|  |  |  |
| --- | --- | --- |
| itu_logo | World Telecommunication Standardization Assembly (WTSA-16)Hammamet, 25 October - 3 November 2016 | CCITT/ITU-T 60th Anniversary logo |
| INTERNATIONAL TELECOMMUNICATION UNION |  |
|  |  |
| PLENARY MEETING | Document 12-E |
|  | July 2016 |
|  | Original: English |
|  |
| ITU-T Study Group 12 |
| Performance, QoS and QoE |
| REPORT OF ITU-T SG12 TO THE WORLD TELECOMMUNICATION STANDARDIZATION ASSEMBLY (WTSA-16), Part II: QUESTIONS PROPOSED FOR STUDY DURING THE NEXT STUDY PERIOD (2017-2020) |

|  |  |
| --- | --- |
| **Abstract:** | This contribution contains the text of the Study Group 12 Questions proposed for approval by the Assembly for the next study period. |

Note by the TSB:

The report of Study Group 12 to the WTSA-16 is presented in the following documents:

Part I: **Document 11** – General

Part II: **Document 12** – Questions proposed for study during the study period 2017-2020

# 1 List of Questions proposed by Study Group 12

| Question number | Question title | Status |
| --- | --- | --- |
| A/12 | SG12 work programme and QoS/QoE coordination in the ITU-T | Continuation of Q1/12 |
| B/12 | Definitions, guides and frameworks related to QoS/QoE | Continuation of Q2/12 |
| C/12 | Speech transmission and audio characteristics of communication terminals for fixed circuit-switched, mobile and packet-switched (IP) networks | Continuation of Q3/12 |
| D/12 | Objective methods for speech and audio evaluation in vehicles | Continuation of Q4/12 |
| E/12 | Telephonometric methodologies for handset and headset terminals | Continuation of Q5/12 |
| F/12 | Analysis methods using complex measurement signals including their application for speech and audio enhancement techniques | Continuation of Q6/12 |
| G/12 | Methods, tools and test plans for the subjective assessment of speech, audio and audiovisual quality interactions | Continuation of Q7/12 |
| H/12 | Virtualized deployment of recommended methods for network performance, QoS and QoE assessment | New |
| I/12 | Perceptual-based objective methods for voice, audio and visual quality measurements in telecommunication services | Continuation of Q9/12 |
| J/12 | Conferencing and telemeeting assessment | Continuation of Q10/12 |
| K/12 | Performance considerations for interconnected networks | Continuation of Q11/12 |
| L/12 | Operational aspects of telecommunication network service quality | Continuation of Q12/12 |
| M/12 | QoE, QoS and performance requirements and assessment methods for multimedia | Continuation of Q13/12 |
| N/12 | Development of models and tools for multimedia quality assessment of packet-based video services | Continuation of Q14/12 |
| O/12 | Parametric and E-model-based planning, prediction and monitoring of conversational speech quality | Continuation of Q8/12 and Q15/12 |
| P/12 | Framework for diagnostic functions | Continuation of Q16/12 |
| Q/12 | Performance of packet-based networks and other networking technologies | Continuation of Q17/12 |

# 2 Wording of Questions

The proposed text of the Questions is provided in the remaining part of this document.

DRAFT Question A/12

SG12 work programme and QoS/QoE coordination in the ITU-T

(Continuation of Question 1/12 - SG 12 work programme and QoS/QoE coordination in the ITU-T)

### A.1 Motivation

A Study Group should identify new or revised Questions to enable its programme of work to evolve. But for new work proposals, a home is needed when they are not directly related to existing Questions. This Question provides that home. Additionally, this Question can address actions requested of the Study Group that have no associated Question or Rapporteur.

SG12 is the Lead Study Group on QoS/QoE, and this Question is where SG12 can provide cross-ITU SG coordination for the many aspects of QoS in order to foster consistency within the ITU, and with related external organizations (e.g. 3GPP, IETF).

SG12 works proactively to help bridge the standardization gap in the area of QoS/QoE. The Regional Group for Africa was created by SG12 in support of the needs of one of the world's regions, and any issues related to SG12 being its parent group are addressed in this Question.

Consistent with the above, this Question itself does not usually produce any Recommendations.

### A.2 Question

This Question asks, but is not limited to, the following:

– What new/revised Questions are needed to evolve the work programme of SG12?

– When contributions or liaisons are addressed to SG12, on topics not covered by any existing Questions, what is the SG12 view—and any recommended action?

– What are the results of TSB initiatives, or actions of other SGs or SDOs, that need to be considered under the Study Group work programme?

– What ITU-T coordination is needed for the studies carried out on QoS/QoE?

– Is harmonization needed among ITU-T Recommendations on QoS/QoE?

– What collaboration is needed on QoS issues with other bodies in the industry?

– What are the needs and issues expressed by developing countries on QoS and QoE, and how can SG12 provide support in the course of its work?

– What contributions from groups for which SG12 is the parent, such as the Regional Group for Africa, can be implemented in Recommendations, Guides or Handbooks?

### A.3 Tasks

Tasks include, but are not limited to:

– identify new/revised Questions needed in the SG12 work programme to address QoS/QoE issues in the rapidly changing ICT marketplace;

– coordinate QoS/QoE-related activities in the ITU-T (ongoing);

– collaborate on QoS/QoE with other standards bodies (ongoing);

– provide leadership on QoS/QoE related issues to TSAG and the TSB, as needed;

– create other SG12 Regional Groups, as needed;

– respond to actions required in liaisons addressed to SG12 on issues for which no other Question is responsible.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=1/12>

### A.4 Relationships

Recommendations

– All Recommendations under the responsibility of SG12

Questions

– Any Question in the ITU-T that has QoS/QoE aspects

Study Groups

– All ITU-T Study Groups with activities related to QoS

Standardization bodies

– All standards-related organizations working on QoS/QoE, such as ETSI, IETF, ATIS, TIA, IEEE, 3GPP, MEF, BBF, etc.

DRAFT Question B/12

Definitions, guides and frameworks related to QoS/QoE

(Continuation of Question 2/12 - Definitions, guides and frameworks related to QoS/QoE)

### B.1 Motivation

This Question covers the Recommendations for definitions needed for supporting new or revised Recommendations developed in the other Study Group 12 Questions.

Additionally, this Question addresses the need for new participants in the ITU-T need to understand the concepts and the Recommendations on QoS, telephonometry, transmission quality, etc. Handbooks and guides can be developed to serve this purpose. To help all members and inform them on the work done in the Study Group, it is useful to create tutorials, frameworks, FAQ, reference implementations, etc., and post them on the Study Group website.

The following major Recommendations/Handbooks, in force at the time of approval of this Question, fall under its responsibility:

– Recommendations ITU-T P.10/G.100, G.100.1, G.191, G.192, P.800.1, P.800.2, G.1000;

– Handbook on QoS; Handbook on Network Planning; Handbook on Practical Subjective Testing Procedures; Handbook on Telephonometry.

### B.2 Question

Study items include, but are not limited to:

– What new or revised definitions need to be included in Recommendation P.10/G.100?

– What are the new sections to be written to update the handbooks? How could we ensure greater visibility and better use of these materials?

– What kind of materials (FAQ, reference implementations, tutorials, etc.) could be made available on the Study Group website?

– What guides would be needed to help the users to implement the new Recommendations?

### B.3 Tasks

Tasks include, but are not limited to:

– drive actions to update existing Recommendations, or to create new Recommendations on definitions;

– update or produce handbooks, guides, tutorials for the benefit of the users of the recommendations;

– create tools that could help non-experts to understand and implement the new recommendations. Some of these tools should be implemented on the Study Group website.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=2/12>

### B.4 Relationships

Recommendations

– All Recommendations under the responsibility of SG12

Handbooks

– All Handbooks under the responsibility of other SG12 Questions

Questions

– All/12

Study Groups

– ITU-T, ITU-R and ITU-D Study Groups with activities related to QoS

Standardization bodies

– IEC, ISO, ETSI, IETF, ATIS, TIA, IEEE, 3GPP, MEF, BBF, etc.

DRAFT Question C/12

Speech transmission and audio characteristics of communication terminals for fixed circuit-switched, mobile and packet-switched (IP) networks

(Continuation of Question 3/12 - Speech transmission characteristics of communication terminals for fixed circuit-switched, mobile and packet-switched (IP) networks)

### C.1 Motivation

With the wide use and fast evolution of communication terminals, the work defined in this Question remains an important area for international telecommunication standardization. On the one hand, there are numerous handsets, headsets and hands-free terminals with traditional appearance already in market or under design, terminals with new physical form and accessories that can be used with terminals providing speech communication functionality are emerging. On the other hand, more sophisticated signal processing and speech enhancement techniques are applied and widely spread in terminal design. How to evaluate these new terminals effectively is still a challenge and should be considered adequately in the future. Furthermore, the application of new test signals, such as real speech signals, are deemed to bring about huge changes on existing terminal measurement methods.

