | Why the group is **not** selected as relevant:   * Consider exclusively quality of the IAS provided over the mobile network; * Therefore cannot be generally applicable to all the IAS offers. |  |

Numbers of parameters within the table are linked to the numbers of the technical parameters given within the Table 1.

Based on the analysis provided in the Table 3, it may be concluded that 5 groups of the parameters are relevant for the general evaluation of the IAS. It is obvious however that five quality of service related parameters are still quite long set of technical characteristics for the not experienced end user. At the same time, it is not deemed possible to diminish such a parameter set.

It is a common understanding that Transmission speed of the IAS is the most popular and the most understandable parameter among end users, including not professional ones. At the same time it is present in any IAS offer advertised and therefore describes each IAS offer available. It may be concluded therefore that Transmission speed is de facto being used for the purpose of the basic evaluation of the IAS. And least but not last, in many countries Transmission speed of IAS is becoming dominating concern of the end users which is expressed in steadily growing number of complaints. Therefore, while considering different alternatives to address the problem of relatively long set of technical values relevant to describe IAS, it is also obvious that, whatever such alternative could be, transmission speed will remain as a part of it in any case.

At the same time when discussing remaining four groups of parameters, it may be concluded that each of them is addressing certain quality feature which cannot be otherwise visible than presenting the value of this certain parameter. Subsequently it means that any combination of three parameters (in addition to Transmission speed) out of four cannot in all the instances represent quality decrease due to the network failure defined by the remaining one. For instance, and as it was presented in the Table 3, quality decrease experienced due to the reasons related to the Delay variation may occur in case values of other four parameters are good enough. It may be concluded therefore that all four parameters, i.e. Delay, Delay variation, Packet loss ratio and Packet error ratio, are equally important and therefore cannot be discriminated. Based on the analysis provided above, it is suggested for evaluation of the quality of the IAS to stick to the Minimum set of five technical parameters suggested in the Table 3 as they are defined in the Table 1: Transmission speed, Delay, Delay variation, Packet Loss Ratio, Packet Error Ratio.

# Determination of the Values and Measured Units of Parameters

This chapter presents the options to determine values of parameters of Minimum set suggested in chapter 5. The values set may be used for publication of information on the Quality of Service, to set minimum requirements on the Quality of Service in the contracts, etc. Some values of parameters are taken from the relevant standards, while some – from national legal frameworks / recommendations on QoS evaluation.

This chapter will also analyse different approaches for setting the values of the parameters and will take an attempt to suggest the recommended approach for setting each respective value.

Within this report it is systematically considered that:

* **Average value** of the measured values, where average is calculated as:  
  ;
* **Minimum value** means the highest of the lower 5% measured values;
* **Maximum value** means the highest of the lower 95% measured values.

For calculation of the Minimum and the Maximum values provided above, the methodology described in ETSI EG 202 057-4 Annex G could be used.

1. Values and Measured Units to be presented for the evaluation of the quality of IAS

| **Nr.** | **Parameter** | **Arguments** | **Suggested Approach for**  **Determination of the Values and Measured Units to be presented** |
| --- | --- | --- | --- |
| 1. | **Transmission speed** | **Maximum value** is not included because:  ISPs normally advertise Maximum values which are those values that are misleading sometimes for the end user. It is not critical for the evaluation of the QoS;  **Average value**:  Represents better the achieved speed and therefore the perception of the Internet access quality;  **Minimum value**:  It is important information for the end user as most of the Internet applications require certain Transmission speeds, i.e. certain Minimum values of the Transmission speed. | Minimum and Average values expressed in Mbit/s or kbit/s |
| 2. | **Delay** | **Maximum and Minimum values** are not included because:  It may be too much complicated for the not professional end user to realize the meaning of the information provided;  Also relevant standardization does not suggest that those values should be included;  **Average value**:  It provides a general information about the parameter;  **Comments:**  The relevant standardization indicates that the Average Standard deviation should be provided. However for simplicity reasons it is not suggested to include such value. | Average value  Expressed in ms |
| 3. | **Delay variation** | **Maximum and Minimum values** are not included because:  It may be too much complicated for the not professional end user to realize the meaning of the information provided;  **Average value**:  It provides general information about the parameter.  **Comments:**  Also ITU-T Y.1540 6.2.4.2 recommends: The preferred method for summarizing the delay variation of a population of interest is to select upper and lower quantiles of the delay variation distribution and then measure the distance between those quantiles. However for simplicity reasons it is not suggested to include such values. | Average value  Expressed in ms |
| 4. | **Packet Loss Ratio** | **Maximum and Minimum values** are not included because:  It may be too much complicated for the not professional end user to realize the meaning of the information provided;  **Average value**:  It provides general information about the parameter.  **Comments:**  ITU-T Y.1540 6.4 recommends that IP packet loss ratio is the ratio of total lost IP packet outcomes to total transmitted IP packets in a population of interest which corresponds to the recommended average value. | Average value  Expressed in x10-3 |
| 5. | **Packet Error Ratio** | **Maximum and Minimum values** are not included because:  It may be too much complicated for the not professional end user to realize the meaning of the information provided;  **Average value**:  It provides general information about the parameter.  **Comments:**  ITU-T Y.1540 6.3 says: IP packet error ratio is the ratio of total errored IP packet outcomes to the total of successful IP packet transfer outcomes plus errored IP packet outcomes in a population of interest which corresponds to the recommended average value. | Average value  Expressed in x10-4 |

# Measurement Methods

This chapter gives an overview about what has to be considered by establishing the measurements.

Possible scenarios (clause 7.1) of measuring described in the standardisation are discussed based on practical experiences collected. Upon that, a summary of different measurement applications and termination units will be given (clause 7.2). Afterwards some guidance for sampling will be offered (clause 7.3) before specifying the test file (clause 7.4).

## Scenarios

The generic overview on the elements and network sections the Internet Access consists of are shown as reference connection in the following Figure 1:



1. Generic overview of the elements and network sections of the Retail internet access, source: based on ETSI EG 202 057-4, Annex A

Out of this reference configuration, two groups of scenarios with different subsections appear:

* “in-net” evaluation methods, which are the focus of this chapter, containing the access network, the concentration access network, the ISP network and, in cases, the network to national or international internet exchange points (IXP)
  + - QoS evaluation within the ISP leg;
    - QoS evaluation between Network Termination Point (NTP) and national IXP(s);
    - QoS evaluation between NTP and international IXP(s).
* “over-the-top” (OTT) evaluation methods, which are the focus of chapter 9, covering the whole network (i.e. ‘end to end’ connection), complementing the in-net evaluation by including the network section between IXP and a content provider (e.g. ASP).
  + - Distributed approach for QoS evaluation;
    - Collecting information from application provider.

“In-net” evaluation methods use typically only one or few test servers measuring the selected terminations, whereas “over-the-top” evaluations methods may use one or more servers supporting the QoS evaluation where measurements may be made directly between users’ terminals, both at application or network level.

As both methods, in-net evaluation and over the top evaluation, complement each other, it would benefit when measurements out of both groups will be used for assessing the IAS.

### QoS Evaluation of the ISP Leg

With the QoS evaluation of the ISP leg, only the network section directly influenced by the ISP will be assessed. The ISP leg consists of the access network part and the ISP network part of the connection of the customer to the ISP.

*Definition in standardisation*

According to the ETSI guide EG 202 057-4, the measurement set-up shown in Figure 2 consists of a Test-PC connected to the NTP and a Test-Server at the ISP’s backbone. Between those devices, the Test Suits will be established.



1. Measurement set-up, source: based on ETSI EG 202 057-4, Annex B

Regarding to the ETSI guide EG 202 057-4, for assessment of only the ISP leg the most essential network section is the access network, consisting of the physical access network and the concentration network. For assessing only the access network, the Test-Server has to be placed as near as possible to the gateway providing the interconnection between the access network and the ISP network.

*Practical experiences and suggested approach for implementation*

In practice experiences, remarks appeared for the model for measuring described in the ETSI guide. The Test-Server has to be placed in the ISP’s network as close as possible to the access network. Furthermore, ETSI defines the values of TCP parameters, for which Transmission speed should be measured, whereas in the case in which the Test-Server was installed as close as possible to the peering gateway, there was no possibility of their settings, moreover, these values were not known. The location of the test server in the ETSI Recommendation is defined as the point of access to the network operator's ISP. The measurement result neither includes the quality of service of the ISP network, nor the quality of service of the Internet network.

Normally the responsibility of the ISP is related with the part of the Internet network it can directly control. For that, when applicable, it should perform QoS testing evaluating a set of QoS parameters defined by the NRA (or other competent national institutions) or, in absence of this requirement, according with the ETSI guide. The network diagram for this test is represented in the following Figure 3.



1. QoS evaluation of the ISP leg

The agreed tests shall be performed by the ISP and the test server shall be connected to the edge of the ISP network. It could be also possible for the user to perform the tests, if the ISP provides a software client or a web based application for this purpose.

Even if the quality of Internet itself should not be contained in the measurements, the quality of the ISP network should be included.

In order to achieve this, the Test-Server should be placed inside the ISP network. The OSI-layer to measure should be Layer 3.

### QoS evaluation of the access to a national IXP

In the QoS evaluation of the access to a national internet exchange point (IXP), the Test-Server is located at a national IXP. This scenario will allow comparing the QoS access to the IXP of the different ISP in a specific country, taking into account a set of parameters specified by the NRA (or other competent national institutions).

*Definition in standardisation*

No concrete specification of this scenario can be found in the standardisation. Therefore this scenario may be considered as the application of the ETSI guidance to a national evaluation point. With regard to the generic overview of the IAS described in Chapter 7.1, the Test-Server will be placed at a national IXP.

*Practical experiences and suggested approach for implementation*

In case of the provider itself measures, as mentioned in the Chapter 7.1.1 “QoS evaluation of the ISP leg”, there is a risk that the results are not comparable. For comparing the IAS between different ISP, a central Test-Server is necessary to establish comparable measurement results. Such a possible location for this central Test-Server is a national IXP as shown in Figure 4.



1. QoS evaluation of the access to a national IXP

In this scenario the tests should be preferential made by the measuring organization, i.e. NRA, other competent national institutions or an independent organization measuring or determining the measurement methods (MO), through a specific equipment, software client or web based application. In any case, depending on the test solution, the results could be obtained with different dispersion errors, since the results depend on the sample and on the method.

As practical experiences have shown, the ISP can recognize the location of the Test-Server, so he can prioritise the connection to and from this Test-Server. This leads into an increasing of the results for this ISP. To counter this, arrangements like a second Test-Server for reference measurements or various alternating IP-addresses for the Test-Server must be taken. This arrangement is only possible if the tests are performed by the MO.

This scenario reflects the performance of the IAS experienced by the end user better than the scenario of the ISP leg does.

In general the comparability of the IASs can be reached in the best way, if all ISPs are connected on a similar way to the central measuring point, or all ISPs agree on this measuring point. At the same time in the reality and in particular in case of the bigger countries, there may be few IXPs present or for instance one IXP could be physically distributed and due to that, the ISPs are not connected on a similar way to the central measuring point. However at the same time it is widely recognised that the bottleneck of the ISP’s network lies within the Access leg and (or) Interconnection points, in case those are of not sufficient capacity. And such bottleneck does not lie within the backbone part of the ISP’s network. Therefore it may be concluded that notwithstanding the fact that the measurements results will be affected due to the fact that ISPs are not connected on a similar way to the central measurement point, such impact may not be considered so significant in order to make the values incomparable.

At the same time it should be noted that there may be other significant points, i.e. other than IXPs, where measurements could be performed. In some countries interconnections points other than IXP could be even more significant than the IXP itself (e.g. interconnection point with incumbent operator).

### QoS evaluation of the access to international IXP

Additional to the previous scenarios, it will be possible to define a third scenario taking into account the international access. But it should be noted that the application of this experience could be limited just to one country placing the testing servers in other countries. Considering that several countries are implementing a test server connected to its national IXP, it could be possible to negotiate among the different countries to allow extending the test parameters to other test servers than only the national. So it will be allowed to compare the access to different countries, but also symmetry between pairs of countries can be assessed and a matrix with several tests from several countries could be created.

*Definition in standardisation*

This scenario is not directly specified in the ETSI guide, but rather is coming from the national experiences of the evaluation of the QoS. Therefore this scenario may be considered as the application of the ETSI guidance to international evaluation points. As can be seen in Figure 5, with international IXP not only one single point is meant, at every IXP a Test-Server can be installed.

*Practical experiences and suggested approach for implementation*

The existing scenario with one national IXP will be extended by using international IXP to be able to compare international connections.



1. QoS evaluation of the access to international IXP

Even if the international IXP is not a physical single point, the results of the measurements should be collected under a single system of analysis to procedure a common set of values for parameters representing the overall performance per ISP.

