23.4.2010

EXPLANATORY NOTES TO REGULATION 58

ON THE QUALITY AND UNIVERSAL SERVICE OF COMMUNICATIONS NETWORKS AND SERVICES

MPS 58

CONTENT

1 LEGAL MATTERS

The aim of this chapter is to give the reader of the regulation a general overview of the provisions this regulation is based on. The chapter also provides other essentially related provisions.

1.1 Legislative basis for the regulation

FICORA's regulation is based on sections 128 and 129 of the Communications Market Act (393/2003 incl. amendments, CMA) [1].

The regulation relates to requirements provided in the following sub-sections of section 128 of the CMA [1], which states that public communications networks and communications services and the communications networks and communications services connected to them shall be planned, built and maintained in such a manner that:
1) the technical quality of telecommunications is of a high standard;
2) the networks and services withstand normal, foreseeable climatic, mechanical, electromagnetic and other external interference;
3) they function as reliably as possible even in the exceptional circumstances referred to in the Emergency Powers Act and in disruptive situations under normal circumstances, and;
12) a telecommunications operator is also otherwise able to meet the obligations it has or those imposed under this Act.

This regulation specifies the above-mentioned technical requirements of section 128 by virtue of the following sub-sections of section 129, according to which FICORA's regulations may cover:
3) the performance capacity of a communications network and communications service;
7) the technical characteristics of a cable television network, antenna system and community aerial system;
15) services provided for users;
16) performance maintenance and monitoring and network management;
17) technical documentation;
20) standards to be complied with, and
21) other comparable technical requirements set for a communications network or communications service.

1.2 EC legislation

The regulation is related to Directive 2002/22/EC [2] of the European Parliament and of the Council on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive).

Article 3(1) of the Universal Service Directive contains the legal requirement for Member States to ensure that the services set out in chapter 2 of the Directive are made available at the quality specified to all end-users in their territory, independently of geographical location.

Article 4(2) of the Directive contains the legal requirement for Member States to ensure that the Universal Service connection is capable of allowing end-users to make and receive local, national and international telephone calls, facsimile communications and data communications, at rates that are sufficient to permit functional internet access, taking into account prevailing technologies used by the majority of subscribers and technological feasibility.

According to Article 11 of the Universal Service Directive, national regulatory authorities must ensure that all designated undertakings publish adequate and up-to-date information concerning their performance in the provision of universal service, based on the quality of service parameters, definitions and measurement methods set out in Annex III. The published information must also be supplied to the national regulatory authority.

Pursuant to Article 22(1) of the Universal Service Directive, 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 services to publish comparable, adequate and up-to-date information for end-users on the quality of their services. The information shall, on request, also be supplied to the national regulatory authority in advance of its publication.

According to Article 22(2) of the Directive, national regulatory authorities may specify, inter alia, the quality of service parameters to be measured, and the content, form and manner of information to be published, in order to ensure that end-users have access to comprehensive, comparable and user-friendly information.

The parameters concerning the supply-time and quality-of-service referred to in Articles 11 and 22 of the Universal Service Directive have been itemized in Annex III of the Directive, according to which the definitions and measurement methods of parameters are presented in the ETSI standard EG 201 769-1 (04/2000). The Directive in question is currently being updated, and with all likelihood, as far as the definitions and measurement methods of the same parameters are concerned, the Directive will refer to a more recent ETSI standard, EG 202 057-1 [3], which is more suitable for current communications networks and services. FICORA has seen it reasonable that the more recent ETSI standard EG 202 057-1 [3] is used for defining the parameters and measurement methods of supply-time and quality-of-service itemized in Annex III of the Universal Service Directive. The parameters and measurement methods in question are taken into account, as applicable, in section 4 of the regulation i.e. special obligations on telephone services and in chapter 2 of the regulation covering the quality of operator services.

1.3 Other related provisions

1.3.1 Communications Market Act [1]

Rights of the user

Section 67d, Defect in the delivery of a communications service (759/2006). A defect in the delivery of a communications service is specified in the provision. According to the section, there has been an error in the delivery of communication services if the quality or the mode of delivery of the communications service does not correspond to what can be deemed to have been agreed. Unless otherwise agreed, the delivery of a communications service is defective, if: the quality of the communications service does not meet the requirements of the law or the Finnish Communications Regulatory Authority regulation issued by virtue of law or the communications service does not meet the marketing information or differs from what the user can normally expect from a similar service.

According to the Communications Market Act, matters concerning the contractual relationship between the telecom operator and user and liability for damages fall outside the authority of FICORA. The quality of a communications service is primarily specified in the agreement made between the telecom operator and user. Within the limits of its mandate, FICORA is unable to provide opinions on when the quality of a communications service differs from the agreement, or from the service quality the telecom operator is committed to in its marketing to an extent that a defect is deemed to be in the delivery of a communications service. The Consumer Disputes Board and general courts of first instance are competent to resolve matters concerning the agreement relationship between a telecom operator and user.

However, FICORA's technical regulation has relevance in the assessment of a defect in a communication service, because a defect in accordance with the CMA is bound to the service quality requirements set out in FICORA's regulations. However, it is important to note that the primary aim of this regulation is to harmonize the definition of producers of technical quality, and measuring them in an environment where several players are active and in different technologies. The aim is to avoid imposing absolute performance characteristic requirements on the services provided to users. The objective of the regulation and related recommendations is, after all, that comparable parameters were available for defect assessment in the long run, and that established parameters would specify the service descriptions of communications service agreements and the service commitments given by telecom operators in their marketing.

Communication about service breaks

Section 72, measures related to the construction and maintenance of a communications network and information security. The provision requires that telecom operators inform their users, in advance, of service interruption whenever possible.

Minimum speed of a universal service connection

Section 60c, Universal service obligation concerning the provision of universal telephone services (*331/2009*). The obligations of a universal service operator are laid down in the section. According to the section, a universal service operator must provide, at a reasonable price and regardless of the geographical location, a subscriber connection to the public communications network at the user's permanent place of residence or location. The telecommunications operator shall supply a subscriber connection within a reasonable time after an order.

The subscriber connection to be provided shall allow outgoing emergency calls, outgoing and incoming national and international calls and use of other ordinary telephone services. In addition, the subscriber connection must also allow an appropriate Internet connection taking into account the connection speed available to the majority of subscribers, technical feasibility and costs. A telecom operator can provide the above-mentioned services via several subscriber connections if no unreasonable additional costs are incurred to the user.

The section encompasses the authorization to regulate the minimum speed of an appropriate Internet connection included in the universal service by virtue of a decree of the Ministry of Transport and Communications.

According to the preamble to the Communications Market Act, a universal service specified by virtue of a decree of the Ministry of Transport and Communications, the practical implementation, measurement and supervision of an Internet connection belonging to the universal service require a detailed technical supervision which can best be implemented by FICORA's technical regulations. Section 129 lists technical requirements set for a communications network of communications service on which FICORA may issue regulation. The authorization is also suitable for a more detailed technical steering related to speed requirements of an Internet connection belonging to the universal service. (HE 223/2008, p. 24.)

Obligation to publish information on customer service quality

Section 82, obligation to publish information on service quality (26/2006). By decision, the Finnish Communications Regulatory Authority may impose an obligation on a telecommunications operator to publish, among other things, the delivery time of a subscriber connection, the call set-up time, the response time of a directory inquiry and correctness of invoicing. By virtue of the provision, telecom operators are obliged to publish data on the response time for operator services (ETSI EG 201 769-1 [3] 'response times for operator services'). The provisions have implemented Article 22 of the Universal Service Directive and Annex III of the Directive.

Supplying information in accordance with obligations to FICORA

Section 112, Supplying information to a public authority *(331/2009)*. This regulation imposes obligations on compiling statistics on various measurements results. FICORA makes use of the data in the technical monitoring of communications networks and services, building a long-term overview and focusing of technical steering.

Collecting information from telecom operators is based on Section 112 of the Communications Market Act. According to it, telecom operators are obliged to collect and, notwithstanding business and professional secrecy, supply to the Finnish Communications Regulatory Authority any information necessary for the guidance and supervision of telecommunications. The provision orders that the information shall be supplied without delay, in the form requested by the public authority and without charge. The authority aims at collecting information in appropriate entities and time periods, but may have to ask for the information randomly in order to examine individual supervisory cases.

For terrestrial digital television networks, there are information collection and data supplying obligations on network licences, too. The measurement and data supplying obligations in the regulation aim at being congruent with licence conditions and the data is also in the supervision of network licences.

The public nature of the information rests on the Act on the Openness of Government Activities (621/1999 incl. amendments), [4].

1.3.2 Consumer Protection Act

According to Section 83 of the Communications Market Act, the legal relationship between the consumer and the telecommunications operator is also covered by the Consumer Protection Act (38/1978) [5]. The Consumer Protection Act applies to the offering, selling and other marketing of consumer goods or services by businesses to consumers. The Act applies also where a business acts as an intermediary in the transfer of goods or services to consumers.

1.3.3 Decree of the Ministry of Transport and Communications on the minimum speed of a functional Internet access service included in the universal service (732/2009) [6]

According to the decree of the Ministry of Transport and Communications, the minimum speed of a functional Internet connection within the universal service for incoming traffic is 1 Mbit/s. According to the decree, it is sufficient that the average minimum speed of an Internet connection for incoming traffic is 750 kbit/s over a measurement period lasting 24 hours and 500 kbit/s over any 4-hour measurement period.

1.3.4 FICORA's technical regulations

Regulation 57 [7] on the maintenance of communications networks and services and procedures in the event of faults and disturbances. The regulation includes obligations on the management of faults and interference related to network management. Both regulations 57 and 58 will order obligations on telecom operators' network management. Section 3 in each regulation includes general obligations on network management.

2 THE OBJECTIVE OF THE REGULATION AND THE CHANGES MADE TO IT

The aim of this chapter is to give the user of the regulation information on the objectives and aims of the regulation. This chapter also includes the most important changes made to the obligations and recommendations preceding the regulation.

2.1 The objective of the regulation

The objective of this regulation is to ensure the reliability of communications networks and services, performance capacity, reliability and quality in normal conditions and specify the meters used for quality assessment of operator services. The regulation also gives a detailed account of the technical implementation of a functional Internet connection referred to in Section 6c of the Communications Market Act [1] and decree of the Ministry of Transport and Communications (732/2009) [6], and imposes measurement requirements necessary for verifying that the obligation is fulfilled.

The marketing of communications services and buying decisions have long been based on the price of the service. However, increasingly more often, consumers base their choice of a communications service on reliability and quality. The objective of the regulation is to ensure that consumer expectations can be met in normal conditions. In other words, the aim is to ensure that the quality experienced by users from end-to-end during the provision of the service, irrespective of the technology used to implement the service or how many players are involved to implement the service.

By way of ensuring and enhancing the performance capacity, reliability and quality of current communications networks and services, the introduction of new communications services is being promoted and thereby the development of information society advances. The above-mentioned objective is one of the most significant objectives of the regulation.

2.2 Key changes and changes made in the past

This regulation repeals FICORA's previous Regulation 29 D/2005 M *on the performance capacity of communications networks and services*. In addition, this regulation and FICORA Regulation 57/2009 M on the maintenance of communications networks and services and procedures in the event of faults and disturbances [7], which enters into force concurrently, repeal FICORA's previous Regulation 50 C/2007 on management of communications networks.

Matters influencing the quality of communications networks and services, performance capacity and their supervision, and maintenance, designing, measuring and minimum level have been adopted from previous FICORA's Regulations 29 and 50 and are now included in this regulation. Requirements concerning the management of faults and interference and supplying information on them are given in Regulation 57 [7].

The requirements in this regulation have been divided into three chapters: Chapter 1 presents the requirements concerning the performance capacity and quality of communications networks and services, chapter 2 introduces the requirements concerning the quality of operator services and chapter 3 includes the requirements concerning universal service.

The obligations given in chapter 1, *the performance quality and quality of communications networks and services,* originate from FICORA's previous regulations 29 and 50. They have been edited and grouped in a service-oriented manner according to requirements concerning communications networks and services, telephone services, television services and Internet access services. The Regulation also includes new obligations and recommendations related to all the above-mentioned categories.

The previous regulations instructed on the application of performance capacity requirements concerning PSTN/ISDN networks, and some of these requirements have now been extended to cover all telephone services. Other previous requirements concerning PSTN/ISDN networks have been removed from this regulation or are now included in recommendations, because the technology of PSTN/ISDN networks has matured, new networks are no longer built and current PSTN/ISDN networks have increasingly less users. These requirements were not removed in order to change the current practice concerning the design or maintenance of the public switched telephone network (PSTN/ISDN). The obligations in question have been omitted because it has become clear, in connection with renewing the regulations, that it is no longer necessary to set separate general obligations for telecommunications operators on these matters.

