

## **Human Factors (HF); Guidelines for real-time person-to-person communication services**

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Reference

DTR/HF-00050

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Keywords

HF, interaction, quality, Qos, VoIP, Video

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## Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Human Factors (HF).

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## Introduction

The present document presents initial guidelines intended for network operators, equipment manufacturers and service providers about real-time person-to-person communication services. In addition to presenting the initial guidelines, the present document provides conclusions for next-stage development of the work into mature guidelines that could form the basis of a future ETSI Guide.

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## 1 Scope

The present document presents and discusses initial human factors guidelines developed from the EC IST-1999-11577 project Eye-2-Eye (Fitness-for-Purpose of Person-Person Communication Technologies). The guidelines are primarily generated from the empirical results of the Eye-2-Eye project that mainly address business use of communication services. Whilst some guidelines are drawn from existing published literature this is not extensive and does not address findings for special user groups (e.g., use of videoconferencing and avatar-telephony by deaf persons).

The communication services examined are real-time text, audioconferencing, avatar-telephony, videoconferencing and multimedia conferencing. Service aspects include audio-video synchrony, video resolution, video delay and packet loss for generic networks and specifically IP networks. Data were collected for a range of objective and subjective measures of user behaviour and opinion.

The aim is the development of guidelines of use to network operators, service providers and equipment manufacturers. The report provides initial guidelines and recommendations for their further development.

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For the purposes of this Technical Report (TR), the following references apply:

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**asynchrony:** when audio and video information that leaves one communicating party at the same time is received by the other communicating party at different times (e.g., typically the audio information arrives before the video information in an asynchronous situation)

NOTE: It is calculated as audio delay subtracted from video delay (e.g., if audio delay is 50 ms and video delay is 200 ms, then asynchrony is 150 ms; if audio delay is 100 ms and video delay is 50 ms, then asynchrony is -50 ms)

**attention:** extent to which the task does (foreground) or does not (background) require the full attention of the parties in the communication

**audio conferencing:** telephone service that does not rely on amplification of the voice signal in very close proximity to the recipient's ear

**audio delay:** time required for a audio signal generated at the talker's mouth to reach the listener's ear

**audio protocol:** set of rules defining the way audio information is represented in a network

**audio telephony:** "ordinary" telephone service as distinct from audio conferencing

**Avatar telephony:** service for transmitting voice signals in real-time over a telecommunication network in combination with a graphical (human) representation of the speaker

**background experience:** overall strength of pre-existing experience held by the communication parties that is relevant to the task (experience of the communication service and goal task requirements)

**bandwidth:** range of frequencies which can safely be conveyed in a communication channel

**burst packet loss:** loss of two or more packets in sequence

**common ground:** extent to which the communication parties have the same understanding of the goal and context of the communication and the concepts involved

**communication activity:** what the end-users (want to) do with a communication service (e.g. social chatting, buying or selling shares, conducting a job interview, etc.)

**communication media:** types of information with which humans communicate

NOTE: Examples are text, audio and moving image (graphics and video). This is consistent with the 'Nature of information' component of the ETSI definition of a *representation medium*, which has various possible coded forms (ETSI ETR 160 [8], 1995).

**communication service:** service that is provided via a telecommunication network

NOTE: Examples are audio-telephony, email, videoconferencing, avatar-telephony, audioconferencing.

**communication situation:** combination of task, motive, content and user (group) characteristics

**communicative behaviour:** end-user behaviour while using a communication service, including turn taking, interruptions, verbal and non-verbal back-channels and gaze

**difficulty:** extent to which a task is difficult or complex versus simple or routine

**duration:** length of time of the communication task

**effectiveness:** (ISO 9241 definition) accuracy and completeness with which specified users can achieve specified goals in particular environments

**efficiency:** (ISO 9241 definition) resources expended in relation to the accuracy and completeness of goals achieved

**emotiveness:** extent to which a task has a strong emotional content

**end-users:** people who use a communication service for person-to-person communication

**extrinsic goal:** extent to which a communication goal has an objective and observable outcome

**fitness-for-purpose:** correct balance between technological performance and human performance, such that the interaction is both sufficient and beneficial for person-to-person communication and consistent with human expectations from face-to-face communication

**form impression:** extent to which the task requires that the communication partners perceive characteristics of each other, such as personality and intelligence

**frame-rate:** frequency by which a full video frame is updated, sometimes called video temporal resolution or image frequency

**general type of task:** aim of the communication stated at its most general level appropriate for all the parties concerned

**geographical remoteness:** extent to which the communication parties are physically dispersed and separated

**group:** (Distance) communication between three or more people

NOTE: Either in a point-to-point or a multi-point configuration

**guideline user:** people or organizations who are going to use the guidelines

**impression of communication partner:** overall rating of the communication partner on multiple person-perception characteristics

**impression of task performer:** extent to which the service users believe they achieved a good result

**interpersonal perception:** extent to which the perception of the other person's attributes (how likeable, intelligent, friendly etc.) is positive or negative

**intrinsic goal:** communication goal that is subjective and personally experienced, with the participants communicating for its own sake rather than to achieve some objective task

**knowledge of other:** overall strength of the pre-existing personal knowledge that the communication parties have of each other

**media effects:** effect a particular communication medium has on an end-users task outcome, communicative behaviour, attitudes and beliefs

**media preferences:** subjective assessment by users or user groups of when a given communication medium is preferred over another

**media/medium:** see Communication Media/Medium

**monitor size:** number in inches of the diagonal of the image screen on a screen

**multimedia conferencing:** service for transmitting voice, video and data signals in real-time over a telecommunication network

**multi-point:** distance communication between three or more locations

**network quality of service:** degree of conformance of the service delivered to a user by a provider with an agreement between them

NOTE: From ITU-T recommendation E.860 [28].