From this specification it is easy to understand that whereas the international IXP is expected to be closer to real perception of user, requires a very strong collaboration of all the NRA’s (or other competent national institutions) and implies challenging set of measures to be implemented.

In this scenario the access capacity of the different Test-Servers should be dimensioned depending on the number of countries accessing to the files and also on the number of possible simultaneous tests.

### Conclusions of the Scenario chapter

Table 5 should answer the question about how relevant is the scenario for the purpose to provide the end user with the comparable, up to date and adequate information about IAS subscribed.

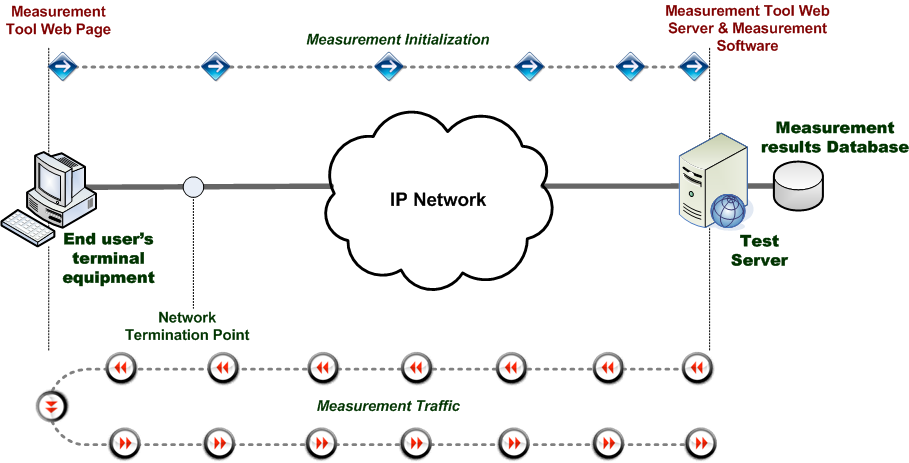
1. Pros and Cons of different scenarios

| **In-net Scenarios** | **Advantages** | **Disadvantages** |
| --- | --- | --- |
| ISP leg | Very fair comparison between the networks of ISPs is possible.  The liability of ISP is more evident. | The end user is not really getting the information about the quality of IAS he (she) is using, because the information that is being measured refers to the ISP network, i.e. very limited part of the Internet network is being measured.  Does not consider the connections that the ISP has to the entire Internet. While this may be considered important to evaluate because it has direct impact on the quality of IAS, e.g. the broader are connections of the ISPs with, the better is the quality of the IAS. |
| National IXP | Is the most pragmatic and mostly used approach to evaluate the QoS at the moment. Also insures fair comparison between the networks of ISPs.  Provides possibility to compare the ISPs, because ISPs directly or indirectly are connected to the national IXP. This provides that the evaluation scenario is the same. | On the one hand, in some cases, QoS information may be misleading. For instance, when the ISP is not connected to the national IXP, but just e.g. to an international IXP (or having direct peering), the QoS results for such ISP could be worse; nevertheless this does not necessarily means that the quality of the IAS is worse.  In general, the comparability of the ISP can be reached in the best way, if all ISP are connected on a similar way to the central measuring point, or all ISP agree on this measuring point. Another scenario is when there are more than one IXP nationally present or if the IXP is physically distributed. |
| International IXP | The Internet connection which ISP is providing to the end user is the entire Internet. The broader is the International Internet connection obtained by the ISP, the better is the Internet quality provided by such ISP.  The values obtained are one step closer to the end user’s perception of experienced quality of the Internet. | From the practical implementation perspective, such approach cannot cover the measurements to all the international connections. Therefore one chosen destination would be discriminated against the others which were not chosen.  Having knowledge where the test servers are placed, ISPs may enhance the connections to those particular destinations. |

## Measurements Applications and Termination Units

In principle the measurements could be performed with or without the Termination unit. The present chapter explores both alternatives and provides information about different termination units which could be used.

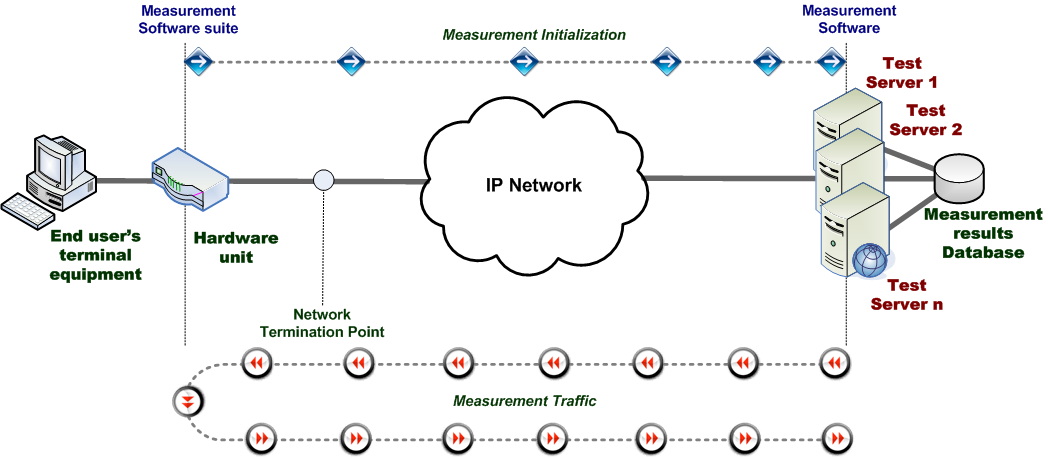
In case that Termination unit is not used, specialized software which is installed on measurement server(s) is used for the purpose of measurements (See Figure 6). The access to measurements application is arranged as the usual access to the web page. Such kind of application is the most common solution used by MOs. The “Speed test” is one of measurements applications examples. This measurements scenario is realized without termination units and measurements cannot be remotely initialized from the centralized measurement tool via the Internet or another connection to the public network.



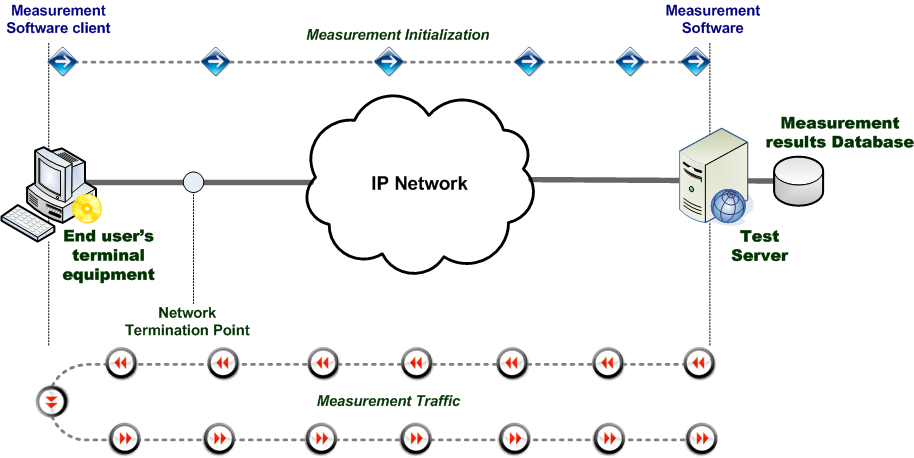
1. Measurement application

In other cases, measurements of quality of IAS are performed using different types of Termination units. In general, the Termination unit could be defined as a specialized unit connected to the NTP in end user premises to provide measurements of quality of IAS. Termination unit may be remotely initialized from the centralized measurement tool via the Internet or another connection to the public network. Below are discussed different types of Termination units:

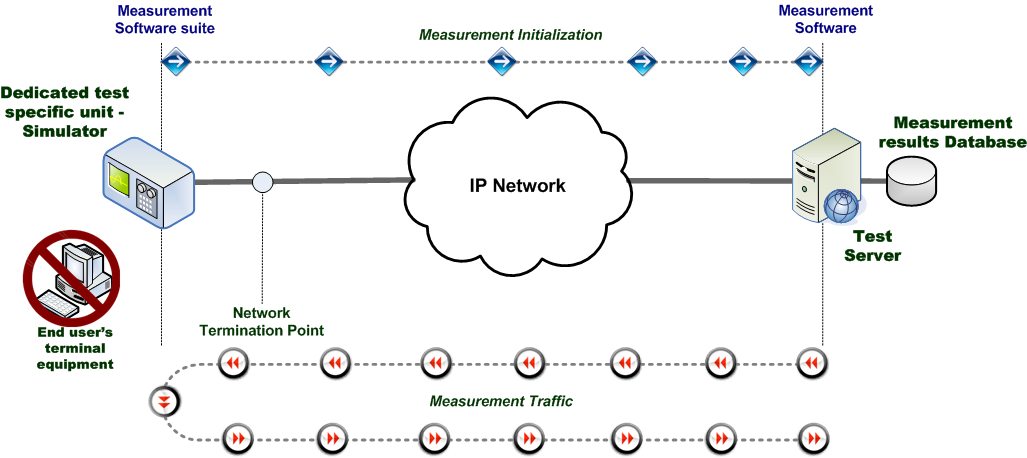
1. **Hardware unit specially designed for the measurement purposes**, i.e. co-existing test specific unit placed between NTP and the user’s terminal equipment.



1. Hardware unit
2. **Software unit** specially developed software for the measurement purposes, i.e. software client installed in end user’s terminal equipment.



1. Software unit
2. **Dedicated test specific unit**, i.e. simulator, which is used just for the testing purposes, replacing the end user’s equipment. While this equipment performs measurements, no other equipment connected to the NTP can be used. It is applicable also in case of the mobile network.



1. Dedicated test specific unit
2. **Hardware unit, which was designed for another purposes**, i.e. Network Termination Unit (NTU) as xDSL modems, Optical network units, etc. These units may have specially modified software to provide measurements. This unit normally performs measurements just on the physical level. At the moment such termination unit is not considered to be recommending, since real examples on the market are not known.
3. Pros and Cons of Measurement applications and different Termination Units

| **Nr.** | **Termination unit** | **Advantages** | **Disadvantages** |
| --- | --- | --- | --- |
| 0 | No termination unit  Web based measurement application | Installation is not needed;  Is not associated with specific user hardware;  Low costs;  Facilitate the widest range of users;  Have the quickest deployment time. | Can only proceed to measurements and to data collection when the users are on line, needs therefore more collaboration from users. The measurements could be altered if there are other activities on the Internet interface.  In case of each measurement some information regarding the IAS, including contract information, may be required to be introduced (each time when software is used). |
| 1 | Software clients | Is not associated with specific user hardware;  Lower cost;  May facilitate a wider range of users;  Likely to have a quicker deployment time. | Can only proceed to measurements and to data collection when the users are on line, need therefore, in the start-up, more collaboration from users than above case since a software installation is needed.  It might be necessary to detect the level of activity of the PC and the one of the Internet interface and proceed to measurements only when appropriate, i.e. without impairing the user’s activity without prior permission; in case of repeated difficulties to measure the requested parameters, messages could be generated inviting users to leave their PC’s active for some time without being used.  Some information regarding the IAS, including contract information, may be required to be introduced when the Software client is being installed. |
| 2 | Co-existing Test specific units | Have the possibility of executing measurements during the periods when the users are not actively using their IAS.  Measurements are normally made when users are not online and in this case   * normally longer test periods are possible and * measurement process does not disturb IAS. | Imply more costs on hardware and transport;  Permanent (7/24) power supply is normally needed;  Longer implementation time of the measurement system is required;  Installation of device requires pre-arrangements with each end user separately. Therefore may be practically implemented only on the premises of limited number of end users. |
| 3 | Dedicated test specific unit | Similar to (2) but tests may be performed permanently. | Similar to (2) but requires a dedicated ‘line’ to connect the termination unit. |
| 4 | Network Termination Unit | Low cost if it possible to integrate appropriate test modules in the NTU;  May be useful for ISP measurements on their own network. | NTU include tests but they cover normally physical layer parameters;  Needs careful verification before being recommended, many Internet access technologies may not have this possibility |

## Sampling Access Lines and Measurement Moments

Guidance in Annex C of ETSI EG 202 057-04 should be consulted before determining the sample to be considered in the test. ETSI TS 102 250-6 offers a detailed and complex study on statistical methods analysing different type of values obtained in the measurements campaigns.

The consultation of norms like MIL-STD-500 and corresponding updates and complementary recognized documents (MIL-STD-1916 and others) when specifying the sampling design is recommended. Nevertheless, to allow a shorter term solution it is recommended to beneficiate from the project ‘samknows.eu’[[6]](#footnote-6) and build upon the experiences gained.