The regulations given in chapter 2, *Quality of operator services*, originate from FICORA's previous Regulation 50, and have been edited to better meet modern needs. They are now independent from the technology used for implementation, which is in line with the service-oriented approach used in this regulation. Obligations on the measurement and supervision of the number of faults and response times are now included in Regulation 57 [7].

This regulation has a new addition called obligations on the detailed technical definition and measuring of the service quality of a universal service connection (Chapter 3 *Universal Service*).

Section 9.2 of these explanatory notes (58) and recommendation on the measurement service provided to users was amended on 23 April 2010. The previous recommendation included that internet service providers may use FICORA's Net Speed Test as a measurement service provided to customers. However, FICORA decided to run down the Net Speed Test service in April 2010. The reason for the shutdown was dated technology. In other respects, no other parts of Section 9.2 were revised on 23 April 2010.

3 SECTION 1 SCOPE OF APPLICATION

The requirements given in chapter 1 of the regulation are applied to *general communications networks and services*, as well as to *public authority networks*. The sections of the Regulation contain detailed information on whether special obligations have been imposed on networks or services implemented by specific technologies. The general obligations on the supervision of the performance capacity of network management in chapter 1 concern all communications networks and services.

The obligations on the supervision of the quality of operator services referred to in chapter 2 of the Regulation are applied to *public communications networks and services.*

The obligations imposed in chapter 3 of the regulation are applied to *an Internet access service provided by a company assigned as a universal service operator.* According to the Communications Market Act, FICORA must issue a decision on the designation of one or several telecommunications operators, with universal service, if it is necessary for ensuring public services in a specific

geographic area. FICORA may assign a network or service operator as universal service operator. The Communications Market Act defines what a network or service operator is.

Public communications network and service

The regulation applies to public communications networks and services. The concepts of a communications network and communications service are defined in the Communications Market Act. They are technologically neutral, which means that they cover all electronic communications networks intended for both targeted communications and mass communications. According to the Communications Market Act, *a public communications network* means a communications network available to a set of users that is not subject to any prior restriction.

Public authority network

The Regulation's scope of application also encompasses public authority networks if the services listed in chapter 1 are provided therein. A public authority network, as defined in the Communications Market Act, means a network built for the needs of public order and security, rescue activities or civil defence.

Liability interface between telecom operator and client

The regulation concerns the quality of a communications network managed by a telecom operator and communications service provided by a telecom operator. Therefore, it is important to specify where the line of responsibility stands between the telecom operator and client. A telecom operator is responsible for the public communications network ending to a house cabinet. FICORA's Regulation 25 has a more detailed definition of a house cabinet. In addition, the explanatory note of the Regulation, MPS 25, contains a recommendation on the definition of the liability interface of a public communications network and internal network of a building in a house cabinet [8].

4 SECTION 2 DEFINITIONS

This chapter examines the definitions used for the regulation.

4.1 Communications network or service component

In this Regulation, a communications network or service component means a network element, device, or information system from which the communications network or service is comprised of or which it uses. Communications network or service components include, e.g. a mobile switching centre, base station control unit, base station, text message centre, broadband network concentrator, name server, network access control server, switch, router, SIP application server, or intelligent network component.

A communications network or service component does not mean transmission links or parts of network elements, such as processor units of a mobile switching centre.

4.2 Internet access service

In this Regulation, Internet access service means a communications service through which a connection can be made to the Internet, and the services available in the Internet can be accessed. The definition is independent from any technology and therefore covers both fixed and wireless Internet access services regardless of their speed. The definition covers data transmission from a subscription to the public Internet, DNS resolvers and DHCP service, which are obligatory for accessing the Internet. However, services such as e-mail, telephone or IPTV used while being connected are excluded from the definition.

It is technically possible to divide an Internet connection into the following sub-categories, also shown in figure 1, affecting the functionality of the service:

- client's communications network (wiring and/or antenna)
- local loop (either wired or wireless)
- network of a network operator and service provider
- Internet

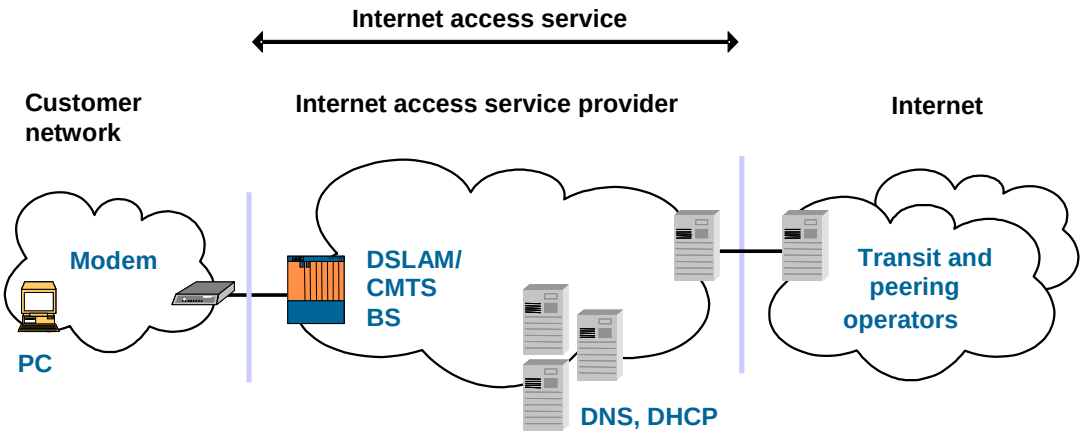

Figure 1: Illustration of the Internet access service

4.3 DVB-T and DVB-C network service

In this Regulation, DVB-T network service means digital terrestrial television broadcasting services in accordance with DVB-T (Digital Video Broadcasting, Terrestrial) standard (ETSI EN 300 473 [9]). In this Regulation, DVB-C network service means digital cable television broadcasting services in accordance with DVB-C (Digital Video Broadcasting, Cable) standard (ETSI EN 300,429 [10]). According to the definitions and figures presented in annexes 2 and 3, both DVB-T and DVB-C network services also consist of other network services such as transmission, coding, multiplexing and remultiplexing, which ensure that television service is delivered to the end-user's reception point.

Figure in Annex 2 depicts the delivery chain of television services from a broadcasting operator to the user via DVB-T network service. As can be seen from the figure, DVB-T extends, at its broadest, from the coding of a program source to the user's reception point. In the case of DVB-C network service, DVB-T network service extends from the coding to the transmitter base of the transmission area, where the delivery chain continues to the user's reception point as a DVB-C network service.

Whereas the figure in Annex 3 depicts the delivery chain of television services via DVB-C network service. It is possible to receive television services to a DVB-C network via several sources. A provider of a DVB-C network service is responsible for delivering a signal from the reception point to the client, up to the delivery interface.

4.4 Quality of service

Quality of service (QoS, Quality of Service) consists of the service features of networks and services provided therein used for the purpose of describing and defining the capability of a network and service provided therein to fulfil the user expectations targeted at them.

The quality of service experienced by the user means the user's personal view of the quality of the service and the auxiliary activity to the provision of the service. The level of quality is often expressed by terms describing satisfaction instead of those describing the level of technical quality.

In this Regulation, the quality of service means characteristics of communications networks and services that can be defined and measured by means of technology, and which contribute to the definition and description of the quality of the service provided by e.g. using quality classification or limiting values. As the quality of service we experience is always personal and affected by many factors independent from the technical network implementation of the service, it is in order that the technical factors of the quality of communications networks and services are approached from the user's perspective.

4.5 Performance capacity

In this Regulation, performance capacity means the capability of the network or a segment of a network to provide activities related to the communications between users. Performance capacity parameters enable service providers to describe and measure the functionality and reliability of their networks or a segment of it, as well as the capability of fulfilling the requirements imposed on it by the service provided in the network. Examples of performance capacity are the utilization rate of the capacity of the component or the delivery/processing time of messages.

4.6 Fixed location

Within the framework of this Regulation, a fixed location means a fixed address where a subscription has been delivered and where the telecom operator has promised that it functions. Leased telephone network subscriptions and xDSL subscriptions are examples of these.

Such mobile communications network subscriptions to which an operator or partner has delivered, for example, a table telephone, wall telephone or a distinct antenna in order to ensure reception, are also regarded as subscriptions delivered to a fixed location. The primary location of use of mobile subscriptions equipped with such auxiliary devices may be regarded as fixed despite that the subscription may be used for mobile purposes, too.

5 SECTION 3 REQUIREMENTS FOR COMMUNICATIONS NETWORKS AND SERVICES

This section includes requirements for performance capacity and quality to be applied to all communications networks and services, and related obligations on measuring. They are basic network management obligations a telecom operator must follow in order to ensure the quality of its service irrespective of the nature of the communications service provided.

Since the obligations are applied to all different communications networks and services, it is justified to allow an opportunity for telecom operators to select the meters best suited for their communications network and service, and service promise. What is relevant is that a telecom operator is, with the help of the meters, able to detect the significant problems affecting the functionality of its communications network or service.

The obligations issued in this section are general obligations and they will be specified, if necessary, later in this section or in other sections on services or networks.

5.1 Follow-up of performance capacity, quality and service reliability

The aim of the obligation imposed in the section is to ensure that a telecom operator monitors the performance capacity, quality and service reliability of the communications network or service it manages. In addition, a telecom operator must have the appropriate mechanisms for detecting major problems affecting the functionality of communications networks or service and for reacting to them.

There are three ways to monitor performance capacity and quality: continuous measurements, momentary measurements and separate measurements. Each measuring can be divided into active or passive measurements. Passive measurements mean the monitoring of actual communications, whereas active measurement means the monitoring of test communications generated for the purpose of measuring the network.

Application

Because the meters necessary and optimal for ensuring the performance capacity and quality of communications networks and services are mainly limited to networks and services, it is reasonable that telecom operators are given an opportunity to assess and select the meters best-suited for their service.

The obligation included in the section means that a telecom operator must make a suitability assessment and an assessment of need for the meters, and create the meters necessary for the monitoring of performance capacity and the quality of service. The section includes an obligation on the processing of measurement results, and it will be examined in more detail in paragraph 5.5.

For example, a telecom operator may assess the adequacy of the measurement of the components of its communications network or service by monitoring the utilization rate of capacity. An obligation on the above-mentioned is included in the section and will be examined in further detail paragraph 5.2. Other examples of measurement are the delivery time of a message, length of a message queue and barring.

In addition, it is advisable that telecom operators specify indicators for attention/alerts of the communications network or service components they manage in order to detect reduction in availability which affect the quality, and to address these before the drop in the quality manifests as a defect.

5.2 Follow-up of the utilization rate of capacity and reaction to exceeded limiting values

The obligation on follow-up of performance capacity and quality of service described in paragraph 5.1 has been specified by an obligation to measure the utilization degree of the components of a communications network or service, as well as by an obligation to define and document limiting values for the utilization rate of the capacity. The limiting values must be adequate to ensure the quality of the service. According to the obligation given in this section, a telecom operator must take appropriate measures in order to ensure that the communications transmission capacity of the network is sufficient, if the above limiting values are exceeded.

In the regulation, a separate section was devoted to the follow-up of the utilization rate of capacity, since although it is not the best meter for detecting all problems, it is nevertheless a good general meter both for detecting eventual problems and for normal capacity and network design.

Application

Depending on the communications network and service, user volumes and the intensity of the variation of the utilization rate of capacity, it may be necessary to monitor the utilization rate of capacity on a daily basis or for example, once a month. Some situations involved in the utilization rate of capacity and its variation may require immediate reaction from telecom operators. These factors must be taken into consideration when measuring the utilization rate of capacity.

A telecom operator must define and document limiting values for the utilization rate of capacity for each component. If they are exceeded, appropriate measures must be taken in order to ensure the communications transmission capacity of the network. Paragraph 5.5 includes detailed information on the follow-up of measurement results and alarms.

5.3 Preparedness for performing separate measurements

The obligation given in the section on performing separate measurements is necessary, because telecom operators need measurements of this kind, for example, for locating defects in communications networks or services, or for determining the audibility and quality of a mobile network.

The requirement to perform separate measurements is given because many of the measurements require personnel resources or consume the capacity of the connection, network or network element to a degree that continuous or regular measurements cannot be grounded.

Application

Unless otherwise ordered in this regulation, telecom operators must decide which meters they use for verifying the quality. What is relevant is that, with the help of these meters, a telecom operator is able to locate and verify eventual defects and assess the performance capacity of the components of a communications network or service as well as the quality of communications services it provides.

The separate measurements referred to in the obligation mean separately-performed active and passive measurements. Examples of separate measurements are field measurements of a mobile network and the verification of the quality of a specific subscription or service.