Currently most of the terminals connecting to fixed/mobile circuit-switched or packet-switched networks are still only capable of supporting narrowband or wideband speech communication. However with the development and deployment of super-wideband and fullband speech codecs, services and terminals covering the entire speech frequency range will be more widely available. The transmission characteristics and objective measurement methods for those terminals need to be considered, so as to guarantee better speech communication quality and user experience.

Speech and audio characteristics and objective measurement methods for multimedia terminals and accessories used with terminals, which are designed not purely for speech communication but keep speech communication as an important functionality, for example, videotel, audio-visual terminal, and personal wearable devices, also require further research and development.

The following Recommendations/Supplements, in force at the time of approval of this Question, fall under its responsibility:

P.300, P.310, P.311, P.313, P.341, P.342, P.350, P.370, P.381, P.382, P Suppl. 10, P Suppl. 16

### C.2 Question

Study items to be considered include, but are not limited to:

– What enhancement or new Recommendation needs to be developed to define headset and hands-free transmission characteristics for mobile and cordless terminals?

– What enhancements to existing Recommendations are needed to specify the performances of noise reduction and speech enhancement within terminals?

– What speech transmission and audio characteristics and measurement methods are needed for cordless and mobile terminals using multiple codecs in narrowband and other wider band applications?

– What speech transmission and audio characteristics are needed for multimedia terminals?

– What speech transmission and audio characteristics are needed for accessories used with terminals?

– What new test methods and signals, such as ones defined in P.501 and P.502, are appropriate for testing speech transmission and audio characteristics of terminal equipment?

– How to use the test signals newly developed in P.501 and measurement methods developed in P.502 to enhance existing Recommendations?

– What speech transmission and audio characteristics and test methods are particularly needed for VoIP terminals, softphones running on PC or OTT speech communication applications on mobile terminals?

– What speech transmission and audio characteristics and measurement methods are needed for terminals using new access techniques (e.g. power line access, WLAN, etc.)?

– What other changes and/or improvements can be done for the existing Recommendations (P.300, P.310, P.311, P.313, P.340, P.341, P.342, P.350, P.370, P.381, P.382)?

### C.3 Tasks

Tasks include, but are not limited to:

– adaptation of speech transmissions and audio characteristics for handset, headset and hands-free terminals, to cover the performance of terminals in super-wideband and fullband mode;

– adaptation of current test methods for terminals according to the application of new test signals.

– Improve existing specifications to handle more sophisticated speech enhancement applied in terminals;

– specify and improve the requirement and test methods at analogue headset interfaces to further increase the QoE and compatibility between headset/headphone and mobile terminals;

– define the requirement and test methods at digital headset interface of mobile terminals to increase the QoE when using digital headsets on mobile terminals;

– investigate the particular requirements and test methods for wearable devices comparing to traditional hands-free terminals;

– investigate the particular requirements and test methods for other accessories to be used with terminal for speech communication or speech based services;

– define the test methods for over-the-top (OTT) applications that support speech conversation running on mobile terminals.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=3/12>

### C.4 Relationships

Recommendations

– P.330, P.340, P.501, P.502, P.1010, G.131, P.1100, P.1110, P.1130, P.1140, P.58, P.581

Questions

– D/12, E/12, F/12, J/12, M/12

Study Groups

– ITU-T SG15, SG16

Standardization bodies

– IEEE, TIA, 3GPP SA4, ETSI STQ, 3GPP2, Bluetooth SIG

DRAFT Question D/12

Objective methods for speech and audio evaluation in vehicles

(Continuation of Question 4/12 - Hands-free communication and user interfaces in vehicles)

### D.1 Motivation

Car infotainment systems, telematic services and all types of mobile communication services are used increasingly in vehicles; an increasing number of modern cars are equipped with integrated infotainment, communication systems and connection possibilities to personal devices such as smartphones. In order to provide a good user experience, low driver distraction, satisfying communication quality and optimum dialog quality for all speech based services under all driving conditions, a variety of user interfaces and technologies have to seamlessly interact and to be optimized for the car environment. All services and technologies deployed in the car should not distract the driver from his main task. Advanced hands-free devices are required which require sophisticated signal processing adapted to the individual car to provide superior speech quality for the driver as well as for far end conversational partner. The special needs for emergency calls need to be addressed. Sophisticated speech recognition and dialog systems are needed to use speech based services in the car. In-car communications systems need to be optimized to provide a mostly natural speech enhancement for all types of in-car communications. Zoning concepts allowing the use of different audio-/ speech-based services in different zones within vehicles need to be considered.

The use of headsets or other hands-free devices, is becoming mandated in an increasing number of countries and states throughout the world. A large percentage of the target market for these vehicles will own headsets prior to purchasing a vehicle equipped with infotainment systems. They will expect to continue to use them in the vehicle, and thus will expect the vehicle to exploit the headset. The introduction of wireless headsets (e.g. Bluetooth, 802.11, DECT) requires the definition of standard behaviour and interactions with the vehicle.

So far Recommendations were developed describing the transmission requirements and test methods for narrowband and wideband speakerphones, for subsystems in cars and for narrowband emergency call communication.

The study within the Question is based on the existing Recommendations P.340, P.313, P.501, P.502, P.583, P.1100, P.1110, P.1130, P.1140. The main focus of the Question will be hands-free systems including emergency call systems, subsystem requirements in cars, in car communication systems, speech recognition and speech dialog systems and requirements on the design of user interfaces in the car.

The following Recommendations, in force at the time of approval of this Question, fall under its responsibility:

P.1100, P.1110, P.1130, P.1140

### D.2 Question

The following items are to be considered within the study of the Question:

– How can the driving situation be simulated while covering the most relevant parameters influencing driver distraction and the speech quality within a laboratory environment?

– What requirements and design guidelines are needed for user interfaces in the car?

– Which are the most influencing communicational speech quality parameters in the driving situation, especially in super-wideband and fullband communication and to what extent are they different from standard hands-free situations?

– What are the differences to be taken into account in emergency call communications?

– Which parameters determine the quality of in-car communication systems and how can they be assessed?

– What are the most influential parameters for speech recognition systems in the driving situation?

– How can we assess and quantify the dialog quality of human-machine interfaces in cars?

– Which of the newly developed methodologies known in ITU can be used and/or adapted to the car hands-free situation?

– Do different mobile networks and network configurations require individual setups for specific parameters?

– What is the appropriate behaviour of a wireless or wired headset in the environment of a telematics enabled motor vehicle?

– What are the desirable features to be presented by the vehicle, and what is their behaviour when operating with a smartphone connected to the car or when connecting services directly to the car’s head unit?

– What enhancements of the Recommendations P.1100, P.1110, P.1130 and P.1140 are needed to be developed to ensure seamless support for users of hands-free devices?

### D.3 Tasks

Tasks include, but are not limited to:

– define the typical operating conditions to be simulated covering the most relevant parameters determining the user experience and influencing driver distraction;

– define the typical operating conditions to be simulated covering the most relevant parameters influencing the speech quality within a laboratory environment;

– define the typical operating conditions to be simulated covering the most relevant parameters influencing the quality of in-car communication systems within a laboratory environment;

– define the typical operating conditions to be simulated covering the most relevant parameters influencing automated speech recognition performance within a laboratory environment;

– define the typical operating conditions to be simulated covering the most relevant parameters influencing dialog systems performance within a laboratory environment;

– laboratory setup and general testing conditions in order to simulate the driving situation for subjective and objective testing ("Car-simulator");

– definition of the environmental conditions for testing the car hands-free terminal and verifying its acoustical performance characteristics under typical operating conditions;

– definition of the environmental conditions for testing the car hands-free subsystems and verifying their performance characteristics under typical operating conditions including the definition of QoS classes for such (sub-)systems;

– definition of the super-wideband and fullband telephonometric parameters needed in order to describe/evaluate the communicational speech quality in typical operating conditions;

– specification of all relevant transmission characteristics;

– definition of test signals and testing techniques for super-wideband and fullband systems in order to evaluate all relevant parameters of modern hands-free terminals which include highly non-linear and time variant signal processing such as background noise reduction, echo cancellation, AGC, compression;

– definition of test signals and testing techniques for emergency call systems with special focus on speech intelligibility;

– definition of test procedures for evaluating automated speech recognition;

– definition of test procedures for dialog systems in cars;

– define the performance characteristics and test setup for headsets used in cars;

– define requirements for ICT systems that interact with drivers of vehicles;

– capture in use cases the proposed behaviour and interactions of all services provided in a vehicle;

The work will result in an update of the existing Recommendations P.1100, P.1110, P.1130, P.1140, in a new Recommendation on "Super-wideband and fullband stereo hands-free communication in motor vehicles", in a new Recommendation "Performance requirements for in-car communication systems", a new Recommendation on "Speech recognition system performance requirements and test methods" and in a new Recommendation "User interface requirements for automotive applications". Depending on input, a new Recommendation on "In-car dialog system requirements and test methods" may be developed.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=4/12>

### D.4 Relationships

Recommendations

– P.340, P.313, P.381, P.382, P.501, P.502, P.581, P.582, P.TBN, P.DHIP

Questions

– C/12, E/12, F/12, I/12

Study Groups

– ITU-T SG16

Standardization bodies

– ITU-R, 3GPP SA4, 3GPP2, ETSI STQ, ETSI ITS, Bluetooth SIG, ISO TC 22/TC 204

DRAFT Question E/12

Telephonometric methodologies for handset and headset terminals

(Continuation of Question 5/12 - Telephonometric methodologies for handset and headset terminals)

### E.1 Motivation

Multimedia evolution leads to an increase of the audio signal bandwidth as well as spatial audio in the New Generation Networks. Beside the existing narrowband and wideband, super-wideband as well as fullband is being developed for the next years. Also, telecommunications is moving from monaural towards binaural.