It is important that high level confidence intervals are aimed for the surveillance studies.

Later versions of the present report may benefit from the experience of the studies based on this first edition. This first version should start a convergence process of methods currently used by MOs; the document is a validation exercise to specify future quality evaluation campaigns using harmonized methods to obtain comparable results.

Other aspect which has implications on the subject in question is decision on whether it is ISP and (or) NRA is (are) performing measurements. It is subject to national legislation to decide who will be performing quality measurements of IAS. Provisions of USD provides that such measurements should be delivered by the undertakings providing public electronic communications networks. However in a number of countries (e.g. Latvia, Lithuania) it is the NRA who is responsible for estimating the quality of IAS. In general there could be three options to arrange measurements as such and each of them is having implications in terms of number of measurements, selection of access lines, etc.:

1. measurements performed by the ISPs;
2. measurements performed by the MO;
3. the combination of option (a) and option (b).

For instance, if these measurements are arranged or provided by ISPs, the number of measurements calculated may be made according the ETSI EG 202 057-04. However it should be taken into account that it is not possible to make a large number of measurements for small ISPs. On one hand, according to ETSI EG 202 057-04 the number of measurements does not depend on the number of customers. In such cases, the recommendation could be to reduce the required level of accuracy and/or a confidence level. This approach may be used if the measurements are arranged (provided) by MOs, or both – MOs and ISPs.

### Selecting Access Lines for Each Speed Range under Study

The main concern should be to have a sample of evaluated users and situations representing well the universe of the access lines within the scope of the study, e.g. one provider, one region, one country or the whole Europe. The biggest is the universe to be analysed, the smaller is the percentage of this units to be evaluated.

In national surveillance studies the percentage of access lines (for each speed range) selected in rural and urban regions should correspond to the national situation. Access lines should not be selected per ISP, unless where the ISP’s are evaluating their own performance or someone is evaluating a single ISP.

In the case of having too many or not enough voluntary users in a specific region (or regions, e.g. business areas or city centres), the distribution of the access lines (for each speed range) in the country should be studied, prior to validate the measurement campaign. In special cases, i.e. for some regions, particular actions to promote the advantages of ‘transparency’ to the consumers may be needed.

In the case of national campaigns (no specific ISP analysis), if the final results of access lines (for each speed range) per ISP correspond approximately to the market share of the ISP’s, it is likely to mean that the sampling criteria were representative. In the case of underrepresentation of access lines offered by some ISP, there should be considered the exclusion of that ISP from the campaign or some specific promotion near the clients of that ISP (similar to the ‘underrepresented regions’).

The aim of the sampling should be to have a stable level for the confidence intervals obtained in different regions and for different ISP’s.

There is the difference between fixed and mobile access to internet in selecting the access point.

Basically it is possible to measure quality of mobile IAS everywhere where the coverage is ensured. The question is how many places should be selected for the measurements across the country: it may be calculated depending on the square of the country, coverage % and has to be divided between rural and metropolitan areas.

Access point selection for fixed ISPs is, as it was already mentioned above, quite a challenging issue, because in order to perform the measurements in most of the cases it is needed to come inside the customer premises and this problem is being faced by both NRA (or other competent national institutions) and ISP. Such obstacle may be solved through development of co-operation between customers and ISP or MO, also voluntary users may help a lot. Experience accumulated so far in this regard shows that in order to develop co-operation and attract sufficient number of volunteers (e.g. students) each such attempt should be led by broad advertisement campaign and provision of information.

### Selecting the Measurement Moments

The moments for the measurements should in principle cover high and low traffic, including peak hours. There should be a ‘permanent’ observation and measurements should be triggered within relatively short time intervals, e.g. every ¼ hour as far as the access line is declared available for measurements. In order to prevent any type of manipulations to effect measurement results from ISP’s side, special measures could be included into schedule of measurements suites, for example random triggering of measurement.

To obtain representative values in a relative short period a permanent observation is recommended, but some of the conceived methods are limited to periods of observation depending on user behaviour.

The frequency of the measurements should be adapted to the number of users participating in the campaign, the option(s) taken for the overall set of measurements and the level of statistical error and confidence intervals acceptable for the project.

It is recommended to take decisions in this area only after all most relevant options are taken in order to best adapt the frequency.

For the matter of simplicity the measurements may cover only high traffic, including this of peak hours. If the IAS is working properly in peak hour (or at least in high traffic hours) the conclusion could be made that quality in low traffic hours should be even more acceptable.

### Final Remarks on Sampling and Accuracy of the Measured Values

To obtain small margins of errors and therefore high levels of credibility, the specification of the sampling design is extremely complex. Nevertheless, this is only one of the complex points to solve in the planned quality surveillance actions. It is therefore important to start carefully with the actions, considering them rather as a validation exercise than as a recognized evaluation method. Results of these initial campaigns need to be carefully cross checked with results obtained by ISP’s, applications providers and other relevant partners (see also Chapter 9 on Complementary methods).

## Specification of the Test File

Guidance in Annex D of ETSI EG 202 057-4 could be consulted in order to define the size and type of the test file to download/upload. This annex of the ETSI guide considers that the test file should:

* consist of incompressible data (e.g. compressed file like e.g. a zip or jpg file);
* have at least twice the size (in kbit) of the theoretically maximum data transmission rate per second (in kbit/s) of the Internet access under consideration.

# Presentation of the Values to the End Users

At the moment of drafting this report, just few countries in Europe were providing end users with consolidated information regarding QoS values of the IAS. While drafting this chapter, available practical experience was considered.

Proper presentation of the QoS information (values) to the end user may be considered as important as measurement and accuracy of QoS values obtained. Therefore this chapter is aimed to give appropriate attention to the manner and form of publication of such information. Other matter which is touched below has to do with defining national approach with regards to who should make available (publish) obtained QoS values to end user.

## Publishing of Consolidated Information on QoS Values

While USD Article 22(1) refers to publication of information, it mainly points out that it is the ISPs who may be obliged to publish information regarding the services they provide. At the same time the last sentence of the USD Article 22(2) provides that such “information shall, on request, be supplied to the national regulatory authority in advance of its publication”.

Considering the increasing number of ISPs providing IAS, it is not easy for the end user to get up to date information about the offers available, because such information even in case available is (or will be) distributed among different web sites. It is difficult to argue therefore that it would be of great convenience for the end user to have access to consolidated information regarding QoS values in a single place. Additionally, it will encourage the end user to make better informed choice of IAS between different ISPs based on such information.

While according to the provisions of the USD Article 22(1) NRAs (or other competent national institutions) are provided with the power to request QoS information, it would be logical to use this provision in order to consolidate and publish in a single place information provided by the ISPs. Other approach is to publish just list of links to QoS values published by different ISPs. The drawback is that the direct comparison of different IAS offers becomes more complicated.

## Form of QoS Measurement Results (values) Publication

In order to ensure easy and visible comparison between QoS values provided by the different ISPs and between different IAS offers of same ISP, such information of QoS measurement results (values) should be published in the similar way. It is a regular practice among NRAs (or other competent national institutions) publishing such information, to develop the dedicated form (template) for publication of QoS measured values.

Such form (template) usually presents a table where IAS offers are structurally split into standard speed ranges (in different rows) and for each speed group defined QoS parameters should be filled (in different columns) (See few examples used in practice in Table 7). The form (template) may split IAS offers not only according to speed groups, but also according to different technologies, or tariff groups. For the measurement methods 0 and 1 listed in Chapter 7, publication of measurement results is managed via measurement application in specific forms.

1. Examples of the Template forms (tables)

| **Name of the ISP** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Protocol: TCP or UDP | Download transmission speed \* (Mean and Minimum)[kbit/s] or [Mbit/s] | Upload transmission speed \* (Mean and Minimum) [kbit/s] or [Mbit/s] | Delay (Mean) [ms] | Delay variation (Mean)[ms] | Packet Loss Ratio (Mean) | Packet Error Ratio (Mean) |
| Offer or speed range 1 |  |  |  |  |  |  |  |
| Offer or speed range 2 |  |  |  |  |  |  |  |
| <...> |  |  |  |  |  |  |  |
| Offer or speed range x |  |  |  |  |  |  |  |

| **Transmission speed \* range X** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Protocol: TCP or UDP | Download transmission speed  \* (Mean and Minimum )[kbit/s] or [Mbit/s] | Upload transmission speed \* (Mean and Minimum) [kbit/s] or [Mbit/s] | Delay (Mean) [ms] | Delay variation (Mean) [ms] | Packet Loss Ratio (Mean) | Packet Error Ratio (Mean) |
| ISP 1-Offer 1 |  |  |  |  |  |  |  |
| ISP 1-Offer n (optional if available) |  |  |  |  |  |  |  |
| ISP 2-Offer 1 |  |  |  |  |  |  |  |
| ISP 2-Offer n (optional if available) |  |  |  |  |  |  |  |
| ISP n-Offer 1 |  |  |  |  |  |  |  |
| ISP n-Offer n (optional if available) |  |  |  |  |  |  |  |

\* Transmission speed is statistical parameter calculated as an average value to number of connections. Transmission speed is not the Guaranteed speed. The Guaranteed speed is subject of the exact contract between the end user and ISP;

In the Table 8 below are presented the speed ranges which are used for the grouping of the IAS offers in practice[[7]](#footnote-7). However, different alternatives for the speed ranges may be decided depending on national circumstances e.g. on the speed ranges of the commonly used technologies in each country, etc.

1. Example of Transmission speed ranges to group the IAS offers

|  |
| --- |
| 256 Kbit/s | < 2 Mbit/s |
| ≥2 Mbit/s | < 10 Mbit/s |
| ≥10 Mbit/s | < 30 Mbit/s |
| ≥30 Mbit/s | < 100 Mbit/s |
| ≥ 100 Mbit/s |

Among alternative ways of presentation of QoS values may be considered interactive database containing all the QoS values for different offers and ISPs. Such database should allow end user to filter and present QoS values for selected groups of IAS offers and (or) compare offers of different ISPs in a very convenient way, etc.

Whatever form of publication of QoS values is chosen, it should provide comparable results between different ISPs and between different IAS offers. According to established practice information on QoS values is being updated and published at least yearly.

## Other Aspects of QoS Information Publishing

It is usually suggested while publishing the information regarding the QoS values, to publish at the same time, in a convenient way, the information regarding relevance of particular parameters for typical Internet applications, e.g. Voice over IP, Video over IP, etc. While doing so, ETSI has published some guidance explaining which parameters are relevant to which application that may be used by end user.

# Complementary Measurement Methods

Chapter 7.1 identified two basic QoS evaluation scenarios: ‘in-net’ and ‘over-the-top’. ‘Over-the -top’ QoS evaluation scenario refers to methods, covering the whole network (i.e. ‘end to end’ connection), complementing the ‘in-net’ evaluation by including the network section between IXP and a content provider (e.g. ASP) (see Figure 1 and Figure 10) or considering the overall connection between 2 users (see Figure 11).

Typically the measurement campaigns explore QoS of IAS provided over different technologies applying ‘in‑net’ QoS evaluation scenarios. ISP typically surveys ISP leg quality and announces offers based on that, but he may have (low cost) interconnection agreements limiting the performance of e.g. video telephony. Specific QoS (QoE) studies centred in this application or considering the overall connection will bring then to evidence this weakness and hopefully stimulate appropriate corrections enhancing user’s perception of the performance.

The purpose of present chapter is, taking into account that background, to look for possibilities to converge good practices and enhance confidence of measurement campaigns while obtaining values of QoS parameters more closely related to the end users’ perception of quality through ‘over the top’, i.e. complementary, QoS evaluation methods.

The present chapter discusses ’over–the-top’ QoS evaluation methods which are based on existing QoS evaluation practices. However it is recognized, that ‘over the top’, i.e. complementary, QoS evaluation methods, when applied together with the ’in-net’ methods discussed in above chapters, may additionally provide following benefits:

* Facilitate the development of a more complete set of QoS information about IAS;
* Enhance the diagnostic of the QoS related weaknesses,
* Provide information about the QoS of the IAS perceived by the population,
* When published, enhance QoS information provided to the end user and
* Contribute to (also performance based) fair competition.

More experienced methods are those referring to within the report as ‘in-net’ measurements which rely more directly on performance of the network layer. However it is recognized that the end user may need and in many cases is willing to obtain information on QoS that is more directly related with his / her own experience or related to applications that he/she most uses. It is therefore recommended, in addition to the ‘in-net’ earlier referred (chapter 7) methods, to perform also complementary ‘over-the-top’ QoS evaluation.

Majority of the methods discussed in this chapter are based on existing standardization and at the same time correspond to practical experience gathered from the field. Nearly all of the complementary methods discussed refer to ‘over the top’ QoS evaluation of IAS.