**packet loss:** loss of one packet that can be described using a certain statistical model

**packet size:** magnitude of a relatively small unit of data transmitted over a packet switching network as part of a message transferred from one user to another

**personal involvement:** extent to which the communication parties are committed to the outcome of the task or perform the task more on behalf of another party than themselves

**point-to-point:** distance communication between two locations

**quality of experience:** user's perceived experience of what is being presented by a communication service or application user interface

NOTE: It presents the overall result of the individual Quality of Services and is a measure of overall acceptability of a service or application that includes factors such as usability, utility, fidelity and the level of support from the application or service provider (e.g., sales, delivery, error corrections).

**Quality of Service:** QoS offered by the service provider is a statement of the level of quality expected to be offered to the user/customer by the service provider

NOTE: The level of quality is expressed by values assigned to QoS parameters. These parameters are usually designed to be understandable to the user/customer. Each service would have its own set of QoS parameters.

EXAMPLE: A service provider may state that the availability of basic telephony service is 99,9 % in a year with not more than a 15 minute break on any one occasion.

**real-time text:** service for transmitting alpha-numeric characters in real-time over a telecommunication network

**relation grouping:** main category for the type of relationship between the communication parties

**relation to partner:** overall strength of the pre-existing personal relation between the communication parties

**remote inspection:** videoconferencing with video as data (sometimes also called Tele-inspection and Tele-data)

**resolution:** term denoting the degree of detail which can be created by a particular visual display system

**satisfaction:** (ISO 9241 definition) The comfort and acceptability of the work system to its users and other people affected by its use

**service (medium) preference:** extent to which the service user would chose that service again for the same kind of communication in the future

**situation Formality:** relative amount of ceremonious or conventional communication versus casual or unconstrained communication

**specific type of task:** type of communication stated at its most specific level if appropriate, such as the name of an experimental task performed in a laboratory

**talking head video:** application of videoconferencing for a person to see their other communication partner(s)

NOTE: Typically the head and torso or head and shoulders of the communicating partners is seen. This is distinct from *Video as data*.

**task effectiveness:** accuracy and completeness which specified service users can achieve specified goals in particular environments

NOTE: Operationalized as the extent to which the service is assessed to help get a favorable result for the task.

**task efficiency:** resources expended in relation to the accuracy and completeness of goals achieved

NOTE: Operationalized as the extent to which the service is assessed to be an efficient communication medium for the task.

**task elements:** features of *tasks* that can be expected to vary (e.g., extrinsic-intrinsic origin, symmetrical-asymmetrical balance, originator-recipient role, ego involvement level, information dependency, sociability level)

**task goal:** aim or object towards which the communication is directed

NOTE: It is what end-users want to do in a specific communication situation.

**task outcome:** extent to which task performance dependent on the medium

**task symmetry:** extent to which the parties in communication are less or more equal with respect to expertise or control of the interaction

**task:** what users of *communicative technology* actually do in order to accomplish some *task goal*

NOTE: In experiments tasks may be described to the participants or they are embedded in scenarios as a part of a *situation*.

**teledata:** task involving communication with video, graphics and/or audio which represents data rather than the presence of other users

**telephony:** service for transmitting voice signals in real-time over a telecommunication network

**telepresence:** task involving communication with or awareness of other users

**urgency:** extent to which a task is particularly urgent or under particular time pressure

**usability:** (ISO 9241 definition) *effectiveness*, *efficiency*, and *satisfaction* with which specified users achieve specified goals in particular environments

**user based Quality of service:** aspects of the service which are assumed to affect the degree of satisfaction of the user of the service expressed in (network) QoS parameters (e.g. the delay, packet loss)

**user groups:** end-users who with respect to their usage of communication service may be grouped together (e.g. business executives, university students, grandparents, deaf people, etc.)

**user satisfaction:** comfort and acceptability of the task performance to the service user. Operationalized as the extent to which the service is assessed to a pleasant communication medium for the task

**video as data:** application of videoconferencing for a person or persons to see something other than the other communication partner(s)

NOTE: Typically the communicator(s) see(s) what is being talked about. This is distinct from *Talking head video*.

**video delay:** time between the input of the first pixel of a particular picture at the sending end encoder and the output of the pixel from the decoder at the receiving end

**video protocol:** set of rules defining the way video information is represented in a network

**videoconferencing:** service for transmitting voice and video signals in real-time over a telecommunication network

**videotelephony:** see Videoconferencing

## 3.2 Abbreviations

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

CIF	Common Intermediate Format – a video format defined by ITU-T
HCI	Human Computer Interaction
IETF	Internet Engineering Task Force
IMTC	International Multimedia Telecommunication Consortium
IP	Internet Protocol

IPR	Industrial Property Rights, Intellectual Property Rights
ISO	International Organization for Standardization
IST	Information Society Technologies
ITU	International Telecommunication Union
QCIF	Quarter CIF
QoE	Quality of Experience
QoS	Quality of Service
RSVP	Resource ReSerVation Protocol
TIPHON	Telecommunications and Internet Protocol Harmonization Over Networks

NOTE: An ETSI project which started in Spring 1997 with members from Europe (including Israel), North America and Australia and co-operating with a Japanese regional standardization organization.

## 4 Purpose and context of report

This clause provides an introduction to the issues of real-time person-to-person communication service provision that can be addressed by guidelines and an overview of the background work on which the initial guidelines that are presented are based. It also discusses the scope of the current guidelines and relationship with other standards' work.

### 4.1 Real-time person-to-person communication services and issues

Current and emerging real-time person-to-person communication services provide complex choices regarding the most appropriate technologies, services and media that are suitable for different communication situations. Communication service groupings are real-time text, audio-telephony, avatar-telephony, videoconferencing and multimedia conferencing. These service groupings offer users the opportunity to interact using the communication media of text, audio, video and data (data is information in addition to audio and video, such as a shared workspace). Furthermore, there are numerous existing and up-coming communication services which employ qualitatively different communication media of different Quality of Service, such as videoconferencing via a desk-top terminal and a mobile terminal (figure 1) and with different demands placed on the communication channel and processing performance (figure 2).