A few examples of separate meters for various services are shown below:

Telephone services - it may be necessary for telecom operators to use R values for measuring delay in telephone service and call set-up time or they may find it necessary to assess the quality of the telephone connection with the help of R values. Chapters 6 and 7 concerning telephone services will discuss these in further detail.

SMS or MMS services - it may be necessary for telecom operators to measure, for example, the supply-time of messages to a communication centre or receiving terminal device. Chapter 16 will give recommendations on the above.

Internet access services - it may be useful to find out whether a customer's modem or network element responds to the sent message, what the data transmission speed of the customer's subscription is, or what the other quality parameters of data transmission, such as delay and packet loss, are. Chapters 8 and 9 concerning Internet access services will discuss these in further detail.

Television services - it may be necessary for telecom operators to use separate measurements to study the reception of the network, signal-to-noise ratio or deterioration of the quality of the picture over a certain period of time.

5.4 Disturbance caused by measurements

According to the obligation given in the section, taking measurements of network performance capacity and quality of traffic must not disturb other use of the network.

The requirement is justified because the measurements must not consume as much of the network capacity as to disturb the use of services.

Active measurements create communication in the networks and therefore consume the capacity of the component of a communications network or service. In addition, measurements may set limits for the use of the measured subscription at the time of the measurement, which is why the requirement concerns the other use of the network, only. A telecom operator must, however, aim at minimizing the disturbances caused to the measured subscription.

Application

The performance capacity of a network and the quality of communication must be measured in such a manner that unnecessary amount of communication is not generated in order to avoid any network disturbance. It must be noted that the above-mentioned effects will appear in the subscription to be measured.

5.5 Processing of measurement results and alarms

The aim of the requirements given in the section is to ensure that the measurements of performance capacity and quality will be utilised for the purpose of designing and assessing the quality, service reliability and capacity of communications networks and services, and that these are sufficient.

Application

The appropriate mechanisms referred to in this section mean, besides normal network management and network design, ability to detect and react to significant changes and problems affecting the functionality of a communications network or service.

A separate obligation on the processing of measurement results will not be imposed on telecom operators in this section. Instead, it states that telecom operators must have methods that are commensurate with the size of its operations. Telecom operators must themselves determine the necessary responsibilities and operative processes with their supervision mechanisms and cycles, limiting values and eventual alarms in order to detect problems and react to them.

Depending on the characteristics of the provided service, alarms may require corrective measures immediately. Or, it may be sufficient that the planning of measures is begun on the following work day or when an inspection is made.

6 SECTION 4 SPECIAL REQUIREMENTS CONCERNING TELEPHONE SERVICES

This section gives obligations on the performance capacity and quality of telephone services. The obligations are independent from network technology.

The requirements given in the section and related recommendations replace the requirements, given in FICORA's previous regulations 29 and 50, set for telephone services implemented by various network technologies. The change is necessary because telephone services have and are being switched from PSTN/ISDN networks to mobile networks and IP networks. In addition, the boundaries of various network technologies have blurred due to network convergence development, which is why it has been more rational to draft the obligations in a more technology-neutral form.

6.1 The availability of components affecting telephone services

The aim of the obligation on measuring and data supply of the availability of components in communications networks or services affecting the availability of telephone services is to ensure that the components of a communications network or service used via telephone services enable that telephone services can be used with as little interruption as possible. By monitoring the availability, a telecom operator is able to ensure the quality of its network and locate and correct, in advance, the eventual cause of the defect.

FICORA will collect data, in accordance with the obligation, on availability from telecom operators. On the basis of this data, FICORA will, in context of the next amendment to the regulation, in order to ensure the availability of telephone services, assess the need to give requirements for availability to components of communications network or services participating in telephone communication. At this stage (2009), FICORA has not seen it necessary to recommend that a telecom operator aims at ensuring that the availability of its components affecting the production of telephone services would be at least 99.9 per cent on a yearly basis.

Application

A telecom operator must measure the availability of the components of a communications network or service used for the production of telephone services. In other words, probability with which call service, regarding these components, can be provided to the user.

The data on the availability of each component must be supplied as actual availability on a yearly basis. This means that the interruptions caused by maintenance and following an advance notice, must be included in the data on availability. However, if the back-up of a component ensures the uninterrupted operation of the call service, there will naturally be no drop in the availability data. Then again, if the back-up of a component fails, it will affect the availability rate. The purpose of the follow-up of availability is to assess the disturbances in telephone services that are visible to the user, and drops in availability. But, the measurement method of availability is component-specific.

Recommendation

FICORA recommends that a telecom operator aims to ensure that the availability of the components of a communications network or service affecting the availability of telephone services is at least 99.9 per cent over a follow-up period of 12 months. In practice, this means that the components of a communications network or service controlled by a telecom operator and affecting the availability of telephone services may be unavailable for a maximum of 8.8 hours a year. Unless the above level of availability is reached, FICORA recommends that the telecom operator examines the reasons that led to the drop and drafts a strategy that helps to reach the availability level in the future.

6.2 Unsuccessful call ratio

Unsuccessful call ratio means the share of unsuccessful calls due to network failure over all call attempts.

The aim of the obligations given in the section is to ensure that the share of blocked calls remains at a low level. The obligation specifies the obligation given in section 3 of the regulation concerning all communications networks and services on the measuring of the utilization rate of capacity and changes therein.

On the other hand, the purpose of the obligation to supply data is to require, pursuant to section 82(1) of the Communications Market Act, telecom operators to publish sufficient and up-to-date information on their supply in universal service based on the quality-of-service parameters, definitions and measurement methods presented in Annex [2] III of the Universal Service Directive.

Application

The obligation to measure and supply data of unsuccessful calls is based on the ETSI standard EG 202 057-2 [15].

The ratio of unsuccessful calls is measured during a pre-defined measurement period. The measurement compares unsuccessful calls due to network failure with all call attempts. According to the obligation given in the section, the components of communications networks and services must be dimensioned so that the unsuccessful call ratio may be, on a yearly basis, no more than 1 per cent of all calls during a year.

An attempt to make a call is an attempt to establish a telephone connection to the recipient's active subscription. The call is unsuccessful if no telephone connection can be established due to network failure. Thus, call set up ends with a release message. The reason for the release may be network-related, or call set up ends when the reception monitoring timeout control of address complete information (e.g. ACM) goes off.

A telecom operator must monitor the unsuccessful call ratio regularly on a component basis, so that eventual problems can be tackled. This fulfils the requirement given in section 3 of the regulation to monitor the utilisation rate of the capacity of components and changes therein.

A telecom operator must supply data on unsuccessful call ratio on a yearly basis. Unless the requirement level is reached, a telecom operator must clarify the reasons that have led to the lower target level, and compile a strategy that helps to reach the required level.

Recommendation

FICORA recommends that telecom operators determine their component-specific measurement objectives for the unsuccessful call ratio. They should also monitor that the objective is reached and the monitoring should be based on busy hours. For example, busy hour reports could be collected.

This means that a telecom operator must measure the capacity of its components and monitor the unsuccessful call ratio so that the situations where there is as much communication in the network as possible are taken into consideration.

FICORA recommends that telecom operators take into consideration special situations causing large, temporary telephone communication in a certain area, or to a certain telephone number. Examples of the latter are open air events and televotings. The objective is that the unsuccessful call ratio experienced by users can be minimized in these situations, too, and that these special situations do not disturb the network's other operations.

6.3 Preparedness to measure and supply data on call set up time

It is unlikely that there are problems with the call set up time in PSTN/ISDN networks. However, the importance of call set up time may rise in situations where a call is routed via several networks, call is made or received in a wireless network or call is dispatched via packet-switched/packet-based networks. A stretched call set up time indicates problems in the network.

Thus, the measurement and data supply of call set up time are good meters of network performance capacity.

On the other hand, the purpose of the obligation to supply data is to require, by separate decision, pursuant to section 82(1) of the Communications Market Act, telecom operators to publish sufficient and up-to-date information on their supply in universal service based on the quality-of-service parameters, definitions and measurement methods presented in Annex [2] III of the Universal Service Directive.

Application

The obligation to measure and supply data of call set up time is based on the ETSI standard EG 202 057-2 [15]. The preparedness to measure and supply data on call set up time means that telecom operators must have the methods for the measuring and supplying data on the measurements, if necessary.

The call set up time is measured during a time period from the moment when the network receives the last number (in subscriber signalling) of the target of the call (B subscriber) to the moment when the calling party (A subscriber) hears the busy tone, ringing tone or receives an automatic response tone. Unsuccessful calls should be excluded from the measurements of call set up time.

Separate statistics must be compiled and measurements made for national and international calls. The statistics must show, at least, the average of call set up time in seconds and the number of observations made.

Recommendation

FICORA recommends that telecom operators measure and supply data on the call set up time regularly.

FICORA recommends that the call set up time is:

- no more than 3 seconds for calls made from a fixed network to another fixed network.
- no more than 5 seconds for calls made from a fixed network to wireless network or vice versa.
- no more than 7 seconds for calls made from a wireless network to another wireless network.

FICORA recommends that telecom operators measure and assess the call set up time of VoIP calls depending on the network the service in question is mainly provided in.

If the above-mentioned rates are exceeded, FICORA recommends that telecom operators take measures to find out the reasons for the long duration of call set up time, and uses appropriate measures to shorten the duration.

6.4 Preparedness to solve disturbances

The purpose of the preparedness to investigate reasons leading to unsuccessful call set up, dropped calls and imperfect call clearing is to ensure that telecom operators have the means to solve the situations that weaken telephone communications and therefore further improve the reliability of their telephone services.

Failure in call set up means that a network has received, from the subscriber, a piece of information that is sufficient for call set up, but is unable to set up a call for reasons other than call-barring.

A dropped call means that a call has been set up between the subscribers, but it is dropped due to a network-related reason.

Imperfect call clearing means that an error has occurred either in the signalling of call clearing or some of the resources used for setting up a call are busy, although the signalling contains all messages required for call clearing.

Application

Telecom operators must have the methods and tools for repeating the call case with regard to situations that weaken the functionality of telephone communication, and monitor call signalling at its various stages in order to find out the factors causing the drop in reliability of service and quality.

7 RECOMMENDATIONS ON FACTORS AFFECTING THE QUALITY OF TELEPHONE SERVICES

This chapter presents FICORA's recommendations on the target values of factors affecting the quality of telephone services, measurements of them and mechanisms used for ensuring quality. The purpose of the recommendations is to help telecom operators improve the quality of the telephone services they provide.

7.1 Recommendation on delay and delay variation

A human ear picks easily up any delays in voice transmission and short-term variation in delay, which have a strong impact on the quality of telephone services the user experiences.

Delay is caused by for example the processing of signals and coding. If parallel delay in telephone services is great (over 100 ms), it affects the dynamics of conversation. In other words, if the delay in hearing the other party's answer grows to the extent that it is noticeable, it is felt as a factor that weakens the quality of the voice connection.

On the other hand, variation in delay occurs in packet-switched networks and results from arrival of packets that are received at different times.

FICORA has decided to give a recommendation instead of obliging regulations, because an obligation would limit the implementation of telephone services at too large a scale e.g. when using IP technology in wireless networks.

The impacts of delay and variation in delay on telephone services have been dealt with in the ITU-T standard G. 114 [11], which can be used for managing delay and delay variation in different networks. It is relevant that telecom companies recognize the impact of the factors on the quality of call service experienced by users and takes them into consideration in its network and system design.

The following guidelines may be given about the values of parallel end-to-end or user-to-user delay [11]:

- More than 100 ms: Delay is beginning to affect the dynamics of conversation
- Less than 150 ms: Acceptable parallel delay - user experience is good
- 150 - 400 ms: Acceptable parallel delay, requiring that the impact of the delay on the quality of telephone services is made known to the user
- More than 400 ms: Unacceptable parallel delay - user experience is poor

Recommendation

FICORA recommends that telecom operators design their communications networks and telephone services so that a parallel end-to-end delay will not be more than 150 ms and that the variation of end-to-end delay is less than 15 ms.

The above-mentioned values have been determined for end-to-end or user-to-user when several telecom operators may be involved in call transmission. In an environment involving several players, the outcome of the measurement of actual delay and variation in delay from user-to-user may be unsuccessful. But, each player must minimize the parallel delay and variation of delay in the components of communications networks and services they administer, so that the quality of telephone services could be as good as possible in this respect.

FICORA recommends that telecom operators aim at reducing the number of media alterations made to call communications in the operators' networks or at NNI (Network to Network Interface) interface in order to ensure as good call service quality as possible.

7.2 Recommendation on management of echo

Echo in the system has a strong impact on a call service user's experience of quality. Echo emerges, for example, in a modification from a double-wire system to four-wire system or as a result of poor acoustic matching in the terminal device. Echo reduces the quality of call connection and the echo of the user's speech bouncing back to the speaker reduces the quality of user experience. Echo may also affect data services transferred in the network.