It is widely recognized, that ‘over-the-top’ QoS evaluation methods provide QoS evaluation which is much closer to the end user’s perception of the IAS. Many services or applications provided benefit from quality enhancing techniques (also referred as traffic management techniques[[8]](#footnote-8)).These quality enhancing techniques are designed to avoid or limit (to the extent possible) the negative impact of poor QoS introduced at network level and enhance the performance of the service or application used. While doing so quality enhancing techniques may affect technical QoS parameters, e.g. may reduce the Transmission speed and (or) increase Latency. Parameters like Packet Error Ratio, Packet Loss Ratio, Delay variation, may, when measured e.g. at ISP leg or at network level, not be so representative from the perspective of the end user.

For these reasons technical QoS parameters suggested for Minimum Set, i.e. Transmission speed, Delay, Delay Variation, Packet Loss Ratio and Packet Error Ratio are considered ‘universally applicable objective parameters’. In order to ensure that both ‘over-the-top’ and ‘in-net’ QoS evaluation methods are comparable and therefore complementary and consistent, it is suggested that both Minimum Set of technical QoS parameters would be evaluated applying ‘over-the-top’ QoS evaluation methods.

In general there may be identified following ‘over-the-top’ QoS evaluation methods:

* Distributed, based on automatic collection and analysis of technical information;
* Subjective, based on end user’s satisfaction measured by subjective evaluation of the service or a particular application.

## Distributed Measurements

There are four scenarios how distributed measurements could be organized:

1. Decentralized measurements made by co-existing test specific units, Dedicated test specific units or Network termination units (see Table 6) distributed among the pre-selected access lines with
   1. Measurements made end-to-end between couples of Terminal units sending the measurement results to centralized data collecting point where the statistical data is processed or
   2. ‘unknown’ central measurement point(s) associated with data collecting and processing.
2. Decentralized measurements made by Web based measurement application or software clients (See Table 6) installed over the pre-selected access lines with
   1. Measurements made end-to-end between couples of measurements applications sending measurement results to centralized data collecting point where the statistical data is processed or
   2. ‘unknown’ central measurement point(s) associated with data collecting and processing.

This chapter briefly discuss advantages and risks for systems performing ‘over-the-top’ QoS evaluation.

Comparing ‘over-the-top’ QoS evaluation scenarios with ‘in-net’ scenarios, discussed in Chapter 7.1.4 and summarized in Table 5, the most valuable advantage of ‘over-the-top’ QoS evaluation is that measurements are performed along the whole ‘end-to-end’ connection as it is established while end user consumes certain services or uses certain application. In case of ‘in-net’ scenarios only part(s) (depending on the scenario) of end-to-end connection referred above is measured.

Options b (in both 1 and 2 cases with ‘unknown’ central measurement point) is represented in the Figure 10 below. In this case or the measurements protocol may be identified and the connections used for the measurement may be associated to preferred routers (e.g. best quality routes). In result the values measured would become not representative.



1. Principle scheme of QoS evaluation applying   
   “‘Unknown’ central measurement point” method

Options a (in both 1 and 2 cases, between couple of hardware or software terminals, see Fig. 11) are preferred to obtain values which represent the situation perceived by the end user. As in the case above, the risk persists that measurement protocols could be identified and also could be associated to priority routes. However since these protocols are used to communicate between a big number of IP addresses and are supposed to cross the networks in ‘all directions’, it may be assumed that the risk of detection is lower.



1. Preferred scheme of QoS evaluation applying   
   “distributed measurements: between couples of terminals[[9]](#footnote-9)” method.

In case of distributed measurements described it is suggested that the entity performing measurements (MO) would collect values of technical QoS parameters per ISP (e.g. identified by the IP addresses of exchanged IP packets) and, in order to complement in the best way the ‘in-net’ measurements, it is suggested that same parameters (See Table 4) would be measured and values obtained would be presented in the similar manner (See Chapter 8.2).

All above alternatives cover ‘end to end’ performance of IAS and are not related to specific applications. If the ISP discriminates specific applications and (or) a particular ASP or ASPs (e.g. of TV over Internet or VoI) in terms of QoS and without general deterioration of IP protocols (UDP, TCP or others), this type of impairment will not be detected by the methods mentioned above. In such cases it might be helpful to collect measurement information from ASPs[[10]](#footnote-10).

Collecting information from ASPs allow to obtain values of QoS technical parameters which closely represent the perception of the end user using the corresponding application. The Figure 12 below shows a hypothetic measurement scenario. It may be presumed as well that ASPs may be willing to collaborate with MO in the context of observation of the QoS of IAS provided with the aim to advice their clients on the appropriate IAS offer in terms of values of technical QoS parameters for their application.



1. QoS evaluation performed by ASP

As well as in the case of distributed measurements described above, it is suggested that the values of technical QoS parameters would be collected from or submitted by ASPs per ISP (e.g. identified by the IP addresses of exchanged IP packets) and, in order to complement in the best way the ‘in-net’ measurements, it is suggested that same parameters (See Table 4) would be measured and values obtained would be presented in the similar manner (See Chapter 8.2). It is believed that the ASPs (normally) can easily correctly identify the ISPs by the Internet addresses of their clients.

## Subjective Evaluation – Global User’s Level of Satisfaction

Subjective evaluation is one of the complementary QoS of IAS evaluation methods, which is aimed to measure Global user’s level of satisfaction. Measurement is performed through obtaining the QoS evaluation directly from the end user while or instantly after the usage of certain application or service over the Internet. Some ASPs use such methods already. The value obtained through such evaluation is known as Mean Opinion Score (MOS).

Subjective methods are used in standardization in order to establish algorithms relating end user’s acceptance of a certain service (directly obtained from the end user) and (or) application (e.g. voice telephony, TV, multimedia, etc.) with the technical QoS parameters. Such algorithms, after appropriate validation, provide network operators with possibility to adjust technical parameters of their networks with the aim of improving service delivery and achieving the best QoS over existing infrastructure.

In contrast to other QoS evaluation methods discussed in this report, MOS is directly linked to certain service or application used. Therefore directly obtained information about the satisfaction perceived may be helpful while complementing ‘in-net’ QoS evaluation methods with information about QoS perception in case of targeted service and (or) application. Such information is helpful in order to identify whether network environment is favourable for delivery of this specific service and (or) application.

Normally the end user is invited to give opinion about the technical and / or administrative aspects of the service and (or) application provided:

1. The user is invited to assign a value to the intrinsic / technical performance of the service, e.g. quality of the sound, image or reaction time to the menu offered (this is the main focus of the present report);
2. The user is invited to classify the support administrative services offered by the service provider (ISP or ASP) reaction time of the support services, time to deploy the service, time to answer a complaint, etc. (this is important but not a priority indicator in the present study).

While providing information about end user’s (dis)satisfaction, from the MOS values obtained it is not obvious whether the responsibility of the (dis)satisfaction relates to ISP(s) and (or) ASP and (or) end user himself / herself. In order to reach the appropriate conclusion it is important to investigate MOS values obtained within the context of all the information on the QoS which could be obtained, including from ‘in-net’ methods. Subjective methods are helpful to evaluate QoS, but due to the above reasons should not be used as standalone QoS evaluation methods. It might nevertheless be used as a standalone method in a preliminary phase as an indicator, prior to initiate more detailed and expensive surveillance campaigns. Appropriate sampling, careful specification of the parameters to evaluate[[11]](#footnote-11) and carefully chosen conditions for the statistical evaluation methods may significantly increase the credibility of subjective measurements.

ITU-T recommendation G.1011, ‘Multimedia Quality of Service and performance – Generic and user-related aspects’ in its Tables 9-1 and I-1 presents a wide range and comprehensive references and working documents to subjective and objective methodologies to assess Quality of Experience (QoE) associated to different types of services. The most common definition used within the subjective evaluation to define the levels of quality is presented in the Table 9.1 below. The graduation presented in the Table 9.1 is used through number of ITU recommendations, including:

* ITU-R BS.1116-1, Methods for the subjective assessment of small impairments in audio systems including multi-channel sound systems;
* ITU-R BT.500-13, Methodology for the subjective assessment of the quality of television pictures;
* ITU-T P.800, Methods for subjective determination of transmission quality, telephone transmission quality;
* ITU-T P.910, Subjective Video Quality Assessment Methods for Multimedia Applications.

1. Opinion score levels based on ITU-T recommendations listed above

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Global user satisfaction** | Level of satisfaction of the end users expressed in MOS (an average of opinions of users within a representative sample); the end user is invited to express his / her level of satisfaction in one of the following 5 levels:   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **Score** | **Overall  quality** | **Impairment** | **Effort required \*** | | 5 | ☺☼ | Excellent | Imperceptible | Complete relaxation possible; no effort required | | 4 | ☺ | Good | Perceptible but not annoying | Attention necessary; no appreciable effort required | | 3 | 😐 | Fair | Slightly annoying, acceptable | Moderate effort required | | 2 | ☹ | Poor | Annoying | Considerable effort required | | 1 | ☹💣 | Bad | Very annoying | No meaning understood with any feasible effort |   *\* - column is adjusted for voice services. In case of other services and applications values should be adjusted respectively.*  The end user may be invited to express his / her level of satisfaction each time after using certain application or service. |

Standardised MOS rating scales are being increasingly used and at the moment ITU-T is drafting a report on ‘Mean Opinion Score (MOS) Interpretation and Reporting’[[12]](#footnote-12).

# Conclusions and Recommendations

1. The report recommends that the Minimum Set of technical QoS parameters consisting of: Transmission speed, Delay, Delay variation, Packet loss ratio, Packet error ratio, would be used to the extent possible harmonized among the CEPT countries for the evaluation of IAS;
2. The Minimum Set is composed to be optimal for evaluation of IAS offers irrespectively of the underlying technology;
3. Taking into account the standardisation in place and considering the results of the analysis of each of the technical parameter with the aim to provide end user with actual, accurate and user friendly information about QoS of IAS, the following definitions, determinations of the values and measurement units are recommended to be used within Minimum Set:

| **Nr.** | **Parameter** | **Definition** | **Determinations of the values and measurement units** |
| --- | --- | --- | --- |
| 1. | Transmission speed | The data transmission rate that is achieved separately for downloading and uploading specified test files between a remote web site and a user's computer.  (ETSI EG 202 057-04 clause 5.2) | Minimum and Average values  Expressed in Mbit/s or kbit/s |
| 2. | Delay | The delay is half the time in milliseconds that is needed for an ICMP Echo Request/Reply (Ping) to a valid IP address.  (ETSI EG 202 057-04 clause 5.5) | Average value  Expressed in ms |
| 3. | Delay variation | For a given pair of IP packets, parameter represents the difference between the delay in one direction, measured for two consecutive packets.  (as defined in ITU-T Recommendation Y.1540 clause 6.2.4 and with a calculation method being based on ITU-T Rec.Y.1541 Annex II) | Average value  Expressed in ms |
| 4. | Packet loss ratio | The ratio of total lost IP packet outcomes to total transmitted IP packets in a population of interest  (ITU-T Rec. Y.1540 clause 6.4) | Average value  Expressed in x10-3 |
| 5. | Packet error ratio | The ratio of total errored IP packet outcomes to the total of successful IP packet transfer outcomes plus errored IP packet outcomes in a population of interest.  (ITU-T Recommendation Y. 1540 clause 6.3) | Average value  Expressed in x10-4 |

1. The Minimum set of technical QoS parameters could be complemented by additional technical and/or administrative parameters taking into account national circumstances;
2. This report defines two generic groups of QoS evaluation / measurement scenarios: (1) “in-net” evaluation methods, containing the access network, the concentration network, the ISP network and, in some cases, the network to national or international internet exchange points (IXP) and (2) “over-the-top” evaluation methods, covering the whole network (i.e. ‘end-to-end’ connection), complementing the in-net evaluation with the network section between IXP (national or international) and a content provider (e.g. ASP);
3. In the context of the “in-net” evaluation methods, it may be concluded that measurements within the ISP leg are the most comparable and directly linked to each ISP; however those results don’t reflect the actual end user’s perception of the IAS used. Measurements to national of international IXP, which are closer to the end user’s perception of the quality of the IAS, are less comparable mainly due to the different connection of ISPs to the measurement point (IXP). For more information on Pros and Cons of different scenarios see Table 5;
4. QoS measurements can be performed using Measurement applications or Termination Units. In general Measurement applications are more convenient to use since e.g. are not associated with specific user hardware, facilitate wider range of end users and have a quick deployment time. On the other hand Termination units can perform measurements independently from the end user, i.e. not only when end user is on-line and normally longer test periods are possible. For more information on Pros and Cons of Measurement applications and different Termination Units see Table 6;
5. In order to ensure easy and visible comparison among QoS values provided by the different ISPs and between different IAS offers of the same ISP, such information of QoS measurement results should be published in the similar way and, whenever possible, would be available from the single source;
6. Different forms of publication could be considered, e.g. pre-defined forms (templates), interactive databases. Whatever form of publication of QoS values is chosen, it should provide comparable results between different ISPs and between different IAS offers;
7. It is recommended that ,according to established practice, information on QoS values is being updated and published at least annually;
8. The end user may need and in many cases is willing to obtain information on QoS that is more directly related with his / her own experience of IAS usage. It is therefore recommended, in addition to the ‘in-net’ methods, to (provide possibility to) perform also complementary ‘over-the-top’ QoS evaluation.
9. **Responses to A Questionnaire on QoS Frameworks and Practices in Case of Retail Internet Access SENT ON SEPT. 2011**
   1. Introduction

The number of Retail Internet users is growing quickly in nearly every country, together with this number the respective number of complaints regarding the QoS of Internet access is increasing. It is important that regulators dealing with end users’ complaints will be able to resolve such complaints in a prompt and transparent manner. In order to cope with this challenge, appropriate QoS requirements (e.g. in case of Functional Internet Access part of Universal Services), as well as efficient technical tools and qualifications need to be ensured in order to investigate QoS complaints.