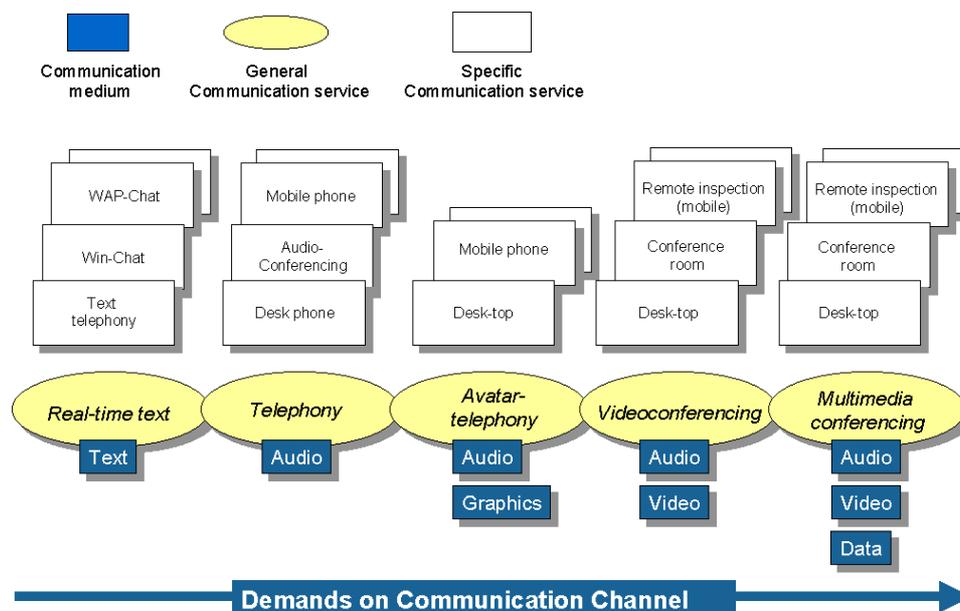
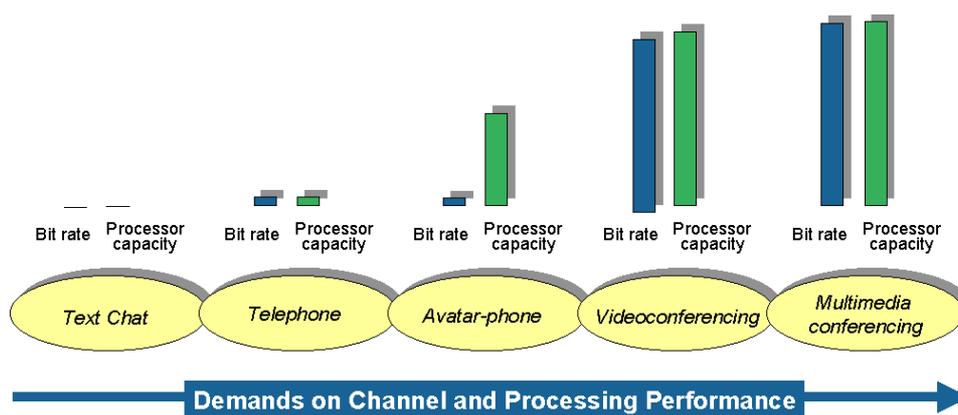


Figure 1: Real-time person-to-person communication media, services and service groupings



**Figure 2: Generalized demands on communication channels placed by different communication service groups**

Different communication services may have different utility and different set-up requirements for different users and tasks. Therefore, knowledge of user behaviour with different communication services should assist network operators, equipment manufacturers and service providers to deliver more user-centred products and services. In particular, knowledge should address:

- 1 the configuration and quality of different communication media;
- 2 the selection between different communication media;
- 3 acceptability of different communication media;
- 4 future applications for real-time human communication services.

## 4.2 Background work

The EC IST project Eye-2-Eye [1] developed a methodology for extracting fitness-for-purpose guidelines for real-time person-to-person communication services from empirical test results [2]. The current report develops the work of Eye-2-Eye with emphasis on the presentation of guidelines to an external audience.

Fitness-for-Purpose is defined by the Eye-2-Eye project as:

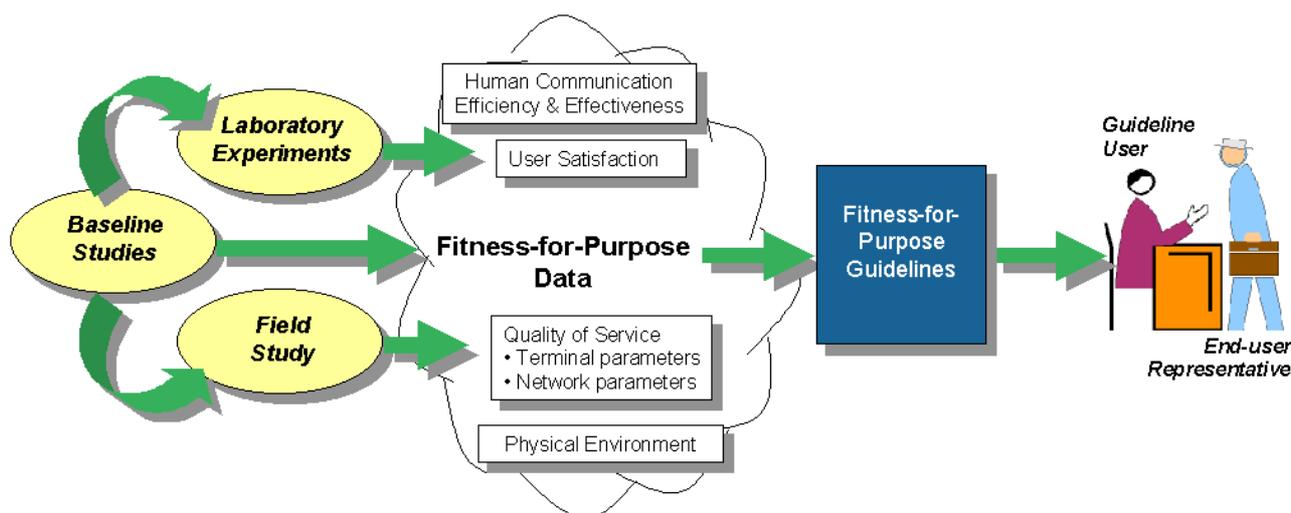
*"The correct balance between technological performance and human performance, such that the interaction is both sufficient and beneficial for person-person communication and consistent with human expectations from face-to-face communication." [3]*