This regulation does not include obligations to telecom operators concerning echo in telephone services. It is essential that a telecom operator recognizes the impact of echo on the user's experience of call service quality.

In FICORA's previous Regulation 29 D/2005 on the performance capacity of communications networks and communications services includes requirements for echo in PSTN/ISDN networks. As PSTN/ISDN network technology is being withdrawn from use, the obligations have been replaced by a recommendation concerning all network technologies on the use of (digital) echo cancellors.

Acoustic echo suppression is pertinent to terminal devices and thus it is not discussed in this recommendation.

Recommendation

FICORA recommends that in order to ensure the quality of call connections in communications networks used for providing telephone services, echo cancellors are used instead of echo suppressors. Echo cancellors must meet the requirements set in the ITU-T standard G.168 [12].

7.3 Recommendation on quality assessment of telephone services

The quality of telephone services may be assessed on the basis of quality models and categories modelling user satisfaction in various cases of use. The models are used for assessing the quality of the current connection and plan the quality provided by a new or renewed connection from the viewpoint of user satisfaction.

The ITU-T standard G.109 [13] gives a definition for five categories for the quality of end-to-end voice transmission of 3.1 kHz telephone services in various networks. The classification is based on the assessment of user satisfaction, and they are tied to the so-called R-values of the E-model. The E-model is a computational data transmission model used for assessing the combined impact of many different data transmission parameters on the quality of 3.1 kHz telephone services. The definition and use of the E-model is presented in ITU-T standard G.107 [14].

Table 1 presents the quality classification for speech transmission. The R-value of each data transmission connection used for transmission of speech to be assessed corresponds a specific quality category and the user satisfaction.

Table 1. Quality classification of speech transmission and satisfactions of users in respect to these categories. [13]

R-value range	Speech transmission quality category	User satisfaction
$90 \leq R < 100$	Best	Very satisfied
$80 \leq R < 90$	High	Satisfied
$70 \leq R < 80$	Medium	Some users dissatisfied
$60 \leq R < 70$	Low	Many users dissatisfied
$50 \leq R < 60$	Poor	Nearly all users dissatisfied

The regulation will not impose obligations on telecom operators on the quality level of telephone services or quality measurements. If telecom operators decide to assess quality, FICORA recommends that the assessment is based on R-values, because they take user satisfaction into consideration with regard to end-to-end connection.

The purpose of the recommendation is to aim at harmonizating the assessment of the quality of telephone services. The use of a harmonized quality classification makes it easier for telecom operators to make agreements with other operators. Also, it will be easier to assess quality and monitor quality.

The recommendation is based on an ETSI standard, EG 202 057-2, [15], which discusses user-oriented parameters of service quality and measurements for telephone services.

Recommendation

FICORA recommends that rating value R is primarily used for assessing the quality of connections by which telephone services are implemented. ITU-T Recommendation G.107 [14], annex B includes modifications between R-values and other quality rating factors. Examples of these are: MOS (Mean Opinion Score), GoB (Good or Better) and PoW (Poor or Worse).

FICORA recommends that the data transmission connections used for the transmission of telephone services are planned and implemented so that their R-value is more than 70.

8 SECTION 5 SPECIAL REQUIREMENTS CONCERNING INTERNET ACCESS SERVICES

Section 5 provides requirements concerning all Internet access services. Internet access services are defined as being independent from any technology and therefore cover both fixed and wireless Internet access services irrespective of their speed.

The importance of Internet access services has grown significantly for both end-users and companies, but it is complicated or expensive to monitor and ensure the performance capacity and quality of these services. Therefore, telecom operators providing the services do not necessarily have an adequate amount of information on the functionality of the subscriptions they provide, which may lead to overestimated service promises, or faults are not detected and corrected.

The quality experienced by customers is greatly influenced by several factors that fall outside the scope of the telecom operator's influence, such as the quality of a customer premise telephone networks or the quality and performance quality of the used service, such as congestion. Therefore, it is important to recognize the role and responsibilities of an Internet access service provider and distinguish these from the responsibilities a customer and service provider used by the customer have in the service.

The requirements concerning Internet access services vary greatly according to what sort of applications the user wishes to use via the connection. Examples of the above are shown below:

- Capacity: browsing the network requires capacity every now and then, only - watching a real-time video clip or downloading large files require an uninterrupted capacity.
- Delay: Transfer of large files will not necessarily suffer from data transmission delay whereas call service delay is extremely disturbing since they are real-time.
- Packet loss: reasonable amount of packet loss will not weaken the quality of real-time speech whereas packet loss makes file transfer always slower, because packets must be transferred several times.

Since there is clear variation in user needs, it is reasonable that telecom operators can productize Internet access services excluding the universal service obligation. This is important because the selected access network technology and the size of the network greatly determine the quality of the service. And, these determine the production costs of the service and the price of the product.

However, telecom operators must be able to fulfil the service promises they have given and to verify the results. These issues are further discussed in paragraphs 8.1-8.3.

8.1 Preparedness to monitor the quality parameters of Internet access services

The obligation in the section on the preparedness to measure the connection speed of the Internet access service provided to the customer is justified in order for telecom operators to verify the eventual defects regarding the customer's subscription.

Application

Regarding subscriptions delivered to a fixed location, telecom operators must be able to measure the connection speed between the customer's subscriptions and the measurement point located in its own network. No measurements must be taken of subscriptions delivered for mobile use since the measurement can be taken statistically. This means that telecom operators must be able to measure the connection speeds between the various coverage area points of the wireless communications network and the measurement points located in its own network. On the basis of this, it is possible to produce a statistical estimate of the connection speed of the Internet access service provided to the customer.

The measurement should include upload and download speed, and the payload of the UPD or TCP protocol is used as basis for calculation. The measurements should primarily be based on the UDP protocol i.e. the payload of the UDP protocol should be used as basis for calculation.

Recommendation

FICORA recommends that telecom operators are prepared to also select other key quality parameters, such as delay, delay variation and packet loss, affecting the quality of the Internet access services they provide to their customers.

Delay means one-way delay which can also be measured by dividing the value of Round Trip Delay (RTD) by two.

Delay variation means non-real time arrival of packets, which can be measured by calculating the greatest remainder of the time used for the transfer of packets.

Whereas packet loss means the ratio of packets lost during the transfer to all sent packets.

8.2 Verification of the quality and features agreed with customer

According to the obligation given in the section, *telecom operators must follow and maintain the performance capacity of their network on an adequate level in order to fulfil its agreement with the customer on the quality and features of Internet access service.* Pursuant to Section 67 of the Communications Market Act [1], communications services agreement must include, inter alia, the quality and features of the services provided.

The Internet access services provided by telecom operators have not always fulfilled the service quality stated in the communication services agreement. Attention should be paid to this when an agreement on the quality and features of the service is made with the customer. In other words, when the subscription giving access to Internet access services is sold or when the speed of the connection is changed. Often, a slow subscription may also be more stable than a one that has been described as fast. Telecom operators must know the performance capacity of their network, so that empty promises of too high connection speeds are not given to the customer.

Ensuring that the network is capable of providing the agreed quality may incur considerable expenses to telecom operators. In addition, it is difficult to specify and measure the accurate quality of service of Internet access services (mobile broadband) provided to mobile usage in mobile networks. Therefore, in this Regulation, telecom operators have been given an opportunity to assess the capability of its network to provide the agreed service to customers.

Application

Wired or wireless Internet access services provided to a fixed location have had difficulties in providing fast connections, or when the customer is far from the broadband network concentrator. On the other hand, Internet access services provided in mobile networks have had difficulties in the assessment of the network coverage area and actual usage of base station capacity, in particular.

Telecom operators are able to measure or assess the network capability of providing a certain connection speed to the customer with regard to Internet access services provided at a fixed location. In mobile networks, it is more difficult to define a specific connection speed due to large variation in user volumes and restrictions set by base station capacity.

The requirement given in the section means that telecom operators must measure the capability of its network to provide the service prior an agreement is made on the quality and features of the service with the customer. Alternatively, telecom operators may base the service quality agreed with the customer on a realistic assessment of the technical features of the network. However, the assessment must be careful so that probability of error can be kept as low as possible.

8.3 DNS resolver, access management and DHCP services

DNS resolver, access management and DHCP services are an essential part of Internet access services and telecom operators must take particularly good care of the performance capacity and quality of these services.

DNS resolver name service means a part of the DNS (Domain Name System) whose task is to find answers to domain name server queries. In practise, this means a transformation from a domain name to an IP address.

Access management service means a service that controls the users' access to the network. In practise, this means the identification of users and management of user rights.

DHCP service means service implemented by DHCP protocol typically used for determining IP addresses and other defaults such as domain name servers and default gateways to the computers connecting to the network.

The purpose of the obligation is that telecom operators measure the response times of these services and is, on the basis of the measurement results, able to tackle eventual problems and plan the capacity need of the services. The regulation also includes an obligation to supply data on response times.

Response time means time that the user spends while waiting for the response to the query he or she has sent to the server.

The Regulation also obliges telecom operators to be prepared to comply statistics of the response times. The purpose of this is to ensure that FICORA may request a telecom operator, during a specific time period, to comply statistics of the measurement results and thus, the authority receives data on the response times of services in accordance with the obligation and response time monitoring made by a telecom operator.

Telecom operators may themselves decide what the follow-up period for eventual alarms and measurement results is.

Application

In order to follow the response time of the DNS resolver, access management and DHCP services they provide, telecom operators must measure the average time used for answering to the queries sent to the server which support the use of these services.

Response times may be measured automatically with the help of network statistics (SNMP) or by using test connections. The monitoring must be as accurate as possible in describing the response time experienced by the user.

The preparedness to comply statistics means that a telecom operator has the mechanisms available for compiling statistics of the measurement results, if necessary, (on separate request) over a pre-determined time period.

Recommendation

FICORA recommends that telecom operators set maximum values to be reached for the response times of the resolver name, access management and DHCP services they provide. If telecom operators find that the measured response times clearly or regularly exceed the response time set as targets, they must find out the reasons for the exceeding and take measures to reduce the response times.

9 RECOMMENDATIONS ON PROVISION OF INTERNET ACCESS SERVICES

This chapter discusses FICORA's recommendations on the provision of Internet access services. The purpose of the recommendations if to help telecom operators improve the quality and user satisfaction of the Internet access services they provide.

9.1 Recommendation on the availability of components affecting Internet access services

The aim of the obligation on measuring and data supply of the availability of components in communications networks or services affecting the availability of Internet access services is to ensure that the components of a communications network or service used via Internet access services enable that Internet access services can be used with as little interruption as possible.

The purpose of the recommendation on the monitoring of availability is to help telecom operators take care of the quality of their network. In addition, it helps telecom operators to identify and correct eventual sources of defects in advance.

Recommendation

FICORA recommends that telecom operators regularly measure the actual availability of the components of its communications networks and services affecting the availability of Internet access services it provides. This means that the interruptions caused by maintenance measures taken in the maintenance window and following an advance notice, must be included in the data on availability. However, if the back-up of a component ensures the uninterrupted operation of the Internet access service, there will naturally be no drop in the availability. Then again, if the back-up of a component fails, it will affect the availability rate. The purpose of the follow-up of availability is to assess the disturbances in Internet access services that are visible to the user, and drops in availability. But, the measurement method of availability is component-specific.

FICORA recommends that a telecom operator aims to ensure that the availability of the components of a communications networks or services affecting the availability of Internet access services is at least 99.9 per cent over a follow-up period of 12 months. Unless the above level of availability is reached, FICORA recommends that the telecom operator examines the reasons that led to this and drafts a strategy that helps operators reach the recommended availability level in the future.

9.2 Recommendation on the measurement service provided to users

The services end-users use over the Internet access service do not necessarily give the right picture of the quality or speed of the Internet subscription the service provider provides to the user. Therefore, it is important that users can use a reliable measurement service, and that the users can trust the results it gives.

Recommendation

FICORA recommends that Internet access service providers provide customers with a measurement service they can use for verifying the actual speed of their subscription.

FICORA recommends that the measurement be taken between the customer's subscription and the measurement point located in the operators' network. The provided service must be able to measure the download and upload connection speed of the subscription.

FICORA recommends that the basis of calculation for measuring connection speed will be the payload of UDP or TCP protocol and that the measurement mainly relies on UDP protocol.

SECTION 6 SPECIAL REQUIREMENTS CONCERNING TELEVISION SERVICES

This section gives minimum obligations on the average availability of channel-specific signalling current of DVB-T and DVB-C network services used for the transmission of television services, monitoring of technical features affecting quality, measurements of the quality of service and average availability of the DVB-T network service transmitters. The regulation also includes an obligation to supply data on the above.