Considering the stated above, the ultimate objective of the present questionnaire is to collect information from the CEPT Member States regarding the QoS monitoring legal frameworks and technical implementation of measurement systems as much as it is related to QoS of Retail Internet Access.

The questionnaire is organized in two parts: Legal and Technical.

* 1. Response to the Questionnaire

The questionnaire was sent to NaN e-mail list by the ECO on 1st of September 2011. The following 15 administrations have replied: Austria, Croatia, Denmark, Finland, Germany, Latvia, Lithuania, Montenegro, Norway, Poland, Portugal, Romania, Spain, Sweden and Switzerland.

* 1. Detailed Answers

|  |  |  |
| --- | --- | --- |
| 1. **Is your institution responsible for the supervision of QoS for electronic communications services (e.g. voice telephony or/and Internet Access)?** | | |
| Austria | The Universal Service Ordinance defines the quality of the universal service. Article 27 of the Austrian Telecommunications Act mandates that providers of universal services have to publish the achieved performance benchmarks once a year and notify them to the regulatory authority. Furthermore the regulatory authority is entitled to undertake independent reviews of the performance benchmarks to be able to check the accuracy. The quality of other electronic communications services is not regulated. |
| Croatia | Yes (voice telephony) | |
| Denmark | Yes, but see below (3) | |
| Finland | Yes – to the extent stipulated in our legal instruments. See  <http://www.ficora.fi/en/index/saadokset/maaraykset.html> | |
| Germany | According to § 78 (4) TKG BNetzA may, after consulting the undertaking with universal service obligations, identify the general demand for the universal services among others in terms of the need for quality of service. In this regard, BNetzA has the power to impose obligations on undertakings in order to secure provision of the service and of service features. However, BNetzA may equally choose not to impose such obligations for all or part of its territory if it is satisfied, after consulting the interested parties, that these service features or comparable services are deemed widely available. | |
| Latvia | Yes. According to the Law “On Electronic Communications” Public Utilities Commission (PUC) is responsible for the supervision of QoS for electronic communications services | |
| Lithuania | Yes | |
| Montenegro | Yes, it is.  In the procedure of expert supervision, the supervisors shall determine the security of networks and services of electronic communications, and compliance with provisions of the Law, concerning confidentiality and secrecy of communications (Law of electronic communications, Article 134, paragraph 6).  However, Agency for electronic communications prepare legal grounds for the development of legal acts adopted by the Ministry and in accordance with Law of electronic communications (Law of electronic communications, Article 8, paragraph 3).  According of that, Agency is in procedure of preparing legal grounds of Rulebook for QoS for public electronic communication networks. | |
| Norway | Yes | |
| Poland | Yes. UKE oversees the quality of universal service (our own measurement system) and publicly available telecommunication services (we rely on research made by entrepreneurs by themselves). According to the Telecommunication Law 9art. 63), entrepreneurs are required to publish quality indicators of its services. Unfortunately there is no implementing legislation (regulations) to the art. 63 paragraph 3. President of UKE announced in 2008 his position on the list of indicators and parameters describing the quality of telecommunications services - including voice services and service called "Internet connection". | |
| Portugal | Yes. ANACOM issued regulations on QoS regarding voice telephony <http://www.anacom.pt/render.jsp?contentId=983509>). For Internet access ANACOM published 4 reports, since 2006 to 2010, with QoS test results to market offers.  (<http://www.anacom.pt/render.jsp?contentId=678378&languageId=1>  <http://www.anacom.pt/render.jsp?contentId=678244&languageId=1>  <http://www.anacom.pt/render.jsp?contentId=920605>  <http://www.anacom.pt/render.jsp?contentId=1056551>), | |
| Romania | ANCOM is responsible for implementing art.22 (quality of service) of Directive 2002/22/EC on universal service and users’ rights relating to electronic communications networks and services. | |
| Spain | Yes | |
| Sweden | Yes. | |
| Switzerland | Yes and No. Yes: We supervise the QoS of the universal telecommunications services (statistical indicators). No: However we don’t supervise the QoS of alternative telephony or Internet access providers.  Remark: a tentative (2009) for including an obligation for service providers with more than 100’000 clients to publish Quality parameters (similar to the USD annex III) was stopped due to the strong opposition from the industry. At present OFCOM studies the possibility of establishing, in collaboration with the industry, a code of conduct specifying the bases for a ‘self-regulated regime for QoS transparency’. | |

|  |  |
| --- | --- |
| 1. **If not, are there any governmental plans to provide your institution with this responsibility?** | |
| Austria | Due to the transposition of the new EU Telecoms Package into national law it is planned that in the future RTR can by the means of an ordinance define the minimum QoS especially to prevent degradation of the services and the slowing down of data traffic. RTR is likely also to get the competence to offer instruments and control possibilities for users to check the QoS of their services. |
| Croatia | N/A |
| Germany | N/A |
| Portugal | No applicable |
| Romania | N/A |
| Switzerland | According to Art 12a of the telecommunication acts the Federal Council may require of telecommunication services to publish information concerning the quality of the services provided by them. Currently it doesn’t require it.  If the above mentioned tentative to establish a ‘self-regulated regime for QoS transparency’ will fail, OFCOM will probably come back to propose some specific regulatory measures in this area. . |

|  |  |
| --- | --- |
| 1. **Have any QoS requirements (parameters, Key Performance Indicators (KPI)) been legally established for Retail Internet Access in your country?** | |
| Austria | No |
| Croatia | No |
| Denmark | No, but current legislation empowers NITA to regulate user access to information, dissemination of information and access to applications and services of the users choice (net neutrality) if deemed necessary. No such regulation is in force at this time. |
| Finland | Yes – see relevant parts of Explanatory Notes to Regulation 58  <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | No |
| Latvia | Yes, Quality of Services requirements for Internet Access service have been established by Public Utilities Commission’ Act and are in force from January 2006. |
| Lithuania | Yes |
| Montenegro | Yes we have. |
| Norway | No legal requirements. But guidelines on “best practice” have been agreed between the regulator, consumer authorities and ISPs on customer service. |
| Poland | Quality requirements in terms of quality levels were in force until May 2011 under the decision of the President of UKE for universal service. For publicly available services such requirements do not exist. As stated in point 1, a regulation is in preparation, while the President of UKE announced his position on this issue, which is not mandatory. There are the indicators which requirements to publish, what are their definitions, which parameters represent various indicators, what research methods to use, statistical sample size to maintain the required accuracy of research |
| Portugal | For the Internet access service there is no Regulation in place till the moment establishing QoS requirements. A Consultation process on this issue was already performed in 2006, but it was considered premature at that time. |
| Romania | Yes |
| Spain | YES. In order to promote transparency on QoS and to provide end users with comparable, relevant and reliable on the QoS offered by the main service providers, the Ministerial Order ITC/912/2006 on QoS conditions on electronic communications services establishes the conditions to publish comparable, adequate and up-to-date information on QoS and specifies the parameters to be measured and the content and format of the published information. Internet access providers with annual income higher than 20M € shall measure, publish and audit a set of QoS parameters, using a common methodology and common criteria. Furthermore, the MITYC publishes synthesis and comparisons of the data provided by operators (quarterly reports with weighted average data).  On the other hand, the Royal Decree 726/2011, amending the R.D. 424/2005 on conditions for electronic communications services, universal service and users’ rights, establishes that the connection providing the universal service shall be capable of allowing broadband data communications at 1 Mbps in download. This speed does not refer to the Internet Access but to the overall speed of the data link to the network and includes both the data transport capability of the link and the overhead (synchronization, control, operations, error correction), or other access-specific functions. For ADSL technology corresponds to the modems’ synchronization speed. For each user the designated operator will ensure that the overall data speed provided by the connection, averaged over any 24 hour period, is not less than 1 Mbps. |
| Sweden | No |
| Switzerland | Yes, but only for the universal service obligation for Internet access |

|  |  |
| --- | --- |
| 1. **If yes, Please list such requirements (parameters, KPI) in your answer below and provide the reference to the appropriate legal act which establishes aforementioned requirements.** | |
| Austria | N/A |
| Croatia | N/A |
| Denmark | N/A |
| Finland | Described in Section 1 of Explanatory Notes to Regulation 58  <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | N/A |
| Latvia | Quality of electronic communications services requirements (<http://www.likumi.lv/doc.php?id=234030> [LV]) issued by PUC of Latvia determines the following Internet Access service quality parameters:  - Supply time for initial connection, calendar days;  - Fault rate;  - Fault repair time;  - Download and upload speed, Mbit/s  - Latency, ms  - Jitter, ms  - Packet loss, %  - Service availability, % |
| Lithuania | The internet service provider is obliged to state minimum download/upload data rate for his provided internet services in the contract with the customer. Also service availability percentage should be stated in the contract. Electronic Communications Service Rules (Žin., 2005, Nr. 152-5627) 8.1. punktas. |
| Montenegro | We have Rulebook for quality of service for Universal Service. According to that, one of parameters of quality of services from the scope of Universal Service is data rate.  Rulebook for quality of service for Universal Service, specifies that data transfer speed that is necessary for functional Internet access is measured in accordance with definitions and methods specified according to the technical information METI ETSI EG 202057-1, and the exit velocity ("upload) and the input speed ("Download") are measured separately. At least 95% of the line must be achieved data rate required for a functional approach internet. |
| Poland | Regulation is in preparation. See Annex 1 to the Position of the President of UKE <http://www.uke.gov.pl/uke/index.jsp?place=Lead01&news_cat_id=470&news_id=7181&layout=3&page=text> and response to point 1. |
| Portugal | No applicable |
| Romania | According to the Decision no.1201/2011  (http://www.ancom.org.ro/en/formdata-1130-51-879) on the establishment of quality indicators for the provision of the Internet Access Service and publication of the due parameters~~[[13]](#footnote-13),~~ the providers of Internet access services have the obligation to publish on their own websites, and to include in the contracts concluded with the end-users, respectively in the general conditions for the service provision, a relevant set of indicators and parameters related to the Internet access service quality. They also have the obligation to publish on their websites information on the measurement procedure. Parameters published on the Internet are to be updated on a quarterly basis.  The Internet access providers will have the obligation to publish the administrative quality parameters such as:  - supply time for providing Internet access;  - fault repair time;  - frequency of the complaints submitted by users;  - frequency of the complaints related to faults;  - frequency of the complaints related to the bill correctness;  - customers complaints resolution time.  Also, according to the decision, ANCOM will create, manage and make available to the users an application meant to real-time measure and assess the technical quality parameters for the Internet access service:  - data transfer speed;  - transfer delay;  - transfer delay variation;  - packet loss rate.  Regarding the inclusion of the technical parameters in the contracts, the providers will be required to specify the maximum/ nominal transfer speed. The provider will decide whether to include the other parameters (including minimum transfer speed). However, if the provider does not guarantee a value for the parameters, it will have to specify in the contract that it does not guarantee the minimum transfer rate, transfer delay, transfer delay variation or packet loss rate.  Providers have the obligation to include in the contracts the levels of service quality offered to the end-users. The abovementioned decision doesn’t impose any minimum QoS requirements on an undertaking providing Internet Access. |
| Spain | YES. In order to promote transparency on QoS and to provide end users with comparable, relevant and reliable on the QoS offered by the main service providers, the Ministerial Order ITC/912/2006 on QoS conditions on electronic communications services establishes the conditions to publish comparable, adequate and up-to-date information on QoS and specifies the parameters to be measured and the content and format of the published information. Internet access providers with annual income higher than 20M € shall measure, publish and audit a set of QoS parameters, using a common methodology and common criteria. Furthermore, the MITYC publishes synthesis and comparisons of the data provided by operators (quarterly reports with weighted average data).  On the other hand, the Royal Decree 726/2011, amending the R.D. 424/2005 on conditions for electronic communications services, universal service and users’ rights, establishes that the connection providing the universal service shall be capable of allowing broadband data communications at 1 Mbps in download. This speed does not refer to the Internet Access but to the overall speed of the data link to the network and includes both the data transport capability of the link and the overhead (synchronization, control, operations, error correction), or other access-specific functions. For ADSL technology corresponds to the modems’ synchronization speed. For each user the designated operator will ensure that the overall data speed provided by the connection, averaged over any 24 hour period, is not less than 1 Mbps. |
| Switzerland | Parameters and statistical performance indicators are defined in section 3.4 of SR 784.101.113/1,2 based on [article 21 [SR 784.101.1 Ordinance on Telecommunications Services](http://www.admin.ch/ch/e/rs/784_101_1/index.html)](http://www.admin.ch/ch/e/rs/784_101_1/a21.html). The parameters are: - Data transmission speed - Successful login ration - Bill correctness complaint |