As the empirical basis for its fitness-for-purpose guidelines the project performed three main phases of user tests (figure 3):

- **baseline studies** were conducted with optimal qualities of the communication services [4]
- **laboratory experiments** focused on varying technical parameters for the communication services [5]
- a **field study** examined user choice for different communication services over time and in realistic settings [6].

In addition, **focus group studies** explored the validity and generalisability of key findings from the earlier test phases [7].

All public reports from the project are available from [www.eye-to-eye.org](http://www.eye-to-eye.org).



**Figure 3: Translation of empirical results from three phases of tests to Guidelines within EC IST Project Eye-2-Eye**

The communication services tested in the **baseline studies** were real-time text, audio conferencing, avatar telephony and videoconferencing. The tests comprised a study of media preferences through survey techniques (N = 53) and controlled experiments for a persuasion task (N = 100), a task involving negotiated outcome based on trust (N = 142) and a joint problem-solving task (N = 82).

The communication services tested in the **laboratory experiments** were audio conferencing, avatar telephony and videoconferencing. Seven main experiments were conducted to investigate effects of:

- changes in task type and its impact on performance and attitudes when communication services were varied between audio-telephony and video-telephony (N = 66);
- different tasks on opinion measures such as social presence and person perception (N = 44);
- manipulating discrepancies between audio and video delays (asynchrony) in a problem solving task (N = 48);
- different image sizes in a task involving negotiation to address questions about the use of small screens for mobile videotelephony (N = 48);
- variations in resolution for small screens and their impact on performance, communication and attitudes with a negotiation task (N = 86);
- delay and their impact on performance, communication and attitudes with a negotiation task (N = 42);
- variations in packet loss and delay in a remote inspection task aimed at simulating mobile communication (N = 48).

The communication services tested in the **field study** were audio conferencing, avatar telephony, videoconferencing and multimedia conferencing. The field study investigated communication service choice in an administrative work setting for five persons in a distributed organization who were provided the communication services for point-to-point communication. All communication services were equally accessible on the participants' desktop and the participants had an established pattern of communication before the field study.

It is primarily the results of these baseline, laboratory and field-based user tests that are expressed in the guidelines presented in the current report. In addition, some guidelines encompass existing standards and expert opinion obtained from interviews.

### 4.3 Scope of the guidelines

The guidelines are considered initial due to the novelty of this area of work. In particular, whilst based on scientifically derived empirical data or expert opinion, the validity of some guidelines remain open for further study. For example, some of the user tests on which the guidelines are based should be replicated and extended to different user groups and task types. Also, the guidelines themselves are open to refinement and validity checking.

### 4.3.1 Focus

The guidelines contained in the current report concern real-time conversation involving point-to-point communication. The majority of the guidelines concern communication between two people. The focus of the guidelines is the selection, quality and acceptability of specific communication services for particular communication tasks.

Most of the guidelines concern dyadic communication (i.e., conversation between two persons). Some of the field data produced results for groups of users (i.e., two or more persons) at one or more of the sites involved in the point-to-point communication.

The guidelines **do not include**:

- multi-point communication;
- call set-up control;
- control of the user interface.

### 4.3.2 Guidelines as statements of advice or principle

It is possible to distinguish guidelines that offer advice (i.e., a recommendation of action) and guidelines that offer principles (i.e., fundamental or general truths).

It can be argued that the most useful description of knowledge is as advice as this can be more directly and easily applied by a guideline user whereas a principle must be interpreted by its user for its implication for a particular context. Therefore where possible the guidelines have been stated as advice, but where necessary the guidelines are stated as principles.

A guideline is stated as a principle rather than as advice when one or more of the following criteria could not be met:

- Result representing a high level of generalisability to different contexts of service use;
- Result representing a threshold of effect of different levels of a technical parameter on user behaviour.

The majority of guidelines offer principles rather than advice.

### 4.3.3 Towards generic and IP networks

The Eye-2-Eye project studied IP based networks. However, most of the results are more generic and so cover a wider area. Therefore, in this report there are general guidelines applicable for all kind of networks and terminals and more network specific guidelines that address both fixed and mobile IP networks. This is an unintended focus of the report and network specific guidelines for other networks would be desirable in the future.

The Fitness-for-Purpose concept as used in the Eye-2-Eye project does reflect a generic approach rather than an IP-based approach. Fitness-for-purpose is relevant for all network types. Some of the guideline users may be more interested in QoS and the guidelines could easily be viewed in that way.

## 4.4 Relationship with other standards' work

Previous standards' work has not focused on the conversation mode of real-time person-to-person communication. Rather, it has been concerned primarily with functions, procedures and control within the more general area of multimedia telecommunications [8] or specifically in videotelephony [9].

The terms of reference of ETSI EP TIPHON include multimedia, but the first 4 releases have been restricted to voice communication. At present ETSI TIPHON is working on Release 5 which also includes multimedia. The main target body within TIPHON for Media Configuration Guidelines is WG5 QoS Aspects. To date three Eye-2-Eye contributions addressing definition of Multimedia QoS classes have been submitted by Telenor to TIPHON 26 (March 11-15, 2002), TIPHON 28 (June 25-28, 2002) and TIPHON 31 (3-6 December 2002). These contributions have been well received and will be followed-up at subsequent meetings of the merged SPAN/TIPHON committee.