This situation brings new challenges in terms of standardization which need to be covered during the next study period. The extension of the bandwidth also leads to a need of the harmonization of the algorithms aiming to calculate Loudness Ratings and loudness for all bandwidths from narrowband to fullband audio signals. Furthermore, the extension of the operating frequency range of measurement equipment is required.

The following Recommendations/Supplements, in force at the time of approval of this Question, fall under its responsibility:

P.16, P.32, P.48, P.51, P.52, P.53, P.54, P.55, P.57, P.58, P.61, P.64, P.75, P.76, P.78, P.79, P.360, P.380, P.581, P Suppl. 20

### E.2 Question

Study items to be considered include, but are not limited to:

– What enhancements in the existing Recommendations P.57, P.58, P.51 and P.79 need to be defined in order to accommodate for the evolution in the frequency range of audio transmissions?

– Determine what new Recommendations are required in order to address new technologies being developed during the study period.

### E.3 Tasks

Tasks include, but are not limited to:

– adaptation of psychoacoustic based loudness algorithms aiming to determine the loudness for all bandwidths ranging from narrowband to fullband audio signals;

– improvement of the specifications for acoustic frontends, mainly artificial ears, in order to better match an extended frequency range and fit modern earphone devices, aiming to revise Recommendation P.57 and P.58;

– investigation of the directivity – including performance behind the lip-plane – as well as extended frequency range of the artificial mouth, aiming to revise Recommendation P.58;

– investigate measurement setups for wearable devices e.g. smart watches;

– investigation of how to aggregate measurements from multiple test positions into an overall measure of transmission performance;

– investigate measurement setups for devices that use bone conducting transducers.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=5/12>

### E.4 Relationships

Recommendations

– P.300 series

Questions

– C/12, D/12 and F/12

Study Groups

None

Standardization bodies

– IEEE / TIA, ETSI, IEC TC 29, 3GPP, CENELEC

DRAFT Question F/12

Analysis methods using complex measurement signals including their application for speech and audio enhancement techniques

(Continuation of Question 6/12 - Analysis methods using complex measurement signals including their application for speech enhancement techniques and hands-free telephony)

### F.1 Motivation

Terminal and network equipment increasingly includes complex signal processing techniques; super-wideband and fullband systems are entering the market place. Most devices can no longer be regarded as linear, time-invariant systems. The subjectively relevant transmission characteristics of such equipment need to be correctly determined using adequate measurement methods. There is a need of having reproducible, well defined measurement methods available -for certification labs as well as for developers which ideally should be combined to one quality value.

Test signals and analysis techniques for use in telephonometry have been collected in previous study periods. This work led to updated Recommendations, P.501, P.502 and P.505. New test signals allow evaluating many different parameters more realistically and are no longer limited to narrowband and wideband. However there is still a severe lack of analysis methods for wideband up to fullband; besides speech and speech like signals also signals such as music should be taken into account since modern speech codecs will allow the transmission of both, music and speech. Existing methods and to some extent signals need to be adapted since they may no longer be appropriate for new signal processing methods. In addition the interaction of signal processing at various locations of a connection needs to be investigated more in detail.

The evaluation methodologies for speech enhancing devices are still incomplete and need further improvement, new technologies in hands-free, conference systems, in-car communication and speech processing require the adaptation of existing testing methodologies and the study of new procedures. There is a need to produce new product-oriented Recommendations including hands-free functions as, mobile, IP, conferencing and audiovisual terminals.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

P.50, P.59, P.330, P.340, P.501, P.502, P.505

### F.2 Question

The following items are to be considered within the study of the Question, special consideration should be given super-wideband/fullband systems, to mobile terminal signal processing, to VoIP terminals and signal processing used in VoIP:

– What kind of new complex signal processing used in terminals, systems and networks may influence speech and audio transmission quality and what objective testing methodology can be used?

– What kind of techniques can be used to simulate time-variant use and time-variant behaviour of telecommunication equipment?

– What type of test signals and testing techniques are needed for wideband, super-wideband and fullband transmission systems?

– What type of test signals and analysis procedures can be used for spatial audio?

– What test signals other than speech and noise are needed and how can they be defined?

– What test signals can be used for the simulation of noisy environments?

– What methods are suitable for the objective assessment of background noise transmission and to what extent can the background noise transmission be assessed without making reference to the background noise signal?

– What testing methods/signals can be used to optimize background noise transmission in combination with VAD and comfort noise insertion techniques?

– What testing methods/signals can be used for real-time signal processing techniques such as in-car communication (ICC)?

– What testing methods are needed for speech and audio enhancement devices and what are the limits for the different quality determining parameters identified?

– What are the consequences on the speech quality of the combination of speech processing devices implemented in hands-free terminals? What characteristics and limits can apply for these combinations?

– What characteristics and limits can apply other speech processing techniques such as speech recognition systems?

– What are the implications of the interaction between terminal signal processing and network signal processing on speech quality?

– How can existing and/or new speech quality parameters be combined to a single speech quality representation covering all conversational aspects?

### F.3 Tasks

Tasks include, but are not limited to:

– improve/adapt existing test signals and objective speech quality testing procedures;

– identify and study new testing methodologies for wideband, super-wideband and fullband systems;

– identify and study new testing methodologies for audio;

– identify and study new testing methodologies for spatial audio;

– identify and study new testing methodologies for real time signal processing techniques used e.g. in ICC (in-car communication);

– identify and study new testing methodologies for background noise transmission quality;

– identify and study the impact of time-variant user behaviour and time-variant signal processing by defining new test methods and setups;

– improve testing methods for speech enhancement devices and identify suitable limits for the different quality parameters;

– add new testing methodologies, improve the existing testing techniques for modern hands-free terminals;

– study the consequences on the speech quality of the combination of speech processing devices implemented in terminals and networks;

– study applications to multichannel sound pick up (arrays) and multichannel/multi-device sound reproduction (incl. spatialization, stereo);

– study specific test methodologies applicable for hand-held, wearable, lap-top, tablet and conferencing systems, and based on the real use context including audiovisual terminals;

– study and define a methodology for a representation of the overall speech quality for non-linear and time variant communication systems taking into account the complete conversational situation.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=6/12>

### F.4 Relationships

Recommendations

– P.300, P.310, P.311, P.313, P.79, G.161, G.168, G.169, P.1100, P.1110, P.1130, P.1140, P.341, P.342, P.370, P.380, P.381, P.382

Questions

– C/12, D/12, E/12, I/12, J/12

Study Groups

– ITU-T SG16

Standardization bodies

– ETSI STQ, 3GPP SA4, 3GPP2, TIA, IEEE, IEC

DRAFT Question G/12

Methods, tools and test plans for the subjective assessment of speech, audio and audiovisual quality interactions

(Continuation of Question 7/12 - Methods, tools and test plans for the subjective assessment of speech, audio and audiovisual quality interactions)

### G.1 Motivation

The work of this Question will be primarily concerned with improved methods of assessing the subjective impact of time-varying impairments and with the design of laboratory testing of speech/noisy-speech/music/mixed content signals, considering the evolution of enhanced telecommunication technologies. These methods and tools will apply to narrowband, wideband, super-wideband and fullband audio telephony.

A Handbook on "Subjective testing practical procedures" was developed during the previous study period for speech and noisy-speech, music and mixed content signals, and will be maintained, adding new procedures whenever they become available and widely used in listening testing laboratories during standard exercises (e.g. for the development of a new coding algorithm within an SDO regular course of action).

As done so far, considering the need for standard subjective testing methodologies will continue to exist for the effective assessment of the transmission performance of new digital systems, like speech/music coders (telephony-band and higher quality bandwidths), or other devices and equipment designed for carrying voice and audiovisual signals, the Question should be mandated to continue to provide the necessary support to produce test/processing plans to execute appropriate subjective tests.

Input could also be provided due to the relevant work in other standards organizations, like ISO/MPEG or fora/consortia like 3GPP and 3GPP2.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

P.85, P.800, P.805, P.806, P.807, P.810, P.830, P.835, P.840, P.851, P.880, P.1501, P Suppl. 24, P Suppl. 25, Handbook STP

### G.2 Question

Study items to be considered include, but are not limited to:

– What new Recommendations need to be developed to evaluate new speech/noisy-speech/music and mixed content quality requirements?

– What new Recommendations need to be developed for a multi-dimensional subjective test methodology suitable to analyse transmitted speech in a telephone conversation?