In the DVB-T network, the obligations of the section concern the transmission of all programmes referred to in the programme licenses in accordance with the Act on Television and Radio Operations and the transmission of related supplementary and ancillary services. In the DVB-C network, the requirements concern the transmission of contents subject to the so-called transmission obligation i.e. programmes and related ancillary and supplementary services referred to in Section 134 (amendment 1329/2007) of the Communications Market Act.

In the DVB-T network service, the requirements thus also concern Pay-Tv services, unlike in the cable television network. The reason for the difference is that due to a large number of channels, the obligations imposed on cable television networks would be unreasonable. On the other hand, cable television network operators have an agreement relationship with the end-user, which increases the end-user's possibilities to influence the monitoring of quality. In practice, cable operators could extend the use of measurements and monitoring to services excluded from the scope of application of this regulation.

Special obligations concerning IPTV and HDTV services are not given at this stage, because these services and their implementation technologies are still under development. However, in paragraph 11.3, FICORA recommends that the provision of IPTV and HDTV services will aim at fulfilling the same obligations on performance capacity and quality as what concerns DVB-T and DVB-C network services. Also, service providers of IPTV and HDTV services must take into consideration the obligations on performance capacity and quality due to other sections of this regulation. For example, obligations given in section 3 concern all communications networks and services in general. The need for special requirements for IPTV and HDTV services will be assessed as these services develop.

Several factors affect the user's satisfaction of the quality of television services - such as availability of the service (coverage area, signalling level, etc.), quality of picture and voice, and subtitling. Each of the latter has several different qualities. Due to the large number of quality factors, several different parties are involved in the delivery chain of television services, which is why systematic cooperation is required in order to ensure the overall quality.

9.3 Availability of DVB-T network service transmitters

The objective of the obligation is that the DVB-T network service transmitters used for the provision of television services function as reliably as possible. By monitoring the availability of transmitters, DVB-T network service providers are able to monitor the functionality and quality of the transmission network.

Application

Availability means time comparison between that of the transmitter's functionability to the calendar.

According to the regulation, unavailability means time when the transmission stream of the transmitter has dropped more than 3 decibels below the normal transmission stream. In case of a maintenance transmitter, e.g. during the repair of a badly-damaged transmitter, the period of time when the transmission stream is more than 6 decibels below the normal power of a transmitter, is counted as unavailability.

Monthly statistics, as moving average of six months, are compiled on the availability of all main transmitters. Respectively, monthly statistics, as moving average of six months, are compiled on the availability of all sub-transmitters. In other words, the availability percentages are calculated on the basis of the previous six months' average of the availability of all DVB-T network service transmitters, separately for main and sub-transmitters.

Recommendation on the publication of availability values

FICORA recommends that DVB-T network service providers publish, e.g. on their websites, the results of the availability measurements of transmitters in accordance with the obligation included in the section. Operators may, if they so wish, disclose what the share of unavailability due to service interruptions that have been planned in advance, is.

9.4 Availability of channel-specific transmission stream of DVB-T and DVB-C network service

Obligations on the availability of the television channel-specific transmission stream of DVB-T network service are given in section 6(3) of the Regulation and those regarding DVB-C network service in section 6(4).

The objective of the obligation is that the DVB-T and DVB-C network services used for the provision of television services function as reliably as possible, and that users may use television services with as little interruption as possible. The availability requirement is regarded as to be best suited for this purpose, because it enables television service-specific monitoring and takes the importance of user experience into consideration. In addition, information on channels serves as source for multiplex-specific data supply for players and authorities.

Another purpose of the obligation is that the monitoring of availability supports the quality maintenance of DVB-T and DVB-C network service quality. In addition, it helps to identify and correct eventual sources of defects in advance.

In DVB-C network service, the obligation concerns programmes referred to in section 134 (amendment 1329/2007) of the Communications Market Act and related ancillary and additional services i.e. transmission of contents subject to the so-called transmission obligation. In DVB-T network service, the obligation concerns all programmes subject to license and related ancillary and additional services.

Application

The availability of the channel-specific transmission stream of DVB-T network service is measured from the point after the multiplexing systems used for national and regional multiplexing have been measured. The same measurement method is to be followed when measuring the stream of main base stations from the RF signal. Monitoring data of transmitter status is used for measuring the availability of sub-transmitters.

The availability of the channel-specific transmission stream of the DVB-C network service is verified from the output terminal of the super head end or QAM modulators of other head ends.

In DVB-T network services, the following must be taken into consideration in monitoring availability: coding, multiplexing, eventual remultiplexing, and the transmission of signalling current. In other words, situations where the transmitter is active, but the signal is not emitted. In DVB-C network services, in addition to the above, the availability or functionality of transmitters is taken into consideration.

The measurement of the availability of channel-specific transmission stream of DVB-T and DVB-C network service consists of three different factors:

1. availability of the multiplex,
2. availability of the channel and
3. availability of programme information.

The reduction on the availability of the entire multiplex encompasses:

- regarding DVB-C network service; time, when the super head end or any other head end is inactive.
- Time during which the stream is affected by a disturbance, referred to in the ETSI Technical Report TR 101 290 [16], First Priority, which prevents the de-coding of the entire multiplex. Examples of these are TS Sync Loss, Sync Byte Error and PAT Error.

The reduction of availability of each channel consists of the period of time when:

- the stream lacks the video of the television service or primary audio,
- PID Error in accordance with the ETSI technical report TR 101 290 [16] in the video of the television service or primary audio, or
- error in stream in accordance with ETSI technical report TR 101 290 [16] First priority, directed at the television service in question, which are PMT Error and Continuity Error.

Unavailability in service information (SI) is monitored from the stream by measuring the availability of the following components and parameters:

- Network Information Table (NIT),
- Service Description Table (SDT) and
- Event Information Table (EIT).

The availability of channel-specific transmission stream is calculated on the basis of the monitoring of availability reduction for each television channel taking into consideration unavailability with regard to multiplexes, channels and service information.

$$service\ information[\%] = \left(\frac{t_m - t_{e(multiplex)}}{t_m}[\%] + \frac{t_m - t_{e(channel)}}{t_m}[\%] + \frac{t_m - t_{e(service\ information)}}{t_m}[\%] \right) \div 3$$

, where t_m = measuring range and $t_{e(x)}$ = time during which each factor is unavailable.

käytettävyys = availability; kanavanippu = multiplex; kanava = channel; ohjelmatiedot = programme information

Monthly statistics, as moving average of six months, is compiled on the availability of the channel-specific transmission stream of both DVB-T and DVB-C network service. This means that the availability percentage is calculated on the basis of the measurements taken over the previous six months as an average of the unavailability duration in time directed at each channel.

Short-term error situations are excluded from availability measurements. The origin of these is when changes are made to the content of the multiplex or changes in the signal routes between system components that function as back-ups for one another. Availability measurements do not either take reductions, which are caused by some other reason than the network service provider, in availability into consideration.

Recommendation

FICORA recommends that DVB-T and DVB-C network service providers publish, e.g. on their websites, the results of the availability measurements in accordance with the obligation included in the section.

9.5 Monitoring of service components

Section 6(5) of the Regulation obliges service and network operators operating in DVB-T or DVB-C networks to monitor the impact of the communications network or service components they control on the service components of the television service. Examples of these are: video, audio and PCR i.e. timing components and possibly subtitling, EPG and teletext TV components, in case they belong to the delivery chain.

The purpose of the obligation is to ensure that the components of different communications networks and services functioning in DVB-T and DVB-C networks enable that the end-user receives television services of good quality.

In DVB-C network service, the Regulation's obligation is restricted to concern programmes referred to in section 134 (amended 1329/2007) of the Communications Market Act and related ancillary and additional services. In DVB-T network service, the obligation concerns all transmitted programmes and related ancillary and additional services. The requirements also concern the service company, or the programme player, if the components referred to in the section are controlled by it, or it is able to influence the functionality of these components. Naturally, the requirements concern the part of the programme player's operations that is subject to the scope of application of

the Communications Market Act, i.e. the distribution and provision of programmes and services deemed to be communications service, excluding the contents.

Application

The obligation given means that network and service operators must have the sort of equipment and methods for monitoring and measurement that are relevant in terms of technology and economy in order for them to be able to detect eventual problems in the functionability of the components of their communications network or service, in case they deteriorate the functionability and quality of the various service components of the television service (picture, audio, timing and eventually subtitling, EPG and teletext TV components).

Relevance means that network or service operators must themselves assess the methods that are reliable enough to detect eventual deterioration caused by the components of the communications network or service it controls to the quality of television services. On the basis of these findings, network or service operator is able to tackle the problems caused by the components of communications networks or services it controls to the various service components of television services.

9.6 Impairment of the quality of television picture

If necessary, both DVB-T and DVB-C network service providers must be prepared to monitor the impairment of the quality of television picture caused by network services in accordance with ITU-R BT.500 [17].

The objective of the obligation is to promote the monitoring of the impacts of communications networks on the quality of television picture, minimize the effects that further reduce the quality, and determine a commensurable method for the assessment of impairment.

The aim of the obligation is to monitor the impact of communications networks on the quality of television picture and minimize the eventual effects that may reduce quality. Furthermore, the obligation promotes the harmonized manner to assess eventual impairments.

Application

The measurements must be taken and the data supplied per service i.e. channel pursuant to ITU-R BT.500 [17].

The measurement must be taken for example by applying two measurement devices in accordance with ITU-R BT.500 [17]. The first one of them measures the quality of television picture before it is coded, and second one measures decoded picture. A comparison of these two measurements will show whether the quality of picture is impaired. The number of samples and the length of the measurement must be sufficient in order that the reliable statistical average is reached.

Recommendation

FICORA recommends that DVB-T and DVB-C network service providers ensure that the network services they provide do not cause any greater impairment to the quality of the picture than 1/2 degree measured by the ITU-R BT.500 [17], nevertheless taking into consideration the restrictions imposed by the coding standard.

9.7 Monitoring of the use of the capacity of video components

Because the available capacity has a major impact on the quality of television picture, the aim of the obligations in section 6(7) is to ensure that the use of capacity is monitored regularly. The monitoring of the capacity of video components is particularly important, because other components of television services are fixed during the transmission.

The objective of the obligation is to obtain information on the adequacy of capacity and encourage players to cooperate with regard multiplex management.

Application

The use of capacity is monitored per service or channel by providing a sample of each service i.e. video bit speed of the channel every 10 minutes.

Statistics are compiled on the use of the capacity for each service i.e. channel as a ratio of the bit speed and time. In addition, statistics are compiled on the monthly average and average of the service's or channel's video bit speed per programme period (Business time, Prime time and Night time). In this regulation, a day consists of three broadcasting periods. Since there is no official definition for broadcasting periods, they are the following in this regulation:

- Business time from 6 a.m. to 6 p.m.,
- Prime time from 6 p.m. to 11 p.m. and
- Night time from 11 p.m. to 6 a.m.

9.8 Performance capacity and quality of DVB-C network service

The requirements for the quality and performance for DVB-C network services is included in IEC 60728-1 [18]. It is justified to apply this standard to the requirement for the performance and quality of DVB-C network service, because the standard in question specifies the basic measurements of performance and quality, as well as target values of performance and service reliability.

However, requirements relying on national implementation methods and technologies must be taken into consideration in applying the standard. This means that, for example, European graphic symbols and QAM128 modulation must be taken into consideration when applying the standard. FICORA has identified the need to determine the guidelines concerning the national implementation of standard IEC 60728-1 [18]. This will be attended to separately.

Application

By taking national implementation methods into consideration DVB-C network service must be implemented and the functionality must be monitored as presented in standard IEC 60728-1 [18].

10 RECOMMENDATIONS ON THE QUALITY OF TELEVISION SERVICES

This chapter discusses FICORA's recommendations on ensuring the quality and performance of television services. The recommendations are related to the requirements issued in section 6 of the Regulation.

10.1 Recommendation on minimizing and notifying users of effects caused by changes in the programme transmission chain

The entire programme transmission chain from the television player via coding and multiplexing to transmitters and further to receivers has an impact on the quality of television services experienced by the user. Changes made in the delivery chain, in particular, and eventual interruptions and disturbances reduce the level of user experience strongly.

The purpose of this recommendation is to ensure that, for their part, the various players regarding television distribution network aim at minimizing the effects caused by changes made to the programme transmission chain, i.e. mistakes that are visible to the user.

In addition, the purpose of the recommendation is that players participating in the programme transmission chain, as well as end-users, receive, at earliest possible moment, extensive information on the impact of changes made to the programme transmission chain, and information on eventual measures that the outcome of the change may demand.

Recommendation

In 2008, FICORA led sectoral players to a mutual agreement on the policy on the changes made in the transmission chain of the digital television. FICORA recommends that the mutually agreed policy be followed.