EPP 3GPP is specifying QoS requirements for mobile applications. The work is carried out by the Technical Specification Group SA (Services and System Aspects). There are also liaisons between 3GPP and TIPHON on specific topics. Among these is QoS, and some of the Eye-2-Eye contributions to ETSI TIPHON may thus have impact on the work of 3GPP.

The ETSI TC STQ (Technical Committee Speech Transmission Quality) Terms of Reference are restricted to speech communication. Accordingly, a limited set of the Eye-2-Eye results may be of relevance.

**ITU-T** study questions of particular relevance to this area are:

- Q 2/12 Speech transmission characteristics and measurements methods for terminals and gateways interfacing packet-switched (IP) networks;
- Q 13/12 Multimedia QoS/performance requirements;
- Q F/16 Quality of Service (QoS) and End-to-End performance in Multimedia Systems;
- Q 2/16 Multimedia over packet networks using H.323 systems.

Both SG 12 and SG 16 study Media QoS issues, with SG 12 as the lead study group on QoS.

ITU-T Recommendation SG 12 has already completed a new recommendation on End-user Multimedia QoS Categories (ITU-T Recommendation G.1010 [29]). A follow up of this recommendation is under way with the objective to provide definitive performance requirements for a range of multimedia services and applications. It is intended that these performance requirements are used as the basis for setting network performance objectives and QoS classes for a range of multimedia services and applications. Where possible, different levels of user acceptance will be taken into account. In January 2003 within ITU-T Recommendation SG 12 it has been proposed to start work on Quality of Experience (QoE) [10].

Requirements for international standardization of text telephony was initiated within ETSI [11] and is now primarily addressed within ITU-T Recommendation SG 16.

**IETF** is only addressing QoS mechanisms and protocols. Possible Internet-Drafts based on Eye-2-Eye results are not likely, but the issue will be reconsidered when the results have been fully interpreted from this perspective. Target groups would be avt, nsis, Diffserv, Intserv and RSVP.

The main focus of **IMTC** is to promote standardization activities and to ensure interoperability of real-time rich media communications. IMTC also focuses on identifying obstacles to ubiquitous utilization of multimedia products and services. Of particular relevance to the real-time person-to-person communication is the QoS and Performance Activity Group which belongs to the Network Infrastructure WG.

## 5 Guidelines

The current guidelines are grouped according to particular real-time human communication services:

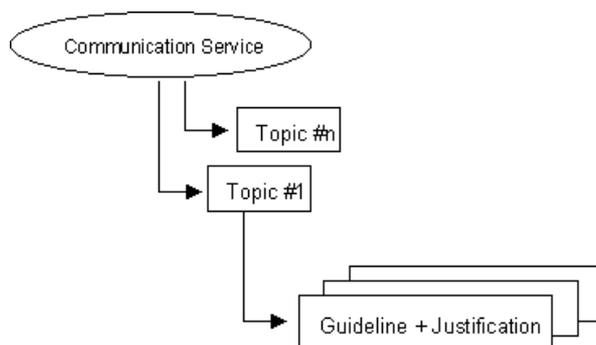
- real-time text;
- audio telephony and audioconferencing;
- avatar telephony;
- videoconferencing;
- face-to-face videoconferencing (talking head video);
- remote inspection (video as data);
- mobile small screens;
- multimedia conferencing.

The following clauses present guidelines for each communication service in turn. For each communication service guidelines are clustered under topics and for each guideline a brief justification is provided, as illustrated in figure 4. Each guideline is also labelled as providing either a "Principle" or "Advice" (see clause 4.3).

The guidelines are stated as interpretations of the empirical data and the supporting justification is provided as an argument for the guideline and not necessarily as proof. The guideline text (in italics) is intended to be concise and easy to read in response to identified guideline user requirements (summarized in annex B.1). Each justification corresponds to an empirical result listed in annex C.2.4 derived either from the Eye-2-Eye laboratory experiments, field study, baseline tests or some selected existing literature.

Table 1 lists the topics addressed and indicates which communication service has a guideline on that topic (marked "GUIDELINE") or is referred to in a guideline concerning a comparison with another communication service (marked "X-REFERENCE" as cross-reference).

The guidelines are derived from semi-formal, detailed intermediate descriptions of test results or expert knowledge that are described in annex C. The process of deriving the guidelines is described in annex D.



**Figure 4: Structure of guideline presentation**

**Table 1: Guideline topics addressed for different communication services**

(Where "GUIDELINE" indicates that the communication service has a guideline on that topic and "X-REFERENCE" indicates that the communication service is cross-referenced in a guideline by comparison with another communication service)

Topic	Communication Service						
	Real-time text	Audio telephony and audio conferencing	Avatar telephony	Face-to-face videoconferencing	Remote inspection videoconferencing	Videoconferencing with small screen	Multimedia conferencing
Asynchrony		X-REFERENCE		GUIDELINE	GUIDELINE		
Packet loss					GUIDELINE		
Screen size				X-REFERENCE		GUIDELINE	
Screen resolution				X-REFERENCE		GUIDELINE	
Influence of delay on a negotiation task				GUIDELINE			
Call set-up time		GUIDELINE					
Service selection		GUIDELINE	X-REFERENCE	GUIDELINE			X-REFERENCE
Duration of communication when negotiating	GUIDELINE	GUIDELINE		GUIDELINE			
Communication behaviour		GUIDELINE		GUIDELINE			
Communication outcome		X-REFERENCE	GUIDELINE	X-REFERENCE			
Outcome of joint problem solving task		GUIDELINE		GUIDELINE			
Persuasion with personal involvement	GUIDELINE	X-REFERENCE		GUIDELINE			
Persuasion on behalf of somebody else		GUIDELINE		X-REFERENCE			
Task suitability as judged by potential users		GUIDELINE		GUIDELINE			
Application area			GUIDELINE				
High quality desktop conferencing		X-REFERENCE	X-REFERENCE	GUIDELINE			GUIDELINE
Experience with different quality levels				GUIDELINE			
Group conferencing		X-REFERENCE		GUIDELINE			GUIDELINE
Eye contact				GUIDELINE			
Person perception			GUIDELINE			X-REFERENCE	
Relation with face-to-face meetings				GUIDELINE			
Acceptance of desktop videoconferencing				GUIDELINE			