– What enhancements to existing Recommendations need to be defined to improve the evaluation of degradations due to codec interoperability aspects, e.g. narrowband-to-wideband-to-super-wideband-to-fullband codecs?

– What methods are required for evaluating the subjective performance of active signal processing devices (particularly noise cancellation, generic sound activity detectors / voice activity detectors, comfort noise generation algorithms/devices, bandwidth extension)?

– What enhancements to existing Recommendations need to be defined to improve the subjective evaluation of speech-based or multimodal interactive services?

– What subjective test methodology is required for evaluating the performance of gaming based applications, in terms of perceived quality by game players?

– What new or revised subjective assessment methods are required for evaluating the effects of time-varying impairments (such as packet loss), and what guidance can be provided for the appropriate provision of sample/noise material for varying degrees of nonstationarity?

– What modifications to existing or new Recommendations need to be developed to assess new speech/music/mixed content digital coding systems, e.g. narrowband/wideband/audio speech and/or music and/or mixed content codecs operated over fixed and/or mobile networks (including Internet Multimedia Services)?

– What new test plans are needed to evaluate (subjectively) the above-mentioned new requirements for speech/noise/music quality improvement in end-to-end communications over fixed and/or mobile networks?

– What new test plans are needed to evaluate (subjectively) end-to-end communications over fixed and/or mobile networks using data obtained by means of "crowdsourcing"?

– What guidance can be provided for collection and post-screening of subjective test results, and global analysis of results from internationally coordinated exercises in general?

– What are the relationships between various subjective test measures, for example in the auditory modality, between intelligibility, listening effort and quality measures?

– What guidance can be provided for collection and evaluation of cultural/language/ nationality dependence of subjective quality?

– What guidance can be provided for collection and evaluation of physiological measures as an additional test method for speech quality assessment?

– Which Questions within SG12, and other standardization activities within ITU, require support for subjective testing?

### G.3 Tasks

Tasks include, but are not limited to:

– maintenance and enhancement of Recommendations in the P-series with regards to subjective testing methods and with regards to the Handbook on Subjective Testing Practical Procedures;

– draft new and revised Recommendations P.ASPD, P.CROWD, P.GSAD, P.MUS, P.SUSE, P.CLN, P.GAME, P.PHYSIO, P.CQS and maintenance / enhancements to the Handbook on Subjective Testing Procedures.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=7/12>

### G.4 Relationships

Recommendations

– P-series, G.700 Series

Questions

– F/12, O/12, I/12, J/12, M/12,

Study Groups

– ITU-T SG9, ITU-T SG16, ITU-R WP6C and ITU-R WP5C

Standardization bodies

– ISO-MPEG, 3GPP, 3GPP2, IETF, ETSI, ANSI

DRAFT Question H/12

Virtualized deployment of recommended methods for network performance, QoS and QoE assessment

(New Question)

### H.1 Motivation

As network service providers seek to take advantage of the scale, flexible deployment, and cost reductions first realized in cloud computing, they have begun to define new architectures for their infrastructure in order to realize network function virtualization (NFV). ETSI NFV has developed an architectural framework that illustrates how virtual network functions (VNF) will be supported and managed when they replace their physical counterparts with dedicated resources.

Therefore, it is timely to begin the study of virtualized network performance, QoS and QoE monitoring and assessment as it applies to the modelling and measurement methods recommended by the Study Group.

The implementation of metrics, models, and their methods of measurement is usually beyond the scope of SG12 Recommendations, except for Implementer’s guides. Therefore, considerations developed in this work must emphasise how the metrics, models, and their methods would change or be augmented in the case where their implementation is virtual. Further, new methods to characterize the deployment environment and adapt the measurements to better suit the current circumstances are desirable.

### H.2 Question

Study items to be considered include, but are not limited to:

1. On-demand deployment:

a) How can measurement methods and systems be packaged so that they can be easily deployed in the NFV infrastructure (NFVI)?

b) What integrity checks will be necessary throughout the lifecycle of a virtual measurement system, including the assurance that network/bitstream access is of sufficient quality and correctly positioned?

c) How can software-defined networks play a role in flexible, on-demand deployment?

2. Accuracy in deployment:

a) How can virtual measurement systems be isolated from high host-loading scenarios?

b) Where we cannot provide isolation, how can we detect and mitigate the effects on measurement results?

c) How can the trade-off between accuracy and cost-effective deployment be balanced for specific systems? (In other words, it would be easy to set gold-plated resource requirements in terms of CPU cores, memory speed, but the cost would be prohibitive.)

d) For systems that require precise timestamps for measurements, how can we meet their time accuracy needs?

3. New opportunities for deployment:

a) Throughout their lifecycle, many VNFs will be "patched", to repair a bug or close a security risk, while maintaining their core functionality. How can virtualized measurement systems support continuous integration and continuous deployment (CI/CD) by providing light-weight In-service assessment of key functions and performance?

b) Different possibilities exist for VNF deployment: Virtual machines, containers, and possibly others. Which are best suited to virtual measurement systems with demanding requirements?

4. Networking needs in deployment:

a) Virtual interfaces and logical ports have very different characteristics than their physical counterparts. How can we utilize virtual interfaces effectively?

b) Which of the features of physical networking do we need to replicate in virtual networks? (Examples are mirror interfaces, tap interfaces, and active injection into limited-access networks provided through tunnelling and network overlays.)

5. Security (in collaboration with SG17 and IETF):

a) Service function chains (the networks of NFVI) need sufficient management features to accommodate testing functions, especially those that monitor traffic or inject traffic. What security management features are required?

b) In general, measurement systems could appear as a "man-in-the-middle" attack when encryption and integrity features have been deployed. How can we ensure that the Security community considers measurement needs from the start?

6. How should the study items areas be organized into tasks?

### H.3 Tasks

Tasks include, but are not limited to:

– Draft new Recommendations on considerations for virtualized measurement systems.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=8/12>

### H.4 Relationships

Recommendations

– P.564, P.863, P.1200, P.1201, P.1202

Questions

– I/12, K/12, L/12, M/12, N/12, P/12, Q/12

Study Groups

– ITU-T SG2, SG13, SG15, SG16, SG17

Standardization bodies

– MEF, IETF working groups on performance issues, IEEE 802 LAN/MAN Standards Committee, 3GPP, 3GPP2, Broadband Forum, ETSI, ANSI, GSMA

DRAFT Question I/12

Perceptual-based objective methods for voice, audio and visual quality measurements in telecommunication services

(Continuation of Question 9/12 - Perceptual-based objective methods for voice, audio and visual quality measurements in telecommunication services)

### I.1 Motivation

The work of this Question will focus on objective, perceptual and mainly signal-based methods for evaluating quality parameters in telecommunication scenarios. Primarily, the methods under study should concentrate on user-perceived quality characteristics. Consequently, these methods and algorithms include perceptual approaches. They model results and procedures, which are applicable in subjective tests. So that subjective procedures will get an objective counterpart by using the same scaling and basic procedures.

An example for that is the successful standardization of Recommendations P.862, P.862.1, P.862.2, P.862.3 and the P.863, perceptual based methods those models objectively Listening Only Tests with Absolute Category Rating for the evaluating of the Listening Speech Quality according to Recommendation P.800. A no-reference counterpart of P.862 was approved as P.563.

This Question will extend the objective evaluation of Listening Quality – the main issue up to now – to other quality aspects of voice telephony like talking quality and wideband / super-wideband / fullband speech, including perceptual, signal-based models for objective rating of multi-channel and spatial audio in telecommunication services. Under consideration of new generation telecommunication services, also other media than speech like music and video as well as the prediction of perception of audio-video synchronization should be taken into account.

Furthermore, the evaluation of transmitted noise – especially after processing by noise suppression systems – should be covered by the work of this Question, the same as objective prediction of speech intelligibility. This Question analyses and recommends also methods, metrics and procedures for statistical evaluation, qualification and comparison of objective quality prediction models.

This Question will also continue and finalize the ongoing work on P.ONRA, P.AMD and P.SPELQ.

The following Recommendations, in force at the time of approval of this Question, fall under its responsibility:

P.563, P.862, P.862.1, P.862.2, P.862.3, P.863, P.863.1, P.1401

### I.2 Question

Study items to be considered include, but are not limited to:

– An already defined work item in the previous study period is the objective assessment of talking quality. Therefore at first a reliable subjective test method has to be established. In a second step, an objective model can be developed.

– In addition to the existing objective models like P.863 or P.563 that are producing single numbers describing the overall quality; a need for additional information about possible quality degradations and quality dimensions are requested by the market. This is studied under P.AMD but has also to be studied in no-reference single ended approaches such as P.563 or P.SPELQ.

– Furthermore, the objective assessment of audio signals such as music transmitted over telecommunication links like WCDMA and LTE with modern codecs and terminals should be investigated.

– The objective rating of the annoyance of noise and residual noise – especially by processing by VQE's – in voice communications has to be investigated. Here a close relationship to the recently approved subjective method P.835 is given. A study item P.ONRA is already launched in this Question.