10.2 Recommendation on notifying users of preventive maintenance

Section 72(1) of the Communications Market Act obliges telecom operators, if possible, to notify users in advance of service interruptions caused by construction or maintenance work. A recommendation on the notification follows here. Obligation to notify and the recommendation also concern the terrestrial mass communications network where the user and service provider do not always act in an agreement relationship. In other respects, section 72 is applicable to agreement-based services only.

Preventive maintenance work made by the network service provider is relevant in order that the functionality and quality of network services can be ensured. When performing preventive maintenance work, it is possible that the users of television services experience service interruptions or reduction in the quality of service. Therefore, it is recommendable that network service providers inform, in advance, users of forthcoming service interruptions and the eventual effects caused by them, as well as the duration of maintenance.

Recommendation

FICORA recommends that network service providers inform television service users of the preventive maintenance work related to the components of the communications network or service they administer, eventual effects caused to users and estimated duration of the maintenance work.

10.3 Recommendation on the quality of IPTV and HDTV services

As discussed in chapter 10, special obligations concerning IPTV and HDTV services are not given at this stage, because these services and their implementation technologies are still under development. However, it is justified that the same methods for ensuring performance and quality are to be followed regarding IPTV and HDTV services as in DVB-T and DVB-C network services.

Naturally, service providers of IPTV and HDTV services must take into consideration the obligations on performance capacity and quality due to other sections. For example, the general obligations on network management given in section 3 concern all communications networks and services. The need for special requirements for IPTV and HDTV services will be assessed as these services develop.

Recommendation

FICORA recommends that IPTV and HDTV service providers comply, where applicable, the same methods for ensuring performance capacity and quality as DVB-T and DVB-C service providers must, pursuant to section 6 of the Regulation.

11 SECTION 7 MONITORING OF THE QUALITY OF CUSTOMER SERVICE

According to the obligation given in the section, telecom operators must:

- measure the time of delivery and store information on the time of delivery , and
- measure the delivery reliability and supply data of that quarterly

regarding telephone and broadband subscriptions delivered to a fixed location.

In addition, telecom operators must, in accordance with the obligation in the section, measure and supply data of the response time for the customer telephone service they provide. Quarterly data supply means the following annual periods of time: 1 January –31 March, 1 April –30 June, 1 July–30 September and 1 October - 31 December.

The parameters are based on Annex III of the Universal Service Directive [2] and their measurement and data collection methods on ETSI standard EG 202 057-1 [3] Paragraphs 12.1 and 12.2. introduce detailed guidelines on the measurement and statistics of the factors the obligation in the section obliges. Of the parameters defined by ETSI, section 4 of this Regulation gives obligations on measurement and statistics concerning the number of unsuccessful calls and call set-up time. Obligations on the measurement and statistics of the number of faults and fault repair time are included in Regulation 57 [7]. The obligation to measure response time for directory enquiry ser-

vices, which was included in FICORA's previous Regulation 50, has been excluded from this Regulation, because it did not involve any major problems. Moreover, the obligation on the monitoring of bill correctness complaints has been removed, because the number of them has been low and stable, according to previously-collected data. According to FICORA's view, one possibility to monitor the quality of customer service with regard to billing is to perform customer satisfaction surveys, which is recommended by FICORA (see paragraph 13.3.). In addition, telecom operators must take into consideration that FICORA's Regulation 31[19] regulates on the technical aspects of charging in communications networks. Also, the regulation includes obligations for telecom operators on the monitoring of correct and rightful charging.

Section 82 of the Communications Market Act [1] includes provisions on the telecom operator's obligation to publish comparable and up-to-date information on service quality referred to in Article 22 of the Universal Service Directive [2]. Under the section in question, FICORA has obliged telecom operators to publish information on the response time for customer service. In addition, it is recommended that the response time report includes information on whether the service and waiting time is free or subject to a fee.

11.1 Supply time and supply reliability of a subscription

Supply time of a subscription means the duration from the instant of a valid subscription is received by a telecom operator to the instant a working service is made available for use. On the other hand, supply reliability means the percentual share of subscriptions delivered within a deadline agreed with the customer.

In FICORA's previous Regulation 50, telecom operators were obliged to monitor the supply time of subscriptions in the telephone network. In this Regulation, the obligation concerns the supply time of telephone and broadband subscriptions delivered to a fixed location. The aim of the obligation given in this Regulation is to ensure that telecom operators monitor the supply times of their subscriptions and will advance its supply process in this respect.

A subscription delivered to a fixed location means a subscription whose primary purpose of use is an apartment, permanent place of business or other permanent address. This means that the obligation excludes mobile subscriptions delivered for mobile use. However, the definition of a subscription delivered to a fixed location is technology-neutral, which means that the monitoring of supply time in accordance with the obligation must be carried out with regard to all telephone and broadband subscriptions delivered at a fixed location irrespective of access technology, wired or wireless.

The obligation concerns individual subscriptions delivered to consumers and companies. Both new and transferred subscriptions must be included in the monitoring of supply times.

Application

Supply time must be measured as duration of time (24 hours a day, including e.g. weekends and bank holidays) from the instant of a valid subscription is received by a telecom operator to the instant a working service is fully made available for use.

The supply times of subscriptions must be collected and stored per subscription. The store data must include at least:

- the reception date of the subscription,
- the supply date of the subscription,
- the postal number of the delivery address of the subscription,
- the length of the subscription supply in days and
- access technology.

If a telecom operator is able to deliver the service on a specific date, but the customer requests a later date of supply, a telecom operator may also store, in addition to the above:

- operator's earliest possible supply date and
- the supply date requested by the customer.

The supply times of subscriptions are not stored, if they are cancelled before the supply.

Leased telephone network subscriptions, xDSL, cable modem and WiMAX subscriptions are examples of subscriptions delivered to a fixed location. Such mobile communications network subscriptions to which an operator or partner has delivered, for example, a table telephone, wall telephone or a distinct outdoor antenna in order to ensure reception, are also regarded as subscriptions delivered to a fixed location. The primary location of use of mobile subscriptions equipped with such auxiliary devices may be regarded as fixed despite that the subscription may be used for mobile purposes, too. Telecom operators may also easily store address information on such a subscription. Telecom operators may, if they wish, itemize supply time data e.g. with regard to subscriptions delivered to a fixed network of their own or service delivered to the fixed network of another telecom operator.

In order to monitor the supply reliability of its subscriptions, a telecom operator must provide quarterly measurements and statistics in percentages indicating the share of subscriptions delivered to the customer within mutually agreed deadline.

The following subscriptions may be excluded from the monitoring of supply reliability:

- subscriptions delayed due to the customer (other player than the one participating in the supply), or
- the subscription is cancelled before the delivery.

An example of a delay reason due to the customer is for example if the customer has not arranged free access to his or her premises. However, according to the definition of supply reliability, the subscriptions whose supply time the customer has postponed to a later occasion than the telecom operator could deliver, must be included in the monitoring of supply reliability. This is because in these cases, a date for delivery has, nevertheless, been agreed with the customer and the aim of supply reliability monitoring is to assess the reliability of the agreed supply time and not the length of supply times.

Recommendation

FICORA recommends that telecom operators publish, e.g. on their website, the percentual figure depicting the supply reliability of the telephone and broadband subscriptions they have delivered to a fixed location in accordance with the above description methods of measurement and statistics.

11.2 Response time for customer service

The emphasis of customer service provided by telecom operators to their customers has shifted from telephone guidance to other forms of guidance. The assessment of quality regarding other forms of guidance is difficult from the customer perspective, and many customers form their opinion of the quality of a telecom operator's customer service on the basis of the response time of customer telephone service. Therefore, the monitoring of the response time for customer service given over the telephone is still deemed to depict the quality of customer service.

The response time for customer service means the waiting time of a customer before his or her call is answered by the customer service.

Regulation 50, which is repealed by this Regulation, included an obligation to monitor the response times of customer service. Among other things, it obliged to measure and compile statistics on the share of telephone calls which were answered in less than 20 seconds. The share was requested to be indicated in percentages. The time limit for the latter method of measurement and statistics in this Regulation is 60 seconds, which is a deviation from the ETSI standard EG 202 057-1 [3]. The change is justified, because it corresponds better to the implementation of measurement systems in use. In addition, the above-mentioned change is not deemed to weaken the quality of service experienced by the customer.

Pursuant to section 82 of the Communications Market Act [1], FICORA's decision of 841/518/2003 obliges telecom operators to publish response time for customer service. In addition, it is also recommended in the decision that the response time report includes information on whether the service and waiting time is free or subject to a fee.

Application

The response time for customer service must be measured from the instant the customer begins to wait for the service to the instant a customer adviser picks the call. This means that call set up time is excluded from response time, and so is the eventual time spent on the use of eventual menu structures. Completely-automated responders are excluded from the monitoring, and phone calls which the user hangs up before the customer adviser picks them, must be excluded from the measurements.

The measurement results must be compiled into statistics and include the following:

- average response time and
- percentual share of calls answered in less than 60 seconds.

If a service provider employs another company to be responsible for customer service, the original service provider is responsible for supplying data on response time measurements. This means that the original service provider may employ en external company to perform the response time measurements, or perform them on its own, as long as the original service provider ensures that the response time measurements are fulfilled in accordance with the requirements set in this section.

Recommendation

FICORA recommends that if a telecom operator has divided its customer service into guidance services which are accessed via several telephone numbers and/or handle different types of contact requests, a telecom operator measures and compiles separate statistics on each of these. For example, this means a division into: customer service for private and business customers, or technical and other customer service.

12 RECOMMENDATIONS ON THE QUALITY OF CUSTOMER SERVICE

This chapter discusses FICORA's recommendations on the verification of the quality of a telecom operator's customer service. The measurements and policy presented in the recommendations support the obligations given in section 7 of the Regulation. Pursuant to section 82 of the Communications Market Act [1], FICORA may oblige telecom operators to publish comparable and up-to-date information on the quality of service provided by the operator. So far, FICORA has obliged telecom operators to publish the response time for their customer service (see paragraph 12.2), although the information described in this chapter qualify for information referred to in section 82 of the Communications Market Act [1]. As the framework of factors in customer service quality is partly in progress, FICORA has decided to promote the assessment of customer service quality by way of the recommendations given in this chapter. Similarly, it enables that customers will find it easier to compare.

12.1 Recommendation on the publication of menu structure of telephone customer service

Due to the versatility of customer contacts, telecom operators have introduced various menu structures in order to steer customer calls to an adviser who is in the best position to serve the customer. The versatile nature of menu structures may lead to that the customer is forced to make several choices in the menu, which in turn affects the user's quality experience of telephone customer service.

The recommendation on the publication of the menu structure of telephone customer service is justified, because it improves the user's possibility to acquaint herself or himself with the structure of customer services and further enables the comparison between various players.

Recommendation

FICORA recommends that telecom operators publish, for example on their website, an up-to-date description on the menu structure of its telephone customer service.

12.2 Recommendation on electronic service channels

Telecom operators have introduced different electronic customer service channels. They may, for example, be that a telecom operator receives e-mail from the customer or the customer sends an electronic form to the operator via its website. As the use of these service channels grows strongly, it is reasonable that their customer service quality will be monitored and developed.

It is important for customers that the electronic service channels are easy to access. Also, it is important for customers to be able to compare the different alternatives of contacting the operator. The purpose of the recommendation on the publication of different electronic customer service channels is to ensure that the customer has as easy access as possible to the operator's customer service and that the customer is able to compare the alternatives provided by telecom operators.

Furthermore, reaction time to their contact request is important to customers. A telecom operator is able to establish a picture of the speed of its electronic customer service by monitoring the share of 'electronic customer contacts answered within the following working day'. When the results of the monitoring are published, information on the speed of the electronic customer service will be shared with customers, too. It is easier to compare different operators when consistent meters are used. Due to the above reasons, a recommendation on the monitoring and publication of 'electronic customer contacts answered within the following working day' has been issued.

The share of electronic customer contacts answered within the following working day gives a good picture of the customer service speed. Therefore, it should be monitored and information on it should be published. In addition, it is easier to compare different operators when consistent meters are used.

Because of the above reasons, a recommendation on measuring and publishing the share of electrically received customer contats answered within the following working day is given here.

By an answer given to a customer within the following working day is meant that a customer adviser has replied to the customer. This means that automatic answers, e.g. automatic response systems, are to be excluded from the measurement.

Recommendation

FICORA recommends that if telecom operators provide electronic service channels, the information on different contact channel alternatives are published so that customers have easy access to them.

FICORA recommends that, each quarter, telecom operators measure, compile statistics on and publish the share of electronically received customer contacts answered within the following working day, in percentage. A suitable place of publication would be the operator's website, for example.