|  |  |
| --- | --- |
| 1. **If not, are there any plans to legally establish QoS requirements for Retail Internet Access in your country?** | |
| Austria | Any further activities in these areas require first a new communications act. |
| Croatia | Yes |
| Germany | The revised regulatory framework is currently transformed into national law. In this context, following Art. 22 USD, it is planned to introduce a new § 45o TKG that would allow the Federal Ministry of Economics and Technology to set minimum quality of service requirements on an undertaking or undertakings providing public communications networks in order to prevent the degradation of service and the hindering or slowing down of traffic over networks. According to § 45o (5) TKG the ministry could transfer to BNetzA the ability to decide on whether and which minimum QoS requirements should be set. |
| Lithuania | N/A |
| Norway | No |
| Poland | See Annex 1 and Annex2 to the Position of the President of UKE <http://www.uke.gov.pl/uke/index.jsp?place=Lead01&news_cat_id=470&news_id=7181&layout=3&page=text> |
| Portugal | It is under consideration |
| Romania | N/A |
| Sweden | No plans for specifying minimum QoS requirements. However PTS finds it important that the end users have information about the service providers´ QoS aspects. For that reason PTS is planning to collect information from service providers on some QoS aspects, for example speed, prioritization and blocking of traffic. The information will be published on PTS Telecom tariff comparison site. |
| Switzerland | The intension of the ‘self-regulated regime for QoS transparency’ is not to establish new requirements; it is rather to agree on a set of selected parameters and evaluation methods facilitating the publication of QoS representative indicators to enhance the transparency and allow the user to make better informed decisions. |

|  |  |
| --- | --- |
| 1. **Please specify if the imposition of QoS requirements (parameters, KPI) was introduced following the requirements of the EU regulatory framework or such requirements were introduced as national measure. Please elaborate on the rationale of the imposition of QoS requirements for Retail Internet Access.** | |
| Austria | N/A |
| Croatia | N/A |
| Denmark | N/A |
| Finland | as described in Section 1.2 of Explanatory Notes to Regulation 58  <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | N/A |
| Latvia | The USO Directive authorises NRAs to specify QoS requirements to be measured. On the other hand ETSI EG 202 057 principles were used to specify the most important QoS requirements, which are sensitive for end users. |
| Lithuania | No requirements were imposed. RRT is conducting regular measurements only of mobile internet access KPIs throughout the year and publishes collected data analysis reports annually. |
| Poland | When setting a list of indicators guided by the requirements of the new package of directives from 2009 No. 136 and No. 140th (ETSI EG 202 009-2 and ETSI EG 202 057-4 and ITU recommendations) See Appendix 1  See Sections 1 Reply  In line with EU requirements in the draft of Telecommunications Law in Article 56 and 63 are applied, among others, requirements on the minimum guaranteed speed of data transmission for Internet access services. |
| Portugal | Not up to now. Please see the above answer. |
| Romania | The imposition of QoS requirements was based on art.22 (quality of service) of Directive 2002/22/EC on universal service and users’ rights relating to electronic communications networks and services. |
| Spain | The only requirement regarding QoS of the EU regulatory framework refers to transparency obligations that shall be imposed on the operator designated for the provision of the Universal Service (article 11.1 of the US directive).  Besides that, the EU framework allows (but does not require) MMSS and/or NRAs to impose specific performance targets for undertakings with universal service obligations (article 11.4 of the US directive), transparency requirements on the QoS provided by the undertakings that provide publicly available electronic communications networks and/or services (article 22.1 of the US directive), and to set minimum quality of service requirements on undertakings providing public communications networks in order to prevent the degradation of service and the hindering or slowing down of traffic over networks (article 22.3 of the US directive)  The requirements adopted in Spain are based on the above mentioned articles 11.1 and 22.1 of US Directive). |
| Sweden | Sweden has chosen the approach to let competition work for itself, while the transposition is closely aligned with the directive. |
| Switzerland | Requirements were introduced as a national measure. The aim is to ensure the quality of the universal service obligation at a reasonable level.  The new ‘self-regulated regime for QoS transparency’ under study aims rather fair competition and transparency on the market. |

|  |  |
| --- | --- |
| 1. **How are published the results of the QoS parameters or KPI? (By the regulator or by each Internet Access Service Provider (ISP) or by somebody else?)** | |
| Austria | N/A |
| Croatia | N/A |
| Denmark | N/A |
| Finland | As described in Section 1.2 of Explanatory Notes to Regulation 58 <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | N/A |
| Latvia | According to PUC legal acts all ISPs have the obligation to send the Quality of Internet Access Service declarations to the PUC. ISP have to declare values of QoS parameters, which are defined by PUC, for the current year. ISPs provide measurements of QoS parameters by themselves. At the end of the current year, ISPs have to send the measurement results to PUC. PUC compares all results with the values declared by ISP and publishes on PUC website. |
| Lithuania | The results are published annually by RRT. The ISPs do not publish the results of their measurements which they conduct for network performance evaluation. |
| Montenegro | We don’t have regulation in area of quality of service yet, but according to the Law of electronic communications operator, providers of public communications services shall be obliged to submit to the Agency, within a deadline defined by the Agency, information on quality of services they provide.  The Agency shall publish that information from paragraph 3 of this Article in the form of parallel overview, showing level of quality for the same type of service from different operators/providers. |
| Norway | QoS parameters on customer service availability and response time according to “best practice” guidelines are published by the regulator. |
| Poland | According to art.63 paragraph 3 of the Telecommunications Law suppliers have an obligation to publish the indicators. However, few of them do that. UKE publishes half-yearly reports made by an entrepreneur that was designated to implement the universal service. UKE publishes an annual report of its own research on quality of universal service. UKE publishes reports of its own research on voice services quality and Internet access on mobile networks GSM and UMTS.. |
| Portugal | Please see the above answer. |
| Romania | The administrative quality parameters will be published by the ISP and the technical quality parameters will be published by the regulator. |
| Spain | Both the regulator and the ISP’s publish the results (see 3). |
| Sweden | Please see answer under question 5. |
| Switzerland | The results are not published at present. With the ‘self-regulated regime for QoS transparency’ under study, the initial intension is to have all the information published by the providers themselves, near the offer as a part of the service description and price announcement. |

|  |  |
| --- | --- |
| 1. **Are there any comparability issues between ISPs regarding QoS parameters or KPI?** | |
| Austria | N/A |
| Croatia | N/A |
| Denmark | N/A |
| Finland | As described in Section 1.2 of Explanatory Notes to Regulation 58 <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | N/A |
| Latvia | Yes, QoS parameters are comparable between ISPs according to groups of Internet Access speed defined by PUC. |
| Lithuania | Methods of measurement are discussed the most. What modems should be used, where the measurements should be conducted, what type of data file should be used, etc. |
| Norway | ISPs are compared on customer service performance, ref. 7 |
| Poland | There are fundamental problems of comparing results, because the provider just does not publish their QoS indicators. |
| Portugal | Yes, in the context of reports published by ANACOM according above answer to question 1. |
| Romania | For the moment there are no data regarding the parameters. The first data will be available in the beginning of trimester II 2012. |
| Spain | Comparability is a main concern, so a QoS working group chaired by the MITYC and composed by service providers associations, users associations, S. U. designated operator and CMT representatives was created under M.O. ITC/912/2006 provisions to advise SETSI on QoS regulation development, elaborate guides, additional requirements and deal with comparability issues. |
| Sweden | PTS is now investigating if consumers can do informed choices and can compare different QoS parameters, for example limitations of offers. |
| Switzerland | Only the provider of the universal service makes the measurements. Therefore there is only one interpretation, no comparison among different providers. The measurements base on the ETSI standard EG 202 057-4. |

|  |  |
| --- | --- |
| 1. **Is your institution dealing with end users’ complaints?** | |
| Austria | Yes |
| Croatia | Yes |
| Denmark | Yes |
| Finland | Yes – to the extent stipulated in our legal instruments. |
| Germany | Yes |
| Latvia | Yes. According to the Law “On Public Utilities Regulators” PUC is responsible for users’ complaints resolution in electronic communications |
| Lithuania | Yes |
| Montenegro | Yes, it is. According to the Law of electronic communications, public communications service users and operators shall have the right to file complaints to the Agency with regard to approach to and provision of services. |
| Norway | No, individual complaints on contracts with ISPs are handled by a separate complaints body |
| Poland | Yes, there is a special department that is dealing with it. |
| Portugal | Yes |
| Romania | As we have said, the abovementioned decision doesn’t impose any minimum QoS requirements on an undertaking providing Internet Access. The National Authority for Consumer’s Protection is empowered to receive complaints about the failure to comply with the contractual obligation established between end-users and ISPs. |
| Spain | YES. The Office for telecom customers is the specific department within the MITYC that centralises the activities regarding users’ rights and implements an off-court resolution system as the referred to in Art. 34 of US Directive. |
| Sweden | Yes, the end users can inform PTS about complaints. PTS does not solve disputes between a service provider and an end user. |
| Switzerland | Not formally. Users have to address complaints to their service provider. If provider and users don’t find an agreement, the user can contact a conciliation organization (www.ombudscom.com). Our office doesn’t supervise nor measure performance indicators of an individual Internet connection. The office collects and classifies user’s complaints but for the moment there is no statistical evaluation of the complaints. |

|  |  |
| --- | --- |
| 1. **Do you have any legal act which specifies the minimum service quality levels for Internet Access to be included in end users’ contract?** | |
| Austria | No. |
| Croatia | At the moment no (in plan for next year) |
| Denmark | No, apart from the Universal Service provider being obliged to provide fixed lines capable of functional internet access. |
| Finland | There is in Finland at the moment a USO (Universal Service Obligation) requirement set to SMP (Significant Market Power) operators to offer an Internet Access of 1 Mbit/s or higher. In our legal instruments the minimum transmission rate for 1Mbit/s access is specified as follows:   * The minimum average transmission rate in downstream direction must be at least 750 kbit/s during any 24 hours long time period and * The minimum average transmission rate in downstream direction must be at least 500 kbit/s during any 4 hours long time period. |
| Germany | Compare Question 6. |
| Latvia | General Authorisation Requirements issued by PUC of Latvia specifies quality requirements should be included in the consumer contracts. |
| Lithuania | Yes. The internet service provider is obliged to state minimum download/upload data rate for his provided internet services in the contract with the customer. Also service availability percentage should be stated in the contract. |
| Montenegro | Rulebook for quality of service for Universal Service, specifies that data transfer speed that is necessary for functional Internet access is measured in accordance with definitions and methods specified according to the technical information METI ETSI EG 202057-1, and the exit velocity ("upload) and the input speed ("Download") are measured separately. At least 95% of the line must be achieved data rate required for a functional approach internet. |
| Norway | No |
| Poland | See reply to point 6 |
| Portugal | ANACOM published guidelines that defined the minimum content to be included in contracts for publicly available telephone services (mobile or at a fixed location) and for Electronic communications Services (other than publicly available telephone services), in which some mandatory particulars must be included, namely, quality of service levels supplied and required time for start-up connections.  Specifically:  The contract must establish the obligation upon undertakings to provide regular and uninterrupted service.  The contract must clearly set the levels of quality which the service provider undertakes to uphold with its customers, i.e. the minimum (target) service levels of quality to which the customer is entitled, non-compliance with which determines the payment of compensation or reimbursement.  Given that service providers have voiced uncertainties with regard to parameters concerning which levels of quality should be set, ANACOM in Appendix I of those guidelines suggests some parameters. This does not preclude service providers from including additional indicators which they may deem relevant, nor does it rule out the possibility of ANACOM eventually instituting specific parameters of quality under the terms of article 40 of the Electronic Communications Law, for the purpose of publishing and providing end users with comparable, clear, comprehensive and up-to-date information on quality of service. In the event that the service provider does not wish to provide or otherwise undertake to uphold any level of quality of service, this must be clearly stated in the contract. |
| Romania | According with the above mentioned decision providers have the obligation to include in the contracts the levels of service quality offered to the end-users. This decision aims at defining the quality parameters for the Internet Access Service and their measurement methods, and not at imposing target values for these parameters. The assumed value of parameters (the quality level) is to be established under the contract for the provision of Internet access services concluded with the end-user. |
| Spain | NO. The M.O. ITC/912/2006 establishes that contracts shall include the commitments on QoS parameters (at least regarding maximum interruption time during a billing period, other compromises are optional), the compensation in case of non-compliance and the procedure to make effective the compensation, but it does not specifies minimum service quality levels. |
| Sweden | The Swedish electronic act states that minimum service quality should be included in the contract. Minimum service quality levels could be defined in secondary legislation. At the time being no such secondary legislation is in force. |
| Switzerland | No |