– Perceptual, signal-based models for objective rating of multi-channel and spatial audio in telecommunication services are interesting under the scope of this Question.

– The determination of the quality of synthesized speech in an instrumental way, e.g. using the objective perceptual methods, is an interesting topic in this Question as well as methods for objective prediction of speech intelligibility.

– Perceptual, image-based models for objective evaluating of video as transmitted in telecommunication networks. Here a close partnership to VQEG and Q14/12 is established. This includes objective models for rating the perception of audio-video de-synchronization in video streaming and video-chat services.

– This Question analyses and recommends methods, metrics and procedures for statistical evaluation, qualification and comparison of objective quality prediction models. These statistics can be applied to objective prediction models which can be translated to an estimated subjective judgment of a dedicated subjective test procedure. This Question discusses frameworks, metrics and example procedures for those statistical analyses and reporting.

### I.3 Tasks

Tasks include, but are not limited to:

– maintenance and enhancement of P-series Recommendations with regards to objective quality testing methods and perceptual models as P.863, P.863.1 and P.563;

– completion of Recommendations on

• objective estimation of individual quality dimensions as full-reference approach P.AMD and its no-reference counterpart P.SAMD;

• a new no-reference model for listening quality prediction in mid-pint and end-point applications (P.SPELQ);

• objective evaluation of noise reduction systems (P.ONRA);

– development of a Recommendation for objective, perceptual quality prediction of non-speech signals (e.g. music) in telecommunication services;

– development of a Recommendation for perceptual, signal-based models for objective qualitative rating the perception of multi-channel and spatial audio in telecommunication services.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=9/12>

### I.4 Relationships

Recommendations

– P-series, G.100- and G.1000-series

Questions

– C/12, D/12, F/12, G/12, K/12, N/12, O/12, P/12

Study Groups

– ITU-T SG9, SG16

Standardization bodies

– VQEG, ETSI TC STQ, ETSI 3GPP

DRAFT Question J/12

Conferencing and telemeeting assessment

(Continuation of Question 10/12 - Conferencing and telemeeting assessment)

### J.1 Motivation

In today's society, audio and audio-visual telemeetings and audio- and video-conferences are gaining in importance. The term telemeeting is used here to cover with one term all means of audio or audio-visual communication between distant locations. The term also emphasizes that a telemeeting is considered to be more flexible and interactive than a traditional business audio- or video-conference. Telemeetings are more and more common also in private usage scenarios, e.g. when families communicate over large distances.

If the perceived quality is good enough, such telemeetings can be used as a complement to face-to-face meetings, and travel time and cost can be reduced. There is a need to develop an agreed way of quantifying the quality of experience of multi-party services that are conversational and interactive.

Telephony has traditionally been a point-to-point service, but a telemeeting is often a multipoint communication, where the participants can use different types of equipment to connect to the (virtual or real) meeting space, e.g. by fixed phone, mobile phone, PC, videoconferencing or telepresence equipment. To obtain a good evaluation of the telemeeting quality of experience, the quality perceived by all participants in a telemeeting needs to be assessed.

There are standardized subjective and objective test methods for several components in a telemeeting, such as speech, audio and video codecs, characterized by bit rate (fixed or variable), frame rate, resolution, noise cancellation, background noise, and synchronization and transmission impairments. Some recommendations on how to assess the interaction between these factors are available, too. In a telemeeting context, however, these factors need to be assessed in the light of multiple users connected via possibly asymmetric links. The main focus from the start has been on subjective assessment strategies. The results from performed tests can then form a base for objective quality assessment of telemeetings and can provide insights on quality aspects for telemeeting services. So the scope of Q10 includes multimedia subjective assessment, objective modelling as well as QoE.

The following Recommendations/Supplements, in force at the time of approval of this Question, fall under its responsibility:

P.1301, P.1302, P.1305, P.1311, P.1312, P Suppl. 26

### J.2 Question

Study items to be considered include, but are not limited to:

– How can the quality of experience of multiparty audio and audiovisual telemeetings be evaluated?

– What performance criteria play a role when it comes to the assessment of audiovisual telemeetings?

– What is the quality impact of the different ways of connecting to a telemeeting?

– What is the quality impact of multiple users connected to the telemeeting from one single-location, from multiple locations or via links of highly different quality?

– What aspects of communication performance need to be addressed when it comes to multiparty interaction across links with delay or limited resources for audio and video?

– How can different quality aspects related to telemeeting quality be quantified, and how can their relative importance for the whole telemeeting quality be assessed with standardized subjective and objective evaluation methods?

– How do telemeeting assessment methods scale with the number of participants?

– Which additional performance criteria need to be assessed, especially when it comes to business meetings in a group-collaboration context?

– How can spatial sound and video be evaluated in a telemeeting (via headphone- or loudspeaker reproduction, with problems such as the microphone placement, echo-cancellation, camera adjustment, lighting conditions, etc.)?

– What are the relative roles of the transmission, the conference bridge or server, and the terminal equipment being employed on quality perception, also with regard to the user experience of the service?

– What is the additional impact of data media such as presentation slides on user perception?

### J.3 Tasks

Tasks include, but are not limited to:

– develop a Recommendation on how to subjectively quantify the quality of audio and audiovisual multiparty telemeetings, where the participants can have different types of connections to the meeting;

– develop a Recommendation on how different delays for different participants affect the meeting quality. Suitable test tasks for evaluation methods of interactive multiparty audio and audiovisual telemeetings are needed;

– develop a Recommendation on subjective and objective methods for simulated conversation tests addressing audio and audiovisual call quality;

– develop a Recommendation on how to evaluate the perceived quality of telemeetings using spatial audio. The methods should be applicable to listening through both headphones and loudspeakers;

– develop a Recommendation on the use of auditory and visual cues for high-quality telemeetings in different application contexts such as business and private meetings (including, for example, aspects such as eye-contact and other visual cues, e.g. in the light of technical characteristics such as screen sizes);

– develop a Recommendation on the quality aspects and implications for telemeeting services of different quality;

– develop a Recommendation on how the quality impact of separate components in a telemeeting that have been tested separately can be weighted together to give an overall telemeeting quality value.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=10/12>

### J.4 Relationships

Recommendations

– P-series, G-Series

Questions

– E/12, F/12, G/12, O/12, I/12, M/12, N/12,

Study Groups

– ITU-T SG5, SG9, SG16 and ITU-R WP6C

Standardization bodies

– ISO-MPEG, 3GPP, 3GPP2, IETF, ETSI

Other groups

– VQEG, IMTC Telepresence AG, IMTC SIP Parity AG, IMTC IMS AG, ATIS PRQC

DRAFT Question K/12

Performance considerations for interconnected networks

(Continuation of Question 11/12 - Performance interworking and traffic management for Next Generation Networks)

### K.1 Motivation

There is a continued need for guidance on general transmission planning and keeping it up with technological evolution. Especially in light of a continuous migration of modern telecommunication networks towards new and future technologies (including 5G / IMT-2020), replacing traditional circuit-switched systems, guidance is needed on transmission planning with respect to heterogeneous and interconnected networks.

With the increasing industry focus on new and future technologies (including 5G / IMT-2020), there is a need for guidance on the associated end-to-end QoS, performance and resource management issues for multimedia services (e.g. voice, video, and data) and prominent OTT applications carried by such networks, in order to ensure customer satisfaction. This includes interworking aspects between different networks (e.g. cellular, wireless, wireline) and packet-based technologies as well as apportionment of performance objectives between different network segments.

In TDM networks, management of transmission impairments has been based on a simple but effective concept: networks have been divided into a chain of network sections and impairment budgets allocated accordingly. Responsibility for management of end-to-end QoS in packet networks is less defined and there are a wider range of provider techniques available to achieve end-to-end service quality. In some cases multiple networks may be available to the end devices simultaneously. Services must therefore be considered as applications executed in the terminal devices, which today have an increased contribution to the quality of experience. Consequently the transport networks are less likely to solely achieve end-to-end QoS, but can provide sets of transport behaviours or classes, selectable by the application, which enable QoS differentiation.

Performance interworking issues requiring consideration include but are not limited to:

End-to-end multimedia performance interworking and interoperability issues, including

– definition of interworking functions;

– impacts of interworking functions;

– performance objectives across multiple networks and technologies.

With current and future technologies the differences between voice services and data services are becoming blurred. For transmission planning with respect to the network performance of services the point of interest is whether the connection will be transparent and what delay will occur. This makes it more important to study the effect of delay on data services/application.

Issues and guidelines for transmission performance necessary to ensure high end-user satisfaction must be reconsidered in light of introduction of VoLTE and ViLTE and their interconnection with existing networks; however, voice and video services over fixed networks are also to be considered.

The following Recommendations, in force at the time of approval of this Question, fall under its responsibility:

G.101, G.102, G.103, G.105, G.108, G.108.1, G.108.2, G.109, G.111, G.113, G.114, G.115, G.116, G.117, G.120, G.121, G,122, G.126, G.131, G.136, G.142, G.172, G.173, G.174, G.175, G.176, G.177, G.1028, P.11, I.352, I.354, I.358, I.359, I.371, I.378, Y.1221, Y.1222, Y.1223, Y.1530, Y.1531, Y.1542

### K.2 Question

Study items to be considered include, but are not limited to:

– Transmission planning for voice, data and multimedia services taking into account that end-to-end connections are established via heterogeneous and interconnected networks with different transmission technologies.