12.3 Recommendation on customer satisfaction survey

It is a challenge to provide technically reliable and consistent measurements of the quality of customer service. In addition, a user's experience of customer service is subjective and only to be assessed by examining the experiences of users or customers. For telecom operators, customer satisfaction surveys are a useful way of assessing the quality of its customer service and develop it further. Therefore, FICORA maintains that it is relevant to recommend that telecom operators carry out customer satisfaction surveys regularly.

The structure and content of a customer satisfaction survey should be as consistent as possible among all telecom operators in order that the comparison could be made. However, no such survey was available at the publication date of this Recommendation (2009). Therefore, FICORA has stated that the recommendation on the publication of customer satisfaction survey results promotes the possibilities of the operator's customers to gain valuable information on other customers' experiences of the quality of the operator's customer service.

Recommendation

FICORA recommends that telecom operators regularly examine their customers' experiences of the quality of customer service by way of customer satisfaction surveys. The survey must take into consideration all the different sub-areas of the customer service provided by the telecom operator.

FICORA recommends that telecom operators publish the results of its customer satisfaction surveys on its website, for example. As they publish the results, operators must also provide information on when and how the survey has been conducted and how many customers have replied to it.

13 8 UNIVERSAL SERVICE

This section issues on a service operator designated with universal service obligation to verify, if necessary, that the Internet access service it provides as universal service fulfils the requirements due to section 60 of the Communications Market Act (331/2009) [1] and decree of the Ministry of Transport and Communications (732/2009) [6]. In addition, the section includes measurement requirements necessary for fulfilling this obligation.

The objective of the obligations given in this section of the Regulation is to ensure that the Internet access services provided by universal service operators fulfil the requirements concerning the minimum speed of an Internet connection laid down in the Communications Markets Act and the decree of the Ministry of Transport and Communications and that the universal service obligation is to be interpreted in a harmonious manner all over in Finland. Also, the Regulation provides harmonious criteria for measurement whose purpose is to clarify the rights of telecom operators and users and to minimize the disturbance caused by the measurements to other use of the network.

The average minimum speed of an Internet connection must be measured by using long-term active measurement (24 hours). A continuous measurement would consume network capacity to a significant extent, and causes harm to other use of network, so in this Regulation, telecom operators have been given an opportunity to perform the measurement based on a sample that is specified in detail.

The sample is defined so that the measurement will not significantly consume the communications network that is the target of the measurement. However, the measurement must be performed in a reliable manner. According to FICORA's view, the selected sample gives a rather reliable picture of the actual speed of the connection, and whether the connection meets the requirement level for the minimum speed of an Internet connection laid down in the Decree.

The measuring obligation has been imposed on universal service operators only, because during the working group session, telecom operators did not see a need to impose separate obligation on a network operator designated as being universal service provider. However, FICORA keeps an eye on the situation and is ready to add the necessary obligations on the network operator, too, if problems should arise in the cooperation of a universal service provider and network operator, and if a satisfactory solution is not reached by way of agreement.

The selected basis for calculation is the payload of the UDP/TCP traffic, because this solution is in line with the measurement services available to users at the time of publication. The calculation basis also corresponds as well as possible the data transmission speed visible to users.

Telecom operators have been given some freedom of choice in choosing the measurement protocol, because although TCP is not properly-suited for measurements based on short-term samples, it simplifies the measurements. In addition, the measurement results based on TCP have been less expensive to users than UPD measurement results.

Application

According to the Regulation, the measurement must follow download data transmission direction and be taken from a point located in the network of a universal service provider to the customer's subscription. In fixed networks, the measurement point at the customer end is either customer premise telephone network or house cabinet. Regarding wireless subscriptions, the measurement point is located inside the customer's premises. If an outdoor antenna is used, the measurement point is either the customer's antenna solution or similar.

The measurement type is called active measurement, which means that traffic is generated from the measurement point located in the network of a universal service provider. For the measurement, universal service providers should maybe block access from other traffic to the subscription during the measurement.

Because the duration of the actual measurement is long and causes harm to the use of the subscription to be measured, universal service providers may first try lighter procedures and measurement methods (see e.g. paragraphs 8.1 and 9.2.) in order to locate eventual problems and ensure that the subscription complies with requirements. If these examinations and measurements and procedures following them do not, however, give the certainty that the requirements have been complied with, universal service providers must begin the measurement procedures described in this section. The measurements must also be taken if FICORA so requests.

The measurements must be made on UDP or TCP protocol and the payload of UDP or TCP traffic is to be used as a basis of calculation.

The duration of the measurement is 24 hours. It is not compulsory for the measurement to be continuous. Unless continuous measurement is applied, the following sampling must be used:

- The measurement interval must be less than two minutes and
- The duration of a sample must be at least 10 seconds.

The average connection speeds are calculated separately from the measurement results of sequences lasting 24 hours and 4 hours. The average of four (4) hours is calculated separately for each sequence of four (4) hours with the precision of one measurement interval (2 minutes).

14 SECTION 9 TRANSITIONAL PROVISIONS AND ENTRY INTO FORCE

This regulation enters into force on 1 January 2010 and will remain in force until further notice.

Section 8 of the Regulation concerning universal service will be, however, applied from 1 July 2010. The transitional provisions are analogous to the Decree (732/2009) of the Ministry of Transport and Communications on the minimum speed of an appropriate Internet connection within universal service. When the Decree of the Ministry of Transport and Communications will enter into force on 1 July 2010, it will be applied to Internet connections provided by an operator designated as an operator with universal service.

15 RECOMMENDATIONS ON THE QUALITY AND PERFORMANCE MEASUREMENTS OF SMS AND MMS SERVICES

This chapter discusses FICORA's recommendations on the quality and performance measurements of SMS and MMS services related to the subject matter of section 3 of this Regulation.

Regarding SMS and MMS services, the user bases his or her experience of service quality mainly on the delivery reliability and delivery time. Because the communication in these services mainly occurs between two mobile communicators, the following affects the delivery reliability and delivery time.

- whether the terminal device is switched on,
- the location of the terminal device (user's) in area with weak radio coverage,
- other simultaneous use of a terminal device,
- congestion of a communications network or service and
- communications network capacity.

The first three of these factors fall outside the scope of telecom operators, but it is possible to influence the two latter ones by, for example, with sufficient capacity planning.

Currently, it is rather complicated and expensive to measure the quality of SMS and MMS services. This concerns measuring the quality from user to user, in particular. For these reasons, at this development stage of the measurement systems, obligations on the monitoring of the performance and quality of SMS and MMS services have, in general level, been issued in section 3 of this Regulation. However, FICORA recommends that when telecom operators comply with these obligations with regard to SMS and MMS services, they should take into consideration the recommendations

on the measurement of quality and performance of SMS and MMS services included in this chapter. FICORA will reassess the binding force of the recommendations in context with the following amendment to be made to the Regulation.

15.1 Supply time to Message Center

The delivery time of SMS and MMS messages to the Message Center (i.e. SMSC or MMSC) is an invisible meter of quality for the end-user. However, telecom operators are well able to use it for assessing the functionality, performance and reliability of their service and network. The delivery time of SMS and MMS messages to the Message Center depicts the delay in service access experienced by the user.

The delivery time to the communication centre is measured as time spent from the instant a SMS or MMS message is sent to the instant the terminal device sending the message receives a confirmation of the arrival of the message to the Center. In practise, this is performed as field measurement.

Recommendation

FICORA recommends that telecom operators measure the delivery time of SMS and MMS messages to the Message Center regularly in order to assess the functionality, performance and reliability of its service and network.

FICORA recommends that telecom operators set a target time for themselves within which a SMS or MMS message is sent to the Message Center. If this time limit is essentially or repeatedly exceeded, telecom operators must take measures to shorten the time.

15.2 Supply time from subscriber A to subscriber B

The delivery time of SMS and MMS messages from the sending terminal device to the receiving terminal device, i.e. from subscriber A to subscriber B, depicts the actual end-to-end delay in service, which is a significant factor in the quality of service.

The delivery time from subscriber A to subscriber B is measured as the time it takes for SMS and MMS messages to reach from the terminal device to the instant it is received by the other terminal device.
In practise, the measurement is made as field measurement and different message delivery chains should be taken into consideration as broadly as possible.

Recommendation

FICORA recommends that telecom operators measure regularly the delivery time of SMS and MMS messages from subscriber A to subscriber B i.e. from one terminal device to another.

FICORA recommends that telecom operators ensure that the delivery time of SMS and MMS messages from subscriber A to subscriber B regarding the components of communications networks and services it administers is less than 10 seconds in a normal situation.

16 RECOMMENDATION ON THE QUALITY CLASSIFICATION OF COMMUNICATIONS SERVICES

This chapter introduces the recommendations on quality classification of communications services related to the subject matter of this Regulation. FICORA maintains that quality classification is particularly important between various telecom operators, and hopes that these recommendations promote the introduction of uniform quality classifications and SLA levels at interconnection interfaces and thus improve the quality of services provided to users.

The quality classification of communications services refers to service levels defined for network traffic generated by a certain service or subscription, and categories in accordance with them.

The placing of a communications service into a specific quality category is based on the user expectations directed to the service. The purpose of quality classification is to ensure that the quality

level that fulfils expectations is reached. Quality classification is one means of managing the network and its resources. In practise, the classification of services means that the delay sensitivity of services is assessed. However, in addition to delay, target-oriented performance values based on services and further on service categories, may be presented for, for example, data transfer speed, delay variation and information loss.

Quality categories may be used for determining the minimum quality of services from user to user, i.e. end-to-end. In an environment involving several players, it is complicated to reach the service levels in accordance with quality classifications. But, it is relevant that each player aims at promoting the service reliabilities of quality classifications regarding the components of the communications networks and services it administers and interconnection agreements it has made.

This Regulation will not impose telecom operators an obligation to put quality classification into practice regarding communications networks or communications services. However, if a telecom operator classifies and, in accordance with this classification, administers network traffic by for example prioritizing certain services, it is recommended that telecom operators put into practice the classification in accordance with the principles presented in this recommendation.

The purpose of the recommendation is to clarify and promote the use of uniform quality classifications. At the time this recommendation was being written, quality classification of services and introduction of the classification in the network were still developing. It is the purpose of FICORA to clarify and develop, together with sectoral players, the principles of quality classification. Thus, FICORA recommends classifications based on international standards, which it regards as being relevant at this point.

This recommendation does not focus on how a telecom operator defines the service level of its products. Committing to a specific quality category is based on agreements a telecom operator makes on communications services with their end-customers or on interconnection with other telecom operators. The recommendation does not either say how telecom operators carry out the marking of traffic which has been generated by a service placed in a certain category. Telecom operators must select the methods they use and agree on the use of the methods with each party regarding interface traffic.

16.1 Service-specific performance requirements

The quality requirements set by the users of the services vary from service to service.
Delay and information loss are parameters that are visible to the user and affect essentially the quality experienced by users. With regard to network and service planning, delay variation affects the quality of service, but user sees it as belonging to the total amount of delay and information loss.

Delay shows in many ways to the user: for example, as duration of establishing a connection to the service or receiving the requested piece of information from the service. The impact of delay depends greatly on the service used, and, in terms of technology, on the network, terminal devices and servers enabling the use of the service.

Information loss has a direct impact on the quality of service irrespective of whether the service consists of speech, picture, video or data. For users, the information loss is not restricted to technically-defined bit errors or packet loss, but includes loss due to information coding.

Also, delay variation is an essential factor in packet data systems, because it causes both delay and information loss in delay-sensitive services. In delay-sensitive services, buffers are used in order to remove variation in delay (or at least reduce them). However, the use of buffers increases the delay affecting the service.

ITU-T Recommendation G.1010 [20] examines the various performance and quality requirements of different service and quality values imposed on them. The proposed performance requirements are end-to-end requirements, which means that the performance values in the network of one player must be clearly tighter than the overall requirements.

Recommendation

FICORA recommends that telecom operators comply with the end-to-end values in accordance with the performance and quality requirements included in ITU-T Recommendation G.1010 [20], and take them into consideration in agreements. In order to assess and measure the performance and quality values of its network, a telecom operator must determine the typical communication implemented in its network, such as a call from PSTN/ISDN network to mobile network as two telecom operators are involved in data transmission. On the basis of this, operators must calculate their share of the proposed end-to-end values.

16.2 Quality classification in mobile networks

The 3GPP has defined four quality categories, also called as traffic classes, for services provided in the mobile network. These are Conversational, Streaming, Interactive and Background, separated from one another mainly by delay-sensitiveness of services. [21]

The quality classification of mobile networks described below can be implemented in packet-switched networks starting from UMTS and GPRS (R99) systems. However, it must be noted that, the quality classifications Interactive and Background in accordance with 3GPP standard can be implemented by the networks, but the request for service level in accordance with classifications Conversational and Streaming must be sent from the terminal devices. At the time of when the Recommendation was being written, there are no such terminal devices in the market that would support the making of such service requests. This means that the implementation of all quality categories as real end-to-end i.e. user-to-user network management is possible as of LTE generation of mobile networks only.