## 5.1 Real-time text

Topic	Principle or Advice	<i>Guideline</i>	Justification
<b>Negotiation time</b>	Principle	<i>Real-time text takes three-times longer with no extra gain</i>	Real-time text with character-by-character transmission for negotiation can take three-times longer with real-time text to reach consensus for no extra gain (compared with audioconferencing and when face-to-face)
<b>Persuasion with personal involvement</b>	Principle	<i>Real-time text can give better results than audioconferencing when trying to persuade with personal involvement</i>	Audio conferencing with 7 kHz bandwidth for persuasion can have a disadvantage if arguing a case with personal involvement (compared with Real-time text)

## 5.2 Audio telephony and audio conferencing

Topic	Principle or Advice	Guideline	Justification
<b>Call set-up time</b>	Advice	<i>Fast call set-up and call forwarding is more important than higher quality audio</i>	<p>Ordinary lower quality audio-telephony with fast call set-up was preferred for managerial work tasks rather than audioconferencing with high-quality audio that required a 7 second call set-up</p> <p>Audio telephony with 3,1 kHz bandwidth, fast call set-up and call forwarding was chosen more for managerial communication than audioconferencing with 7 kHz bandwidth, 7 second call set-up and no call forwarding</p>
	Advice	<i>Low quality audiotelephony with fast call set-up is preferred over high quality audioconferencing with 7 second call set-up</i>	<p>Audio-telephony with fast call set-up is preferred for managerial work tasks (compared with audioconferencing with high-quality and 7 second call set-up)</p> <p>See also Call set-up time</p>
<b>Service selection</b>	Advice	<i>Provide audiotelephony for short and urgent communication</i>	Audio-telephony is regarded the best way to conduct short and urgent communication for managerial work tasks (compared with office-based audio conferencing, video conferencing, multimedia conferencing and avatar telephony)
	Advice	<i>Low quality audiotelephony with fast call set-up is preferred over high quality audioconferencing with 7 second call set-up</i>	<p>Audio-telephony with fast call set-up is preferred for managerial work tasks (compared with audioconferencing with high-quality and 7 second call set-up)</p> <p>See also Call set-up time</p>
	Advice	<i>Low quality audiotelephony with fast call set-up is preferred over high quality audioconferencing with 7 second call set-up</i>	<p>Audio-telephony with fast call set-up is preferred for managerial work tasks (compared with audioconferencing with high-quality and 7 second call set-up)</p> <p>See also Call set-up time</p>
<b>Communication behaviour</b>	Principle	<i>Audioconferencing and videoconferencing produce the same outcome but less is said with audioconferencing</i>	Videoconferencing with high quality for negotiation can increase the amount users say in order to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
	Principle	<i>Users interrupt less with audioconferencing than with videoconferencing</i>	Videoconferencing with high quality for negotiation can increase users' interruptions to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
	Principle	<i>Audioconferencing produces the same communication process for negotiation as 200 ms videoconferencing</i>	Videoconferencing with 200 ms delay for negotiation can have no significant difference in communication process (compared to audioconferencing)
<b>Outcome of joint problem solving task</b>	Principle	<i>Audioconferencing can give better task outcomes than videoconferencing</i>	Audio conferencing with 7 kHz bandwidth for joint problem solving can lead to a better task outcome (compared with Videoconferencing)
<b>Task suitability as judged by potential users without direct experience</b>	Principle	<i>People without audioconferencing experience may not expect it to be suitable for communicating to solve a shared problem</i>	Audio conferencing with 7 kHz bandwidth for joint problem solving is not considered suitable by potential users without direct experience
	Principle	<i>People without audioconferencing experience may not expect it to be suitable for communicating to persuade</i>	Audio conferencing with 7 kHz bandwidth for persuasion is not considered suitable by potential users without direct experience
<b>Duration of communication when negotiating</b>	Principle	<i>The time to reach consensus through negotiation is the same for audioconferencing, Videoconferencing and face-to-face</i>	<p>Audio conferencing with 7 kHz bandwidth for negotiation may not lead to a significant difference in time to reach consensus (with efficiency comparable with Videoconferencing and when face-to-face)</p>
			<p>Videoconferencing with high quality for negotiation may not lead to a significant difference in time to reach consensus (with efficiency comparable with audioconferencing and when face-to-face)</p>

<b>Persuasion on behalf of somebody else</b>	Advice	<i>Audio conferencing can give better results than videoconferencing when it is necessary to persuade on behalf of someone else</i>	Audio conferencing with 7 kHz bandwidth for persuasion can have an advantage if arguing for a third party (compared with Videoconferencing)
	Advice	<i>Audio conferencing can give better results than face-to-face communication when it is necessary to persuade on behalf of someone else</i>	Audio conferencing with 7 kHz bandwidth for persuasion can have an advantage if arguing for a third party (compared with face-to-face)
	Principle	<i>Audio conferencing can make users appear more formal than videoconferencing when it is necessary to persuade on behalf of someone else</i>	Audio conferencing with 7 kHz bandwidth for persuasion when arguing for a third party can lead to users being perceived as more formal (compared with Videoconferencing)

### 5.3 Avatar telephony

<b>Topic</b>	<b>Principle or Advice</b>	<b>Guideline</b>	<b>Justification</b>
<b>Application area</b>	Principle	<i>Avatar-telephony is not regarded suitable for business communication</i>	Avatar-telephony with poor audio and good graphics has no managerial communication activity for which it is regarded as suitable
<b>Communication outcome</b>	Principle	<i>Avatar-telephony produces the same outcome as mobile videoconferencing</i>	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation has no significant difference in task outcome (compared with videoconferencing with 3,5 inch screen)
	Principle	<i>Avatar-telephony produces the same outcome as audioconferencing</i>	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation has no significant difference in task outcome (compared with audio conferencing)
<b>Person perception</b>	Principle	<i>Avatar-telephony creates the same perception of the other partner as for mobile videoconferencing</i>	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation has no significant difference in how users perceive their communication partner (compared with videoconferencing with 3,5 inch screen)

### 5.4 Videoconferencing

Guidelines on videoconferencing are clustered within three areas:

- Application of videoconferencing for distance "face-to-face" communication (also referred to as "talking head video")
- Application of videoconferencing to remote inspection (also referred to as "tele-inspection" or "video as data")
- Mobile videoconferencing with a small screen.