– Studying the effects of the transmission delay on services including multimedia.

– What guidance can be provided in transmission planning for the interconnection of evolving Networks?

– What are the main performance parameters in end-to-end communication paths and how can the values of performance parameters be managed across multiple network segments?

– How can the cases of multiple concatenated networks be considered, based on a flexible apportionment of transmission impairments?

– What are the interworking requirements necessary to support interfacing between the many combinations of wireless and wireline networks sufficient to enable service providers to comply with end-to-end performance objectives for the QoS classes and to take into consideration the network performance parameters across network sections?

– Maintenance of existing documentation on traffic management and traffic engineering.

– What reference models and parameters should be used as a basis for specifying and measuring the call processing performance of IP-based networks?

– Studying the effects in cases of service handover in order to elaborate transmission planning guidelines and performance considerations (like e.g. allowable packet loss and handover latency during handover).

– Determination of the impairment effect of each new coding algorithm, so that it can be considered in the context of Recommendation G.113.

### K.3 Tasks

Tasks include, but are not limited to:

– analysis of end-to-end QoS aspects of interworking between different network sections (e.g. cellular, wireless, wireline networks);

– maintenance of existing documentation on traffic management and traffic engineering;

– analysis of impact of 5G / IMT-2020 technologies on end-to-end QoS;

– revisions of ITU-T G-Series Recommendations as may be needed to accommodate end-to-end QoS interworking between different network sections (e.g. cellular, wireless, wireline networks);

– development of new Recommendations specifying the performance of interworking between different network sections (e.g. cellular, wireless, wireline networks);

– development of new Recommendations specifying performance parameter apportionment functions and methods between different network sections (e.g. cellular, wireless, wireline networks);

– frequent update of Appendix I to G.113;

– creation of a new Recommendation, providing guidance on transmission planning and performance for service handover;

– creation of new Recommendations on transmission planning aspects as needed.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=11/12>

### K.4 Relationships

Recommendations

– G.100 – G.149, G.170-series, G.1000-series, I.350 series, I.360 series, I.370 series, Y.1541, I.350, I.351, I.353, I.356, I.358, Q-series Recommendations defining layer 3 call processing protocols

Questions

– C/12, O/12, L/12, M/12, N/12, Q/12

Study Groups

– ITU-T SG9, SG11 SG13, SG15, SG16, FG IMT-2020

Standardization bodies

– ETSI STQ, ATIS PRQC, IETF, Broadband Forum, MEF

DRAFT Question L/12

Operational aspects of telecommunication network service quality

(Continuation of Question 12/12 - Operational aspects of telecommunication network service quality)

### L.1 Motivation

It is essential to specify network service quality parameters to enable telecommunication services to be offered to customers/users in order to satisfy customers'/users' quality of service expectations. These parameters relate to both implementation and ongoing use of the service. Service quality is also related to all aspects of network assessment and management. Service quality of networks needs to be assessed as a total connection, focusing on the end-to-end network service offered at all times. Service quality parameters are required in order to meet customers'/users' expectation of a service, and related network performance parameters should relate to service quality parameters. Network providers must plan, dimension and operate their networks to parameters which will ensure that services offered to customers/users meet the latter's quality of service expectations.

The following Recommendations/Supplements, in force at the time of approval of this Question, fall under its responsibility:

E.420, E.421, E.422, E.423, E.424, E.425, E.426, E.427, E.428, E.431, E.432, E.433, E.434, E.436, E.437, E.438, E.439, E.440, E.450, E.451, E.452, E.453, E.454, E.455, E.456, E.457, E.458, E.459, E.460, E.470, E.801, E.802, E.803, E.804, E.807, E.810, E.820, E.830, E.845, E.846, E.850, E.855, E.800‑series Suppl. 8, Suppl. 9, Suppl. 10, Y.1545

### L.2 Question

Study items to be considered include, but are not limited to:

– How can existing Recommendations covering network performance be interpreted to meet customers'/users' expectations of service quality under operational scenarios?

– What new or revised Recommendations are required to ensure that adequate network service quality can be provided to meet customers'/users' expectations under operational scenarios?

### L.3 Tasks

Tasks include, but are not limited to:

– revision of Recommendations E.803, E.804, E.807, Y.1545, and Supplements 9 and 10 to ITU-T E.800-series Recommendations;

– continuation of work on E.CEMI, E.QMME, Y.FMIPQoS, and Annex to E.802.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=12/12>

### L.4 Relationships

Recommendations

None

Questions

– K/12, M/12, Q/12, QSDG

Study Groups

– ITU-T SG2, SG11, SG13

Standardization bodies

None

DRAFT Question M/12

QoE, QoS and performance requirements and assessment methods for multimedia

(Continuation of Question 13/12 - QoE, QoS and performance requirements and assessment methods for multimedia)

### M.1 Motivation

A major challenge for emerging IP-based networks is to provide adequate Quality of Experience (QoE) and Quality of Service (QoS) for new multimedia services and applications. An example is web-based applications, including so-called cloud-based applications such as on-line gaming. Another example is DFS (digital financial services). In such applications, QoE is affected not only by network QoS, but also by server and terminal performance. These services are inherently multi-media, incorporating audio, video, text, graphics, and interactive control functions, and performance requirements and associated measurement methodologies for each of these aspects need to be defined.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

G.1010, G.1011, G.1030, G.1031, G.1040, G.1050, G.1070, G.1071, G.1080, G.1081, G.1082, G.1091, P.1010, Y.1562

### M.2 Question

Study items to be considered include, but are not limited to:

– identify end-user performance expectations and associated metrics for audio, video, text, graphics quality and control functionality;

– define the key performance parameters and values required to satisfy end-user expectations;

– determine how these requirements can be related to the underlying network, server, and terminal;

– identify simple analysis techniques for estimating end-to-end performance for multimedia applications;

– identify QoS/QoE monitoring methodologies for multimedia services;

– identify sets of KPIs and QoS metrics for different services and investigate the relationship with QoE;

– investigate techniques and methods to perform complex data processing and to make consistent and significant decisions for quality management and assurance;

– multimedia performance considerations for IP gateways;

– QoS and QoE considerations for digital financial services and related applications.

### M.3 Tasks

Tasks include, but are not limited to:

– development of new Recommendations providing guidance on end-user performance expectations for multimedia applications, such as high quality audio and video immersive applications, web-browsing including web-based applications, and gaming;

– development of new Recommendations on planning models for estimating end-to-end multimedia performance;

– development of new Recommendations providing guidance on performance monitoring methods for multimedia applications, such as high quality audio and video immersive applications, web-browsing including web-based applications, and gaming;

– development of new Recommendations on framework of quality management and assurance;

– development of new Recommendations providing guidance on QoE evaluation/measurement;

– development of new Recommendations (and other documents as needed) on QoS and QoE aspects related to digital financial services;

– revision of Recommendations G.1010, G.1011, G.1030, G.1031, G.1040, G.1050, G.1070, G.1071, G.1080, G.1081, G.1082, G.1091, Y.1562 and P.1010 as necessary.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=13/12>

### M.4 Relationships

Recommendations

– G.1000-series, Y.1000-series, P.310, P.311, P.340, P.342, P.501, P.502, P.800.1, P.800.2, P.1201, Y.1540, Y.1541, Y.1544

Questions

– C/12, D/12, F/12, O/12, I/12, J/12, K/12, N/12, , P/12, Q/12

Study Groups

– ITU-T SG9, SG11, SG13, SG15, SG16

Standardization bodies

– IETF, ETSI STQ, ETSI HF, ETSI TISPAN, 3GPP, TIA TR-41, T1A1, TIA TR30.3, VQEG, ATIS IIF

DRAFT Question N/12

Development of models and tools for multimedia quality assessment of packet-based video services

(Continuation of Question 14/12 - Development of parametric models and tools for multimedia quality assessment)

### N.1 Motivation

A major challenge for emerging IP-based networks is to provide adequate Quality of Experience (QoE) and Quality of Service (QoS) for new multimedia services and applications such as IPTV, internet media including over-the-top (OTT) video, and immersive video. In previous study periods, new Recommendations have been developed by Q.14/12:

– P.1201 ("P.NAMS") and P.1202 ("P.NBAMS") have successfully been developed to meet the challenge of assessing the quality for video transmitted over UDP in a scalable manner, proposing different no-reference, trace analysis based audio, video, and audiovisual quality models.

– An extension of P.1201 was created (Appendix III, "P.NAMS-PD") addressing progressive download video quality monitoring, hence considering TCP-based transmission and respective re-buffering-related stalling.

Since TCP based and OTT video services are very popular, methods like P.1201 and P.1202 were addressed to include TCP and OTT video, considering both adaptive and non-adaptive streaming.