Table 2 depicts quality categories with their descriptions and examples of placing different services into each category.
The most important difference between the categories with regard to delay experienced by traffic is that the Conversational category is intended for extremely delay-sensitive traffic and category Background for the least delay-sensitive traffic.

Table 2. Quality categories in mobile networks. [21]

Quality category	**Conversational**	**Streaming**	**Interactive**	**Background**
Description	Real-time, two-way services (minor delay)	Real-time, one-way services (minor delay variation)	Interactive services (low BER)	Background services (low BER, no user expectations for delay)
Examples of services	Telephone services Videophone services Interactive game services	Audio services Video services	Voice messaging services www browsing Database searches Server accesses	Download of e-mails SMS and MMS services File downloads

The bearer service under the application layer of the mobile network enables the use of quality categories. It contains service attributes which define and administer the quality of service which is provided by the network for the end-to-end applications. The values, purpose and use of service attributes in terms of quality category have been presented in 3GPP standard TS 23.107 [21]. Service attributes apply to download and upload traffic and their values can be agreed upon symmetrically or asymmetrically.

Recommendation

FICORA recommends that the quality categories and network management methods specified in the 3GPP specification TS 23.107 [21] are used as quality categories in mobile networks.

16.3 Quality classification in IP networks

ITU-T has confirmed [22] six (6) service categories for services provided in the IP network. Table 3 depicts these quality categories with their descriptions and examples of placing different services into each category.

Table 3. Quality categories in IP-based networks. [22]

Quality category	Description	Examples of services
0	Real-time, highly interactive services (sensitive to delay and delay variation)	Telephone services (VoIP) Videophone services Interactive game services
1	Real-time, interactive services (sensitive to delay variation)	Audio services Video services
2	Highly interactive transaction services (sensitive to delay)	Voice messaging services
3	Interactive transaction services	Www browsing
4	Transactions sensitive to information loss	Database searches Server accesses
5	Background services, traditional internet services	Download of e-mails File downloads

In addition to the quality categories described in Table 3, ITU-T has introduced two additional categories: categories 6 and 7, which are to be applied as quality categories of IPTV services, in particular. The categories (or their minimum service levels) have not, however, been confirmed, because there is not enough experience of using them. The inclusion of quality categories 6 and 7 into the sphere of this recommendation will be considered later.

In its recommendation Y.1540 [23], ITU-T has determined performance factors to describe matters impacting the service quality and network management.
These are, for example, one-way delay (IPTD, IP Packet Transfer Delay), delay variation (IPDV, IP Packet Delay Variation), packet loss (IPLR, IP Packet Loss Ratio) and error ratio (IPER, IP Packet Error Ratio).
Based on these factors, recommendation Y.1541 [22] discusses a minimum end-to-end i.e. user-to-user service level specified for each quality category. The highest service reliability value of the traffic of services is placed in category 0, whereas the lowest one is placed in category 4. No minimum quality level has been specified for services in category 5. Any service may be placed in quality category 5 (so-called Best Effort quality category), as long as it is accepted that no performance or quality values have been specified for the services in the category.

In practice, quality classification can be implemented between the user and telecom operator or two telecom operators by way of static quality classification, where the traffic of a subscription or certain service is classified and placed in a specific quality category, and the traffic is served according to the agreed classification during the entire delivery of the service.

Static quality classification on layer 3 (L3) can be implemented by using DiffServ (Differentiated Services) architecture which gives rates to IP packets. With regard to IPv4, the rate is given by using the ToS (Type of Service) field and with regard to IPv6, by using the Traffic Class octect. The rating of IP packets includes a piece of information on the desired quality classification. In accordance with this rating, the aim is to implement network management so that the service level of packets corresponds to the performance and quality values of the packets.

Quality classification on layer 2 (L2) i.e. MAC layer can be implemented in accordance with the IEEE standard 802.1p [24]. The standard is an extension of the IEEE standard 802.1Q, which defines the use of VLAN (Virtual Local Area Network) identifier. A VLAN identifier consists of two parts: 12-bit VLAN ID field and 3-bit prioritization field. The 802.1p [24] defines the use of the prioritization field in particular. The implementation of the quality classification on L2 level from user-to-user is problematic, because subscriber connection does not typically support the use of identifiers in accordance with the 802.1Q standard. With regard to upload traffic, PE (Provider Edge)

Switch must be able to alter the quality classification values of layer 2 to meet the quality classification values of layer 3.

Recommendation

FICORA recommends that quality categories 0 to 5 defined in the ITU-T standard Y.1541 [22] are used as quality categories in IP networks. As long as individual networks or users do not exceed the agreed capacity or traffic agreements, data transmission is possible, telecom operators' network management should, in a harmonious manner, support the performance limits (defined for user-to-user) suggested for these quality categories during the entire life of the data transmission connection.

16.4 Quality classification at interconnection interfaces

Above, paragraphs 17.2 and 17.3 discuss quality categories defined in international standards for mobile networks (four pieces) and IP networks (six pieces). ITU-T document COM 13 – D 533 Cor. 1 [25] discusses the mapping of quality parameters of these categories and their implementations at the interface between the mobile network and IP network. The correspondence with the categories with one another has been presented in Table 4. The aim of the mapping is to ensure quality from end-to-end i.e. user-to-user.

Table 4. Mapping of quality categories of mobile and IP networks [25]

IP network quality category	Mobile network quality category
0	Conversational
1	Streaming
2	Interactive (according to priority)
3	
4	
5	Background

The protocol or rating decision with which a telecom operator places services into a specific quality category, handles packets and maps quality categories between networks, falls outside the scope of this recommendation, because the use of these methods has not become established. By way of technological development, it remains to be assessed whether the use of certain methods are included in the recommendation.

Other quality categories than those of mobile and IP networks have not been defined. Traffic terminating on mobile or IP networks from other networks can, at the interface, be placed in a quality category based on the type of service (see Tables 2 and 3). Respectively, traffic originating from mobile and IP networks and terminating on other networks loses its quality category. Thus, it should be noted that the network management referred to by quality categories cannot ensure that the performance and service quality, in accordance with the quality category, can be provided from user to user.

Recommendation

FICORA recommends that the quality categories with regard to interconnection of mobile and IP networks are mapped between each other in the manner presented in Table 4.

FICORA recommends that terminating traffic from other networks to mobile or IP networks is placed in suitable quality category on the basis of the type of service and the service level agreed upon with the customer (see Tables 2 and 3).

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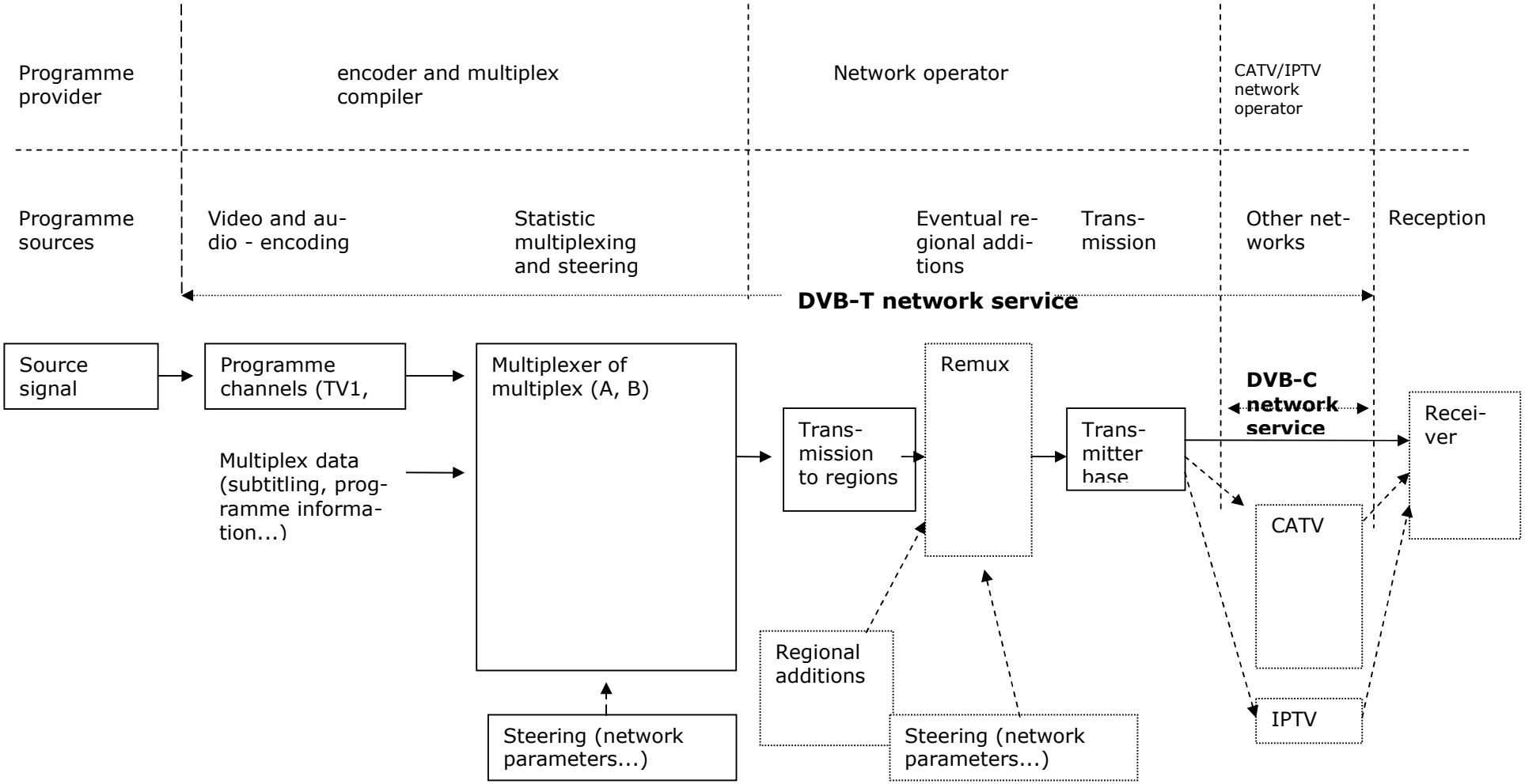
18 APPENDICES

Abbreviations

3G	Third Generation
3GPP	3rd Generation Partnership Project
@450	Wireless data transmission network using the 450 MHz frequency range
ACM	Address Complete Message
BER	Bit Error Rate
CMTS	Cable Modem Termination System
DHCP	Dynamic Host Configuration Protocol
DiffServ	Differentiated Services
DNS	Domain Name System
DSLAM	Digital Subscriber Line Access Multiplexer
DVB-C	Digital Video Broadcasting, Cable
DVB-T	Digital Video Broadcasting, Terrestial
GFI	Guidelines for Implementing
GOB	Good or Better
GPRS (R99)	General Packet Radio Service (Release 99)
GSM	Global System for Mobile communications
EIT	Event Information Table
EPG	Electronic Programme Guide
ETSI	European Telecommunications Standards Institute
EC	European Communities
HE	Government Bill
HDTV	High-Definition Television
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISDN	Integrated Services Digital Network
IP	Internet Protocol
IPDV	IP Packet Delay Variation
IPER	IP Packet Error Ratio
IPLR	IP Packet Loss Ratio
IPTD	IP Packet Transfer Delay
IPTV	IP Television
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
ITU-T	ITU Telecommunication Standardization Sector
L2	OSI model Layer 2 (Data link)
L3	OSI model Layer 3 (Network)
LTE	Long Term Evolution
MAC	Media Access Control
MMS	Multimedia Messaging Service
MOS	Mean Opinion Score
NIT	Network Information Table
NNI	Network to Network Interface
OSI	Open Systems Interconnection Reference Model
PAT	Programme Association Table
PC	Personal Computer
PCR	Program Clock Reference
PID	Packet Identifier
PMT	Program Map Table
POW	Poor or Worse
PSTN	Public Switched Telephone Network
PTS	Presentation Time Stamp
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
RF	Radio Frequency
RTD	Round Trip Delay
SDT	Service Description Table
SI	Service Information
SIP	Session Initiation Protocol

SMS	Short Message Service
SNMP	Simple Network Management Protocol
TOS	Type of Service
TS	Transport Stream
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
VLAN	Virtual Local Area Network
VLAN ID	VLAN Identification
VML, CMA	Communications Market Act
VoIP	Voice over IP
WiMAX	Worldwide Interoperability for Microwave Access
xDSL	Digital Subscriber Line

Supply chain of DVB-T network service



Supply chain of DVB-C network service