Face-to-face communication through videoconferencing focuses on the typical current business and service provision market for office-based and residential videoconferencing. However a major new application of videoconferencing is for an office-based expert to remotely inspect a visual scene while in audio discussion with a colleague at the remote site [12]. Remote inspection is an example of mobile videoconferencing in which a mobile worker may use a relatively large screen, although other mobile applications may include handset technology incorporating a small screen.

### 5.4.1 Videoconferencing: Face-to-face communication (talking head video)

Topic	Principle or Advice	Guideline	Justification
<b>Asynchrony</b>	Principle	<i>Asynchronous videoconferencing produces the same task outcome as when synchronous</i>	Videoconferencing with 200 ms asynchrony for joint problem solving may not significantly affect task outcome compared with videoconferencing with synchrony
	Principle	<i>Communications with asynchronous videoconferencing are similar to audiotelephony</i>	Videoconferencing with 200 ms asynchrony for joint problem solving can lead to communications similar to telephony
<b>Experience with different quality levels</b>	Advice	<i>Users used to high quality videoconferencing find low-quality videoconferencing unacceptable</i>	Videoconferencing with high-quality for managerial work tasks can lead to non-acceptance of low-quality videoconferencing for the same work tasks
<b>High quality desktop Videoconferencing</b>	Advice	<i>If people have videoconferencing on their desktop, then they are likely to use it</i>	Videoconferencing with high quality from a personal office can become integrated with daily work communications (compared with videoconferencing rooms)  Videoconferencing with high quality from one's own office for managerial work is judged to be an improvement relative to travelling to a dedicated videoconference room
	Principle	<i>Videoconferencing is used when face-to-face communication is not an option</i>	Videoconferencing with high quality is perceived to be a good way to conduct a broad range of communication tasks when face-to-face communication is not an option
	Principle	<i>Business users of videoconferencing judge it to be suitable for all communication tasks</i>	Videoconferencing with high quality for managerial work tasks between colleagues is perceived to be suitable for all communication tasks
	Advice	<i>Provide videoconferencing for non-urgent and long communication</i>	Videoconferencing with high quality from a personal office for non-urgent and long communication is judged to be an improvement relative to using a telephone  Videoconferencing with high quality for managerial work tasks is selected more often if the duration of the call is long (compared with audio-telephony)
	Principle	<i>Videoconferencing is preferred for process-oriented communications</i>	Videoconferencing with high quality is preferred for managerial communications that are open-ended and interactive (compared with audio-telephony, audioconferencing and avatar-telephony)
	Principle	<i>More is said with a videoconference, but the outcome does not differ from audioconferencing</i>	Videoconferencing with high quality for negotiation can increase the amount users say in order to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
	Principle	<i>People interrupt each other more with videoconferencing</i>	Videoconferencing with high quality for negotiation can increase users' interruptions to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
	Principle	<i>Easy access videoconferencing does not replace face-to-face meetings</i>	Videoconferencing with high-quality and easy and low-cost access for managerial work tasks does not change the pattern of face-to-face meetings

<b>Acceptance of desktop video conferencing</b>	Advice	<i>An easy to learn desktop videoconferencing service is accepted quickly</i>	Videoconferencing with high quality for managerial work tasks can become comfortable to use within a time period of weeks or months by people who initially report being not immediately comfortable with videoconferencing
<b>Eye contact</b>	Advice	<i>Parallax differences are acceptable if less than 8 degrees</i>	Videoconferencing with non-eye contact systems should provide a parallax differences of less than 8 degrees to be within the acceptable range according to the ETSI ETR 297 [9]
	Principle	<i>There is no consumer demand for systems with perfect eye-contact</i>	Videoconferencing equipment manufacturers and service providers do not provide eye-contact systems on the market as users are not asking for them  Videoconferencing in general conditions does not require the optical axes of camera and monitor coinciding  Videoconferencing in a conference room with non-exact eye contact is reported as satisfactory for general use by users and service providers
<b>Relation with face-to-face meetings</b>	Principle	<i>Easy access videoconferencing does not replace face-to-face meetings</i>	Videoconferencing with high-quality and easy and low-cost access for managerial work tasks does not change the pattern of face-to-face meetings
<b>Service selection</b>	Advice	<i>Videoconferencing is preferred for non-urgent and long communication</i>	Videoconferencing with high quality from a personal office for non-urgent and long communication is judged to be an improvement relative to using a telephone  Videoconferencing with high quality for managerial work tasks is selected more often if the duration of the call is long (compared with audio-telephony)
	Principle	<i>Increased delay leads to shorter communication</i>	Videoconferencing with 650 ms delay for negotiation can lead to shorter communication (compared with videoconferencing with no delay)
<b>Influence of delay on a negotiation task</b>	Principle	<i>Increased delay does not change the outcome of communication</i>	Videoconferencing with 650 ms delay for negotiation can have no significant difference in negotiation outcomes (compared to videoconferencing with a delay of 200 ms)
	Principle	<i>Increased delay does not change the number of interruptions</i>	Videoconferencing with 650 ms delay for negotiation can have no significant difference in interruptions (compared to videoconferencing with a delay of 200 ms)
	Principle	<i>Increased delay does not change the amount of turn taking</i>	Videoconferencing with 650 ms delay for negotiation can have no significant difference in turn taking (compared to videoconferencing with a delay of 200 ms)
	Principle	<i>People without Videoconferencing experience can expect it to be suitable for communicating to solve a shared problem</i>	Videoconferencing with high quality for joint problem solving is considered suitable by potential users without direct experience (unlike audioconferencing)
<b>Task suitability as judged by potential users without direct experience</b>	Principle	<i>People without Videoconferencing experience can expect it to be suitable for communicating to persuade</i>	Videoconferencing with high quality for persuasion is considered suitable by potential users without direct experience (unlike audioconferencing)