This is reflected in the standardization activity P.NATS Phase 1 on non-intrusive assessment of TCP-based streaming. The P.NATS Phase 1 development activity, targeting integral quality estimates for videos between 1min and 5min duration, was started in Study Period 2013-2016, and finalization is planned for 2016, focusing on the integral model including the short-term audio and video quality modules (Pa, Pv), as well as the long-term integration module (Pq).

P.NATS Phase 2 will focus on improved and extended short-term video quality modules Pv, including aspects such as 4k/UHD and additional codecs such as HEVC and VP9. The topic of 4k/UHD and the related increased spatial resolution and colour gamut are topics of increasing relevance for the market. Hence, upcoming standards on monitoring solutions should include such new technology. For P.NATS Phase 2, the Question collaborates with the AVHD project of the Video Quality Experts Group (VQEG). In this project, various types of video quality models will be validated on the same dataset: Signal-based (Full Reference, No Reference, Reduced Reference), bitstream-based (Modes 0, 1, 2 and 3 according to the P.NATS Phase 1 work) and hybrid models.

Since today’s over-the-top services increasingly involve encrypted transport, mid-network quality monitoring becomes more and more challenging. Bitstream or media-related information may not be readily available, and respective monitoring algorithms may need to apply heuristics. If network operators wish to assess the quality of the media services offered over their networks, they often need to rely on proprietary solutions that are not using current, standardized approaches. Here, it will be needed to provide the market with means to validate certain proprietary tools in terms of their predictions of Key Performance Indicators such as buffer behaviour and/or MOS predictions. To address this aspect, the Question will work on the newly created work item P.ENATS (Encrypted non-intrusive assessment of TCP-based streaming), in collaboration with Q17/12.

Further work items may be addressing extensions of the P.NATS framework towards High Dynamic Range and Wide Color Gamut, as well as work on IP-based 360° video quality assessment.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

P.1200-series

### N.2 Question

Study items to be considered include, but are not limited to:

– What further aspects of a continued characterization of P.1201 and P.1202 models should be considered?

– How do P.1201 and P.1202 need to be maintained, and what further application guidance towards, for example, network-centric monitoring solutions needs to be provided?

– What are relevant subjective test methodologies, especially when it comes to capabilities of 4k/UHD and respective high dynamic range and enhanced colour gamut, and which respective new standards need to be developed (possibly in cooperation with other standardization bodies)?

– How can 4k/UHD video quality be assessed using bitstream-based monitoring approaches?

– How can audiovisual quality be monitored for streams with encryption such as transport layer security (TLS)?

– How can bitstream-, signal-based and hybrid models be evaluated in a comprehensive standardization activity on the same type of data?

– What relationship exists between the subjective responses of users at the terminals and the objective measurements made from the point at which the non-intrusive assessment system is connected?

– How can audiovisual synchronization be reflected in parametric models such as P.1201, P.1202 and P.NATS?

– What are the requirements on future updates of P.NATS for TCP- and HTTP-based video quality monitoring?

– How can knowledge on short-term measurements and their temporal pooling for longer-term predictions be generalized to complete sessions of multimedia quality monitoring?

– How can different quality-related aspects of a multimedia service be combined to an integral quality index for general service monitoring? An example is that of an IPTV session with content selection, viewing, zapping, EPG usage, etc.

### N.3 Tasks

Tasks include, but are not limited to:

– maintenance of Recommendation P.1201 Parametric non-intrusive assessment of audiovisual media streaming quality;

– maintenance of Recommendation P.1202 Parametric non-intrusive bitstream assessment of video streaming quality;

– development of new Recommendation(s) on guidance for the use of P.1201 and P.1202 in operational contexts;

– considerations on bitstream-based audio quality evaluation;

– development of tools that are used in the course of model development;

– maintenance of Recommendation for non-intrusive assessment of TCP-based multimedia streaming quality (P.NATS) and its extensions to further media formats;

– development and maintenance of a new Recommendation on non-intrusive assessment of TLS-encrypted, TCP-based multimedia streaming quality (P.ENATS);

– development of a new Recommendation for temporal pooling of multimedia quality for longer sequences (P.MMSTP – multi-media session temporal pooling);

– development of a new Recommendation on integral index of quality for general service monitoring (P.INQX).

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=14/12>

### N.4 Relationships

Recommendations

– P.564, G.1000-series, J series recommendations on video quality

Questions

– M/12, Q/12

Study Groups

– ITU-T SG13, SG16, ITU-R WP6C

Standardization bodies

– ETSI (STQ), IETF, ATIS, VQEG, HGI, Broadband Forum

DRAFT Question O/12

Parametric and E-model-based planning, prediction and monitoring of conversational speech quality

(Continuation of Question 8/12 - E-Model extension in wideband transmission and future telecommunication and application scenarios - and Question 15/12 - Objective assessment of speech and sound transmission performance quality in networks)

### O.1 Motivation

The telecommunications industry is working to adopt more flexible infrastructure to control costs and facilitate the introduction of new services. Examples are 5G or generally next generation IP-networks which provide flexible transmission bandwidths and user interface connections, however at the expense or quality which varies with the transmission scenario and with time. A proper transmission planning, as well as flexible prediction and monitoring of Quality of Experience (QoE) are useful in managing the efficient operation and the effective services of such networks.

Regarding transmission planning of such scenarios, Study Group 12 has established the E-model, a computational model for use in transmission planning, see Recommendation G.107. This model is now frequently applied to plan traditional, narrow-band and handset-terminated networks, and to an increasing extent also for wideband and packet-based networks, using the extension of the E-model described in Recommendation G.107.1. While being popular, the E-model still shows a considerable number of limitations, namely when applying it in super-wideband and fullband networks, which non-handset terminal equipment, and with speech processing devices (such as echo cancellers, noise reduction, or alike) integrated in the network or in the terminal.

Regarding the quality prediction and monitoring of such scenarios, the industry is already benefiting from ITU-T Recommendations for objective speech quality assessment. However, most of the techniques described in these recommendations are signal based and address listening only contexts. Typical communications involve interactive, two-way, conversations. IP and mobile networks can be particularly deleterious to interactive applications, including voice conversation; for example due to increased delay, which in turn will increase the probability of double-talk and increase the perceptibility of echo. Thus, there is a need for a real-time, or near real-time, conversational speech quality assessment and monitoring.

In the end, what is needed is the integration of listening-only, talking-only and interaction quality on a common scale which could be used for planning, predicting and monitoring conversational quality in real-life networks. Such a scale would allow for an easier interpretation of the QoE provided by the different network and service scenarios, and thus make use of the flexibility offered by the respective networks in order to provide optimum services to the customer.

It is envisaged that new methods under this question would be developed collaboratively.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

G.107, G.107.1, P.56, P.561, P.562, P.564, P.833, P.833.1, P.834, P.834.1

### O.2 Question

Study items to be considered include, but are not limited to:

– How can the E-model be used to facilitate transmission planning in super-wideband, fullband, and mixed-band scenarios?

– Which quality issues have to be taken into account when extending the E-model to terminal equipment other than standard handset telephones (e.g. HFTs, headsets)? Which parameters can be used to describe such terminal equipment?

– How can the perceptual effects introduced by speech-processing devices included in the network or in the terminal equipment (e.g. (acoustic) echo cancellers, level control devices, voice activity detectors, noise suppression devices) be covered by the E-model?

– Is the E-model suitable for quality monitoring? How would such a monitoring application take into account strongly time-variant channel characteristics, e.g. due to bursty frame or packet loss, or in a cellular network?

– Is it possible to derive a universal quality scale which would be applicable across a range of narrowband, wideband, super-wideband and fullband scenarios, and which would integrate listening-only, talking-only and interaction aspects into one estimation of conversational call quality?

– How can non-intrusive measurements of voice quality at the IP layers be implemented and improved, for instance by taking into account signalling protocols not yet used by existing methods (e.g. SIP SDP, RTCP XR) or network technologies not covered by existing methods (mobile VoIP)?

– What relationship exists between the subjective responses of users at the terminals and the objective measurements made from the point at which the non-intrusive assessment system is connected?

– What are the critical components of conversational speech quality? What existing models and measures addressing these components could be used as inputs and building blocks for the development of new methods?

– What subjective test methods should validation of new objective methods for the assessment of perceived conversational quality be based on?

– How can talking quality and conversational quality be measured in a non-intrusive way?

– How can existing measurement methods for voice quality be applicable for other services than telephony, in particular for video-telephony?