|  |  |
| --- | --- |
| 1. **Does your institution performs the measurements/evaluation of QoS parameters of Retail Internet Access in the context of dealing with end users’ complaints?** | |
| Austria | No. |
| Croatia | Yes |
| Denmark | No |
| Finland | We used to do that - but not anymore.  Operators/Providers must have that capability; see   * Regulation 58 Section 3 and 5 (Special requirements for internet access services). * Explanatory Notes to Regulation 58 section 9 (Recommendations on provision of Internet Access Services)   <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | No |
| Latvia | PUC performs the measurements of the quality parameters for Internet Access services in cases when PUC receives a complaint from end users about the quality. |
| Lithuania | Yes |
| Montenegro | No. |
| Norway | No, only in case of severe radio interference degrading end user services |
| Poland | UKE has its own equipment for testing QoS parameters, and uses these tools when it is necessary use these tools. UKE also uses the services of a third party (independent measurement companies and institutions). |
| Portugal | No |
| Romania | Regarding technical parameters, ANCOM will create, manage and make available to the users an application meant to measure these parameters. Most contracts contain the maximum/ nominal transfer speed, the service being provided as best effort type. |
| Spain | YES. In case a user’ complaint on Internet access malfunction is received, the Inspection Department can verify the Internet access’ speed and its performance. |
| Sweden | No, another organization is doing that. .SE (The Internet Infrastructure Foundation) is an independent organization for the benefit of the public that promotes the positive development of the Internet in Sweden. The Broadband Check is a consumer tool for checking your broadband connection. It provides a simple way of testing your broadband speed directly in your web browser. You can find out if you have the right speed and if you get what you are paying for. |
| Switzerland | No |

|  |  |
| --- | --- |
| 1. **What Internet Access QoS parameters does your institution evaluate?** | |
| Austria | N/A |
| Croatia | Only data speed (bandwidth) upon receiving end user complaint |
| Denmark | N/A |
| Germany | As of today, none |
| Latvia | - Download and upload speed, Mbit/s  - Latency, ms  - Jitter, ms  - Packet loss, % |
| Lithuania | Service Non-Accessibility; Data Transfer Setup Time; Mean Data Rate; Data Transfer Cut-off Ratio, Latency, Jitter, Lost Packet Ratio. |
| Norway | QoS data on ISP customer service availability and response time are evaluated. |
| Poland | See Annex 1 and Annex2 to the Position of the President of UKE <http://www.uke.gov.pl/uke/index.jsp?place=Lead01&news_cat_id=470&news_id=7181&layout=3&page=text> |
| Portugal | In the periodic tests performed by ANACOM, the followings QoS parameters are evaluate: Service access failure; Causes of failed service access; Activation/connection time; Latency; Time to load a page (web browsing); File transfer speed; Loss of Packets; Jitter; DNS (Domain Name System) resolution time. |
| Romania | See question 4. |
| Spain | The definition and measurement method of the QoS parameters referred to the connection providing universal service are under study.  Regarding to transparency on QoS, each service provider has to implement QoS measurement system covering the most relevant services commercialised. The set of QoS parameters comprises general parameters measured together with the telephone service (Supply time for fixed access network, response time for admin/billing enquiries, frequency of customer complaints, customer complaints resolution time and bill correctness complaints), non-technical specific parameters for Internet access service (supply time for Internet access (over line in service), fault report rate per fixed access lines (from Q4 2011), fault repair time for fixed access lines (from Q4 2011)) and technical specific parameters (successful log-in ratio, unsuccessful data transmission ratio and download data transmission speed achieved)). The MITYC does not measure any QoS parameter, but supervises and enforces of service provider’s obligations. |
| Sweden | N/A |
| Switzerland | See question 4 |

|  |  |
| --- | --- |
| 1. **Which of them are the most important to evaluate overall Internet Access quality for end users?** | |
| Austria | N/A |
| Croatia | N/A |
| Denmark | N/A |
| Finland | Connection speed, overall maintenance, response time of DNS resolver, access control and DHCP services as described in Regulation 28 section 5 - but performed by operators/providers.  <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | N/A |
| Latvia | The importance of QoS parameters depends on end user activities on the Internet, for example, for file downloading important are download speed and packet loss, but for VoIP and IPTV more significant are latency and jitter. |
| Lithuania | Mean Data Rate |
| Poland | See Annex 1 and Annex 2 to the Position of the President of UKE <http://www.uke.gov.pl/uke/index.jsp?place=Lead01&news_cat_id=470&news_id=7181&layout=3&page=text> |
| Portugal | It depends on the application, but latency and loss of packets are quite important because of VoIP. The following table from ITU-T clarifies it better:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Service | Speed | | Delay | | Loss | | Downstream | Upstream | RTT | Jitter | | Browse (text) | ++ | - | ++ | - | - | | Browse (media) | +++ | - | ++ | + | + | | Download file | +++ | - | - | - | - | | Transactions | - | - | ++ | + | - | | Streaming media | +++ | - | ++ | ++ | ++ | | VoIP | + | + | +++ | +++ | +++ | | Games | + | + | +++ | ++ | ++ | |
| Romania | We consider them equally important. The significance of each parameter depends on the type of application used. |
| Spain | All of them are important but end users mainly focus on data transmission speed. |
| Sweden | N/A |
| Switzerland | The parameters relate only to the quality of IP packet transmission between “Network termination point” at the modem/router in the home and the test server in the network of the Internet provider. There are no measurements of the overall Internet access quality as experienced by an end user. |

|  |  |
| --- | --- |
| 1. **What standards/recommendations does your organization apply to define Internet Access QoS parameters as well as their evaluation methods?** | |
| Austria | N/A |
| Croatia | N/A |
| Denmark | N/A |
| Finland | As described in section 17 (page 39) of Explanatory Notes to Regulation 58 <http://www.ficora.fi/en/index/saadokset/maaraykset.html> |
| Germany | As of today, none. If BNetzA will define QoS requirements for Retail Internet Access these would be in line with those international standards that suit best the aim of the chosen measurement system. |
| Latvia | The ETSI EG 202 057principles were used to define Internet Access QoS parameters. |
| Lithuania | RRT has a developed Internet Access QoS evaluation methodology approved by the order of Director of RRT based on ETSI EG 202 057 - 4 V1.2.1 (2008-07) (angl. „Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 4: Internet access) where all KPIs are defined and measurement methods described. |
| Norway | ETSI EG 202 057 is used for reference where applicable |
| Poland | See Annex 1 and Annex 2 to the Position of the President of UKE <http://www.uke.gov.pl/uke/index.jsp?place=Lead01&news_cat_id=470&news_id=7181&layout=3&page=text> |
| Portugal | The tests performed to produce the periodic report on the QoS Internet access are based on the ETSI guides EG 202 057-1 (User related QoS parameter definitions and measurements; Part 1: General) and EG 202 057-4 (User related QoS parameter definitions and measurements; Part 4: Internet access) and the ITU-T recommendations Y.1541 (Network performance objectives for IP-based services) and G.1010 (End-user multimedia QoS categories). |
| Romania | Decision no.1201/2011 follows recommendations given in ETSI EG 202 057 – 1 – Speech processing, Transmission and Quality Aspects (STQ); User Related QoS parameter definitions and measurements; Part 1: General and ETSI EG 202 057 – 4 Speech processing, Transmission and Quality Aspects (STQ); User Related QoS parameter definitions and measurements; part 4: Internet Access, but we also have taken into consideration the following documents: ITU-T Y.1540 - Internet protocol data communication service –IP packet transfer and availability performance parameters, ITU-T Y.1541 Network performance objectives for IP-based services, ITU-T G.1000: "Communications quality of service: A framework and definitions, ETSI EG 202 009-1: "User Group; quality of telecom services; Part 1: Methodology for identification of parameters relevant to the Users", ETSI EG 202 009-2: "User Group; Quality of telecom services; Part 2: User related parameters on a service specific basis", ETSI EG 202 009-3: "User Group; Quality of telecom services; Part 3: Template for Service Level Agreements (SLA)", ITU-T Recommendation E.800: "Terms and definitions related to quality of service and network performance including dependability". |
| Spain | The definition and measurement method are based on ETSI EG 202 057, parts 1 to 4, and additional requirements developed by the QoS working group which complement the method described in the ETSI guide. |
| Sweden | N/A |
| Switzerland | ETSI EG 202 057-1, ETSI EG 202 057-4 |

|  |  |
| --- | --- |
| 1. **Does your institution have its own Internet Access QoS parameters measurement system or does it use systems belonging to another institutions/organizations?** | |
| Austria | N/A |
| Croatia | Development of our own measurement system is in plan for the next year |
| Denmark | N/A |
| Finland | We used to have – but not anymore |
| Germany | N/A |
| Latvia | PUC has own Internet Access service quality measurement system. |
| Lithuania | RRT has two sets of own equipment for measuring Internet Access QoS parameters. One for testing services of mobile internet access service providers, and other is a web-page based data rate evaluation tool www.matuok.lt designed for all Lithuanian Retail Internet Access end users |
| Norway | An own online broadband measurement tool has been developed |
| Poland | See reply to point 11 |
| Portugal | No. The study and the tests were made by subcontracting external companies. |
| Romania | Most likely, ANCOM will use the services of a company specialized in measuring Internet Access Service quality, but the application will be tailored to ANCOM requirements. |
| Spain | The measurement system is implemented by each service provider.  Basically, general and non-technical QoS parameters are derived from information collected by each service provider (e. g. CRM). Besides, in order to measure the technical specific parameters each ISP have to deploy a number of test probes dependant on the total amount of customers and perform measurements against a server at ISP’s network with a periodicity of at least every 20 minutes. The measurements collected during the period are averaged and weighted according to its traffic pattern. |
| Sweden | N/A |
| Switzerland | No.  The provider of the universal services measures itself (partly with 3rd organisation). The private institution “Cnlab” collaborates with several ISPs in Switzerland. Users can measure their Internet speed with http://www.cnlab.ch/speedtest/. |