### O.3 Tasks

Tasks include, but are not limited to:

– maintenance and enhancement of the E-model described in Recommendation G.107 and G.107.1 and input to depending Recommendations;

– maintenance of the Recommendations P.833 and P.834 and corresponding wideband Recommendations for determining equipment impairment factors;

– development of a new approach to provide a universal quality scale;

– changes and/or improvements to existing ITU-T Recommendations P.56, P.561, P.562 and P.564 to take into account new technologies;

– development of new models (both parametric and signal-based), to combine multiple objective measurements to provide an objective assessment of the perceived conversational speech quality;

– development of new models and/or relative conformance testing methodologies to assess the perceived listening and/or conversational quality of mobile IP voice and videotelephony services.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=15/12>

### O.4 Relationships

Recommendations

– E.804, G.108, G.108.1, G.108.2, G.109, G.113, G.114, G.115, G.131, G.1050, G.1070, P.11, P.340, P.56, P.800, P.800.1, P.805, P.831, P.832, P.862, P.863

Questions

– C/12, F/12, G/12, I/12, K/12, L/12, M/12, N/12, Q/12

Study Groups

– ITU-T SG9, SG15, SG16

Standardization bodies

– ETSI TC STQ, IETF (IPPM, XRBLOCK), TIA TR30.3

DRAFT Question P/12

Framework for diagnostic functions

(Continuation of Question 16/12 - Framework for diagnostic functions and their interaction with external objective models predicting media quality)

### P.1 Motivation

With the increased number of connected devices and the proliferation of IoT (Internet of Things) applications, web and multimedia services and data centre services, the network is likely to be subject to increased network incidents and sporadic network changes resulting in service interruptions. Hence, in order to meet user expectations and provide network visibility, it is important to provide the industry with tools to monitor networks in order to diagnose, anticipate or remediate issues.

Future networks will continue to support multimedia services and objective quality assessment algorithms will continue to be enhanced, but measuring multimedia network performance is not sufficient. Typical QoS/QoE assessments provide a numerical indication of the perceived quality that can indicate unsatisfactory service quality; however it is highly desirable to develop methods for determining the source of the impairments which could be for example network components, terminals or applications.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

G.1029

### P.2 Question

The Question is intended to derive a framework for diagnostic functions and to provide guidance on how diagnostic functions can be triggered from network and application logs or reports, from external objective quality predicting models in networks and terminals or from models developed for degradation analysis - irrespective of the type and number of media involved.

The Question will also provide a framework for root cause analysis.

Study items to be considered:

– identify the service related parameters that could be subject to diagnostics;

– provide guidance on inter-relations between such parameters;

– determine the characteristics of an objective measurement or anomaly detection that would help identify the root cause of the impairment using an algorithm or an analytic tool such as big data;

– define a set of network diagnosis maintenance metrics (e.g. time to repair, time to fault isolation) based on the characteristics of all objective measurements or anomalies;

– develop a strategy that can use externally and objectively predicted service quality values for the purpose of determining the root cause of a specific problem with a telecommunication link;

– develop objective models that produce metrics dedicated to diagnostic functions;

– develop a framework for analytics functions and diagnostics functions and provide guidance on how they interact with each other and objective quality assessment and prediction models in networks and terminals - irrespective of the type and number of media involved.

– What enhancements to existing Recommendations are required to provide network visibility and analytics directly or indirectly in Information and Communication Technologies (ICTs) or in other industries? What enhancements to developing or new Recommendations are required to provide such network visibility?

### P.3 Tasks

Tasks include, but are not limited to:

– develop one or more Recommendation(s) to provide guidance on interaction between diagnostic functions and objective models;

– develop one or more new Recommendation(s) providing guidance for the implementation of diagnostic functions;

– specification of requirements for methods that can be used for diagnostic functions.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=16/12>

### P.4 Relationships

Recommendations

– P.86x-series, P.56x-series

Questions

– I/12, O/12, Q/12

Study Groups

None

Standardization bodies

– ISO/IEC JTC1 SC6

DRAFT Question Q/12

Performance of packet-based networks and other networking technologies

(Continuation of Question 17/12 - Performance of packet-based networks and other networking technologies)

### Q.1 Motivation

As critical communications services increase their reliance on new networking technologies like MPLS and Ethernet over various network domains, network performance remains important to the user's experience. When several network operators work together to provide end-to-end communications, each needs to understand how to achieve the end-to-end performance objectives. Such objectives must be both adequate for the service being offered and feasible based on the available networking technologies.

A framework is needed to guide the development of Recommendations for performance aspects of new network capabilities, transmission facilities, and transport services (e.g. forward error correction and retransmission protocols), including those supported by the emerging and heterogeneous infrastructure. Such a framework is also essential for relating performance Recommendations focused on other protocols or service layers to the networking layers.

When new networking technologies are proposed, it is not clear whether they will become sufficiently important to warrant the development of one or more new Recommendations on performance parameters, methods of measurement, and/or numerical objectives. Some investigation of each technology is worthwhile to determine whether it is an appropriate candidate.

The following major Recommendations, in force at the time of approval of this Question, fall under its responsibility:

G.1021, G.1022, I.350, I.351, I.353, I.355, I.356, I.357, I.381, Y.800, Y.1540, Y.1541, Y.1543, Y.1544, Y.1546, Y.1560, Y.1561, Y.1563, Y.1564, Y.1565, Y.1566

### Q.2 Question

Study items to be considered include, but are not limited to:

– General and cross-technology performance studies

• How should the generic measurement points, reference events, communication functions, performance outcomes, and performance parameters defined in ITU-T Recommendations be supplemented to address new network capabilities (e.g. multipoint connections, multi-connection calls, and modification of connection attributes), new access arrangements (e.g. wireless, satellites, HFC, xDSL, Passive Optical Networking), and new services/applications (e.g. interactive multimedia communications, personal and terminal mobility including IMT-2020 systems, flexible routing and charging, security, IP network service access, web browsing, Network Function Virtualization, NFV, and virtual private networks)?

• How can the measurement of packet networks be improved, for example, to support more meaningful service level specifications between network operators and their customers?

• How can the measurement of packet networks be coordinated, to address the issues and complexities associated with large network scale?

• How should Recommendations on network performance address communications built on heterogeneous networking technologies, such as seamless wired-wireless communications support?

• What new metrics can be developed and specified to serve the packet network infrastructure, including the needs of measurement systems and other fundamental applications (such as timing systems)?

• How can the definition or the measurement of packet loss be improved to discriminate events that affect end systems and user applications?

• How can the definition or the measurement of packet delay variation be improved to provide more information to end-system designers?

– Network performance, including new technologies and existing technologies such as virtual network overlays, IP, MPLS, and Ethernet:

• Which layer(s) or other conventions have end-to-end significance in specifying performance the new technology?

• What reference events will be available to define performance parameters for these networks?

• What performance parameters and statistics should be standardized for such networks?

• How can complex topologies be assessed, such as multipoint-to-multipoint?

• What QoS levels will be needed by the services supported on these networks?

• How will the end-to-end QoS objectives for new services be achieved when more than one network participates in the provision of communications?

• To what extent will QoS commitments depend on the existence of traffic contracts that completely specify the characteristics of the offered traffic?

• How will QoS commitments of networks be verified?

The above technologies are being deployed in new network domains, such as wired and wireless, access and transport, and within the home and business. The scope of this Question includes all these domains.

What QoS class descriptions can assist the interconnection of network domains?

– IP network performance

• What additional performance objectives for systems employing application-layer packet loss compensation should be specified in Recommendation Y.1541?

• How will the end-to-end QoS objectives for IP-based services be achieved when more than one IP network participates in the provision of communications?

• How will users of IP-based services communicate their need for an IP QoS commitment?

• What additional performance objectives for compressed data (e.g. MPEG video, G.72x codec signals) should be specified in Recommendation Y.1541?

• In addition to the applications and services mentioned above, will machine to machine (M2M) and camera and sensor networks influence the objectives or require new QoS classes?

– TCP and other transport protocol performance

• How will evolution of these protocols be reflected in new performance parameters?

• How will evolution of these protocols influence IP objectives or QoS classes?

– Modelling transmission-related components of end-systems

• What end-system components should be modelled, so that the UNI-UNI performance can be estimated in mid-path measurement deployment?

• What verification procedures are useful, when models of performance cannot be standardized, but available systems can be tested?

– How should the study items areas be organized into tasks?

### Q.3 Tasks

Tasks include, but are not limited to:

– draft new Recommendation on new technology performance parameters;

– updates and maintenance of the Recommendation QoS class mapping between domains;

– updates and maintenance of the Recommendation on various performance parameters;

– updates and maintenance on Y.1540 IP performance parameters and Y.1541 IP-based network objectives;

– update the fundamental Recommendation on general aspects of quality of service and network performance in digital networks, I.350;

– continue to develop and expand the current Recommendations on assessment (testing) of key performance parameters to serve many audiences, including diagnostic and monitoring operations;

– new or revised Recommendation on IP/packet performance parameters;

– additions and updates to other existing Recommendations.

An up-to-date status of work under this Question is contained in the SG12 work programme <http://www.itu.int/ITU-T/workprog/wp_search.aspx?q=17/12>

### Q.4 Relationships

Recommendations

– I.371, I.381, I.610, O.191, G.828, Y.1710, Y.1711, Y.1731

Questions

– K/12, M/12, N/12

Study Groups

– ITU-T SG2, SG13, SG15, SG16, SG17

– ITU-R SG5 and SG6

Standardization bodies

– MEF, IETF working groups on performance issues, IEEE 802 LAN/MAN Standards Committee, 3GPP, 3GPP2, Broadband Forum, ETSI, ANSI, GSMA

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_