|  |  |
| --- | --- |
| 1. **If your institution has own Internet Access QoS parameters measurement system please describe them:** | |
| Austria | N/A |
| Germany | (-) |
| Portugal | Not applicable |
| Sweden | N/A |
| Switzerland | Not applicable |
| **a. Please provide a rough sketch of your measurement system.** | |
| Latvia | The measurement system is arranged as the server connected to the National Internet Exchange points. System engine is built as Java application with the system core from Visualware http://www.visualware.com (MyConnection Server BusinessCenter) and with interactive web interface which developer is the Latvian company . This measurement system measures download and upload speed, latency, jitter and lost packets. The measurements are performed from the Network termination point to Latvian Internet Exchange point. |
| Lithuania | Internet access service evaluation system for home users: Dedicated web-page with online speed measurement software accessed by end users via internet browser.  Mobile telephony services evaluation system: “Ascom” system x1000 with integrated modems, control interface and measurement data processing database. This system is designed for Voice and Internet Access services evaluation.  Additional independent equipment is used for mobile internet access KPI evaluation: Laptop computer with connected 3G and WiMAX modems. The computer runs an automated script to perform measurements. This system can be left without manual attention in different locations to evaluate QoS in specific geographical areas around the clock. |
| Norway | The measurement tool measures latency and upstream/downstream capacity from the user’s broadband access to the largest national Internet exchange point. It also offers measurement statistics and provides user guidance. |
| Poland | UKE has a nGenius System (Netscout USA) [www.nescout.com](http://www.nescout.com) |
| 1. **On which OSI level does the system work (IP, Application, etc.)?** | |
| Latvia | Transport level; used TCP and UDP |
| Lithuania | Application |
| Norway | The system measures capacity and latency related to the Application layer (HTTP). |
| Poland | nGenius examines the quality of services in the transport layer and higher layers up to the application layer (the measurement is based on passive observation of the data stream passing through the probe). |
| 1. **Does your system provide statistical Internet Access QoS parameters figures? If yes, please describe for what period and how many samples your system performs to evaluate statistically consistent QoS parameters.** | |
| Latvia | Today the data base saves four years statistics. It is possible to define a time frame or ISP or IP address to select statistical dates. To analyse the statistics the additional application is used. |
| Lithuania | Data collected from the measurements using www.matuok.lt service is not analysed and statistical figures are not provided.  Data of mobile internet access evaluation system is analysed and annual reports are published. Most of statistical figures are calculated manually. We try to collect as many data samples throughout the year across different cities in Lithuania. Last year over 6k of data samples for Mobile Internet Access QoS evaluation were collected, this year it is already over 30k data samples for all Mobile ISPs. |
| Norway | Users can choose to save their measurement result to a database. Provided the measurement passes a set of quality filters, it will be added to the statistics database. For each Internet access product (e.g. 25/25 Fibre, 8/1 ADSL) the statistics section of the measurement tool can be filtered by the user according to upload or download capacity and latency. Statistics can be divided into monthly time frames. |
| Poland | Every 15 minutes, spacecraft "throws" statistics data to the measuring server nGenius (UKE). It is a passive system (inactive) - there are so many attempts on current user activity.  The system maintains data from the 2 months period. |
| Romania | We intend to publish statistical data quarterly concerning all 4 technical parameters, based on the tests users perform. |
| 1. **What Internet destination address (es) (servers) does your system utilize in order to evaluate Internet Access QoS parameters (popular national websites, popular international websites, governmental organizations websites, special servers placed in IXP, Internet Access provider’s servers, etc.)** | |
| Croatia | We are still in a process of defining architecture and functionalities of this measurement system. |
| Latvia | Destination addresses on special servers placed in National Internet Exchange point (IXP) |
| Lithuania | RRT uses a dedicated server which hosts data files of particular size and ETSI recommended web-page for QoS evaluation “Copernicus”. |
| Norway | The network destination address for measurement is the Norwegian Internet eXchange point in Oslo (NIX). |
| Romania | The application will test the quality of the service or the link between the end-user’s terminal equipment and a testing server located in an interexchange internet node. |

|  |  |
| --- | --- |
| 1. **Has your measurement system being utilized to solve users’ complaints?** | |
| Austria | N/A |
| Croatia | It’s planned to be. |
| Denmark | N/A |
| Germany | N/A |
| Latvia | Yes. Additional testing equipment (Probe) to be connected to Network Termination Point in customer premises is used together with the measurement system. |
| Lithuania | No, for [www.matuok.lt](http://www.matuok.lt) .Yes, for mobile internet access. |
| Norway | It is available on a voluntary basis and can be used by everyone. Users can share their measurement results with their ISP, in case of a complaint. |
| Poland | Yes |
| Portugal | No |
| Romania | This measurement system isn’t going to be utilized to solve users’ complaints |
| Sweden | N/A |
| Switzerland | Not applicable |

|  |  |
| --- | --- |
| 1. **Is it possible for Internet Access Service Providers (ISP) to use your Internet Access QoS parameters measurement system?** | |
| Austria | N/A |
| Croatia | It’s planned to be. |
| Denmark | N/A |
| Germany | N/A |
| Latvia | Yes |
| Lithuania | The web-page internet speed evaluation application [www.matuok.lt](http://www.matuok.lt) is publicly available, so ISPs are free to use it any time. |
| Norway | Yes |
| Poland | We have not yet identified such points of access to measurements of Internet access services. UKE strives to make such items available by vendors for purposes of measurement. |
| Portugal | No |
| Romania | This measurement system will be used only by the end users. |
| Sweden | N/A |
| Switzerland | Not applicable |

|  |  |
| --- | --- |
| 1. **If yes, is it free of charge or do ISPs have to pay for measurements?** | |
| Austria | N/A |
| Croatia | Not defined yet. |
| Germany | N/A |
| Latvia | Any ISP may have the access to this system free of charge. For the security reason they have to sign the agreement with PUC. After the agreement is signed ISP receives from PUC username and password to access the measurement system. |
| Lithuania | No |
| Norway | Free of charge |
| Poland | We have not considered this option yet. |
| Portugal | Not applicable |
| Sweden | N/A |
| Switzerland | Not applicable |

|  |  |
| --- | --- |
| 1. **Is it possible for Retail Internet Access end users to use your Internet Access QoS parameters measurement system?** | |
| Austria | N/A |
| Croatia | It’s planned to be. |
| Denmark | N/A |
| Germany | N/A |
| Latvia | Yes |
| Lithuania | Yes, for the web-page internet speed evaluation application [www.matuok.lt](http://www.matuok.lt). It is designed for Retail end users and is publicly available. |
| Norway | Yes, it is available for all interested parties |
| Poland | N/A |
| Portugal | Not for the existing system methodology, but it will be possible in the future |
| Romania | Yes, the system is meant to serve end-users |
| Sweden | N/A |
| Switzerland | Not applicable |

|  |  |
| --- | --- |
| 1. **If yes, is it popular among end users?** | |
| Austria | N/A |
| Croatia | N/A |
| Germany | N/A |
| Latvia | Yes, more than two thousands measurement sessions fixed in measurement system database each month. |
| Lithuania | To this date in year 2011 [www.matuok.lt](http://www.matuok.lt) has generated about 500 visits per day on average. |
| Norway | Yes, the service has more than 50 000 visitors each month. |
| Poland | N/A |
| Portugal | In the future there will be two different solutions: one based on an agent based application and a second one based on a web based application. |
| Romania | This measurement system isn’t implemented yet. |
| Sweden | N/A |
| Switzerland | Not applicable |

* 1. Summary of Answers



1. **The information about estimated (planned) values publication for new Internet Access offers and for estimated (planned) values publication**
   1. Experience of estimated (planned) values publication

Two different approaches estimated (planned) values publishing may be used according to national legislation.

Later on when real (measured) values are available for same time period (e.g. one year), publication of the estimated values against the real (measured) values again may provide end user with useful information, e.g. whether the ISP chosen was too optimistic with its estimations or not. In contrast to above case, this time end user will be provided with such information on regular basis.

In case the estimated (planned) QoS values will be published, the publishing form as in Table 8.1 may be used and it will be placed near by the form with measured values.

* + 1. Estimated (planned) values publication for new Internet Access offers and for new undertakings

New Internet Access offer ISP cannot publish statistical (measured) QoS information since the service is not actually being provided. However some estimated (planned) QoS values should in principle be available while ISP dimensions and adjusts the network for provision of new service.

Obligation to provide estimated QoS values for newly launched Internet Access services is rather rare practice at the moment, however from the standpoint of the end user QoS information should still be available even in case the service is new.

According to the experience from the field, practical application of such obligation may be considered as rather beneficial for the end user while planned values were being estimated quite precisely.

* + 1. Estimated (planned) values publication on regular basis

Taking into account flexibility of the relevant USD provisions, some NRAs may consider it beneficial to provide end users with information not only about the actual QoS values, but also about estimated (planned) QoS values for up communing defined period of time, e.g. next calendar year. In this case NRAs should oblige ISPs to publish and (or) to submit their plans for QoS values for the defined time horizon (QoS Declaration).

In this case QoS Declaration is being published starting to provide services and being updated every defined time period for the next defined time period, e.g. once a year for the next year. Received QoS Declarations are published on the NRAs web site.

1. **List of references**
2. Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services.
3. Directive 2009/136/EC of the European Parliament and of The Council of 25 November 2009 amending Directive 2002/22/EC on universal service and users’ rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws.
4. A framework for Quality of Service in the scope of Net Neutrality, BEREC, 8 December 2011.
5. Guidelines for Quality of Service in the scope of Net Neutrality - Draft for public consultation, BEREC.
6. ETSI EG 202 057-1 V1.3.1 (2008-07) Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 1: General.
7. ETSI EG 202 057-4 V1.2.1 (2008-07) Speech Processing, Transmission and Quality Aspects (STQ); User related QoS parameter definitions and measurements; Part 4: Internet access.
8. ETSI TS 102 250-1 V2.2.1 (2011-04) Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 1: Assessment of Quality of Service.
9. ETSI TS 102 250-2 V2.2.1 (2011-04) Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 2: Definition of Quality of Service parameters and their computation.
10. ETSI TS 102 250-3 V2.2.1 (2011-04) Speech and Multimedia Transmission and Quality (STQ); QoS aspects for popular services in mobile networks; Part 3: Typical procedures for Quality of Service measurement equipment.
11. ETSI TS 102 250-4 V2.2.1 (2011-04) Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 4: Requirements for Quality of Service measurement equipment.
12. ETSI TS 102 250-5 V2.2.1 (2011-04) Speech and multimedia Transmission Quality (STQ); QoS aspects for popular services in mobile networks; Part 5: Definition of typical measurement profiles.
13. ETSI TS 102 250-6 V1.2.1 Speech Processing, Transmission and Quality Aspects (STQ); QoS aspects for popular services in GSM and 3G networks; Part 6: Post processing and statistical methods.
14. ETSI EG 203 165 V 1.1.1 (2012-04) Speech and multimedia Transmission Quality (STQ); Throughput Measurement Guidelines.
15. ETSI EG 202 765-3 V 1.1.2 (2010-07) Speech and multimedia Transmission Quality (STQ); QoS and network performance metrics and measurement methods; Part 3: Network performance metrics and measurement methods in IP networks.
16. ITU-T Recommendation Y.1540 (03/2011) Internet protocol aspects – Quality of service and network performance; Internet protocol data communication service –IP packet transfer and availability performance parameters.
17. ITU-T Recommendation Y.1541 (12/11) Internet protocol aspects – Quality of service and network performance; Network performance objectives for IP-based services.
18. ITU-T Recommendation P.800 (08/96) Series P: Telephone transmission quality; Methods for objective and subjective assessment of quality; Methods for subjective determination of transmission quality.
19. ITU-T Recommendation P.910 (04/08) Series P: Telephone transmission quality; Methods for objective and subjective assessment of quality; Subjective video quality assessment methods for multimedia applications.
20. ITU-R Recommendation BS.1116-1 (10/97) Methods for the subjective assessment of small impairments in audio systems including multichannel sound systems.
21. ITU-R Recommendation BT.500-13 (01.12) Methodology for the subjective assessment of the quality of television pictures.
22. ITU-T Recommendation G.1010 (11/01) End-user multimedia QoS categories.

1. http://berec.europa.eu/eng/news\_consultations/Closed\_Public\_Consultations/2012/961-public-consultation-0712-in-relation-to-net-neutrality [↑](#footnote-ref-1)
2. Mobile and fixed solutions are to be considered. [↑](#footnote-ref-2)
3. USD Article 22 paragraph 1: “Member States shall ensure that national regulatory authorities are, after taking account of the views of interested parties, able to require undertakings that provide publicly available electronic communications networks and/or services to publish comparable, adequate and up-to-date information for end-users on the quality of their services and on measures taken to ensure equivalence in access for disabled end-users. That information shall, on request, be supplied to the national regulatory authority in advance of its publication.” [↑](#footnote-ref-3)
4. USD Article 22 paragraph 2: “National regulatory authorities may specify, inter alia, the quality of service parameters to be measured and the content, form and manner of the information to be published, including possible quality certification mechanisms, in order to ensure that end-users, including disabled end-users, have access to comprehensive, comparable, Where appropriate, the parameters, definitions and measurement methods set out in Annex III may be used.” [↑](#footnote-ref-4)
5. The ITU and ETSI standardisation deliverables are normally free of charge available at: <http://pda.etsi.org/pda/queryform.asp>; <http://www.itu.int/en/ITU-T/publications/Pages/recs.aspx> [↑](#footnote-ref-5)
6. https://www.samknows.eu/ [↑](#footnote-ref-6)
7. Example of speed ranges used by Latvian NRA [↑](#footnote-ref-7)
8. i.e. error correction, packet reconstruction, buffering, etc. [↑](#footnote-ref-8)
9. particular in the case of low cost software device downloaded from a central server [↑](#footnote-ref-9)
10. possibly on a voluntary basis [↑](#footnote-ref-10)
11. quality of the image / sound, or performance of the users’ support service, or satisfaction with billing methods etc. [↑](#footnote-ref-11)
12. ITU-T plans to publish the corresponding conclusions in 2013 [↑](#footnote-ref-12)
13. [↑](#footnote-ref-13)