<b>Persuasion with personal involvement</b>	Principle	<i>Videoconferencing can give better results than audioconferencing when trying to persuade with personal involvement</i>	Videoconferencing with high quality for persuasion can have an advantage if arguing a case with personal involvement (compared with audioconferencing)
	Principle	<i>Videoconferencing can give better results than audioconferencing when trying to persuade with personal involvement</i>	Audio conferencing with 7 kHz bandwidth for persuasion can have a disadvantage if arguing a case with personal involvement (compared with Videoconferencing)
<b>Communication behaviour</b>	Principle	<i>Videoconferencing leads to more words said for the same outcome</i>	Videoconferencing with high quality for negotiation can increase the amount users say in order to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
	Principle	<i>Videoconferencing leads to increased interruptions between users</i>	Videoconferencing with high quality for negotiation can increase users' interruptions to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
<b>Outcome of joint problem solving task</b>	Principle	<i>Videoconferencing can give worse task outcomes than audioconferencing</i>	Videoconferencing with high quality for joint problem solving can lead to a lower task outcome (compared with audioconferencing)
<b>Duration of communication when negotiating</b>	Principle	<i>The time to reach consensus through negotiation is the same for audioconferencing, Videoconferencing and face-to-face</i>	Audio conferencing with 7 kHz bandwidth for negotiation may not lead to a significant difference in time to reach consensus (with efficiency comparable with Videoconferencing and when face-to-face)
			Videoconferencing with high quality for negotiation may not lead to a significant difference in time to reach consensus (with efficiency comparable with audioconferencing and when face-to-face)
<b>Group videoconferencing</b>	Principle	<i>Group videoconferencing is chosen for planning and task distribution meetings when cost matters</i>	Videoconferencing with high quality is chosen more for group managerial work tasks that involve planning and task distribution when cost of meeting matters (compared with face-to-face communication)
	Principle	<i>Group videoconferencing is chosen for communication that involves group processes and active involvement from the participants</i>	Videoconferencing with high quality is chosen more for group managerial work tasks that involve group processes and active involvement from the participants (compared with audio-telephony)  Videoconferencing with high quality is chosen more for group managerial work tasks that involve planning and task distribution (compared with audio-telephony)

### 5.4.2 Videoconferencing: Remote inspection (video as data)

Topic	Principle or Advice	Guideline	Justification
<b>Asynchrony</b>	Principle	<i>500 ms asynchrony in remote inspection works well</i>	Remote inspection with 500 ms asynchrony for giving advice on a procedure does not affect task performance (compared with remote inspection with no delay)
<b>Packet loss</b>	Advice	<i>Up to 7 % packet loss does not affect task performance</i>	Remote inspection with 7 % packet loss for giving advice on a procedure does not affect task performance (compared with remote inspection with no packet loss)

### 5.4.3 Videoconferencing: Mobile small screens

Topic	Principle or Advice	Guideline	Justification
<b>Screen resolution</b>	Advice	<i>QCIF works as well as CIF on a small screen</i>	<p>Videoconferencing with 3,5 inch screen and QCIF resolution for negotiation can result in no significant difference in task outcome ( compared with videoconferencing with 3,5 inch screen and CIF resolution)</p> <p>Videoconferencing with 3,5 inch screen and QCIF resolution for negotiation can result in no significant difference in communicative process (compared with videoconferencing with 3,5 inch screen and CIF resolution)</p>
<b>Screen size</b>	Principle	<i>A 3,5 inch screen does not affect task performance</i>	<p>Videoconferencing with 3,5 inch screen for negotiation may not have a significantly negative affect on task outcome (compared with a 29 inch screen)</p> <p>Videoconferencing with 3,5 inch screen for negotiation may not have a significantly negative affect on communicative process (compared with a 29 inch screen)</p> <p>Videoconferencing with 3,5 inch screen for negotiation may not lead to significantly different dialogue content (compared with a 29 inch screen)</p>

## 5.5 Multimedia conferencing

The guidelines for face-to-face (talking head) videoconferencing (clause 7.4.1) are also relevant for multimedia conferencing in addition to the following specific guidelines.

Topic	Principle or Advice	Guideline	Justification
<b>High Quality desktop multimedia conferencing</b>	Principle	<i>Multimedia conferencing is considered the most useful new real-time communication service</i>	Multimedia conferencing with high quality for managerial work communication is considered the most useful new service (compared with videoconferencing, audio conferencing and avatar-telephony)
	Advice	<i>Multimedia conferencing becomes integrated into daily work communications if on the user's desktop</i>	Multimedia conferencing with high quality from a personal office can become integrated into daily work communications (compared with a videoconferencing room)
	Principle	<i>Multimedia conferencing is preferred because of the ability to present information on the screen</i>	Multimedia conferencing with high quality for managerial work is preferred because of the ability to present information on the screen (compared with videoconferencing, audioconferencing, audio-telephony and avatar-telephony)
	Principle	<i>Easy access multimedia conferencing does not replace face-to-face meetings</i>	Multimedia conferencing with high-quality and easy and low-cost access for managerial work tasks does not change the pattern of face-to-face meetings
	Principle	<i>There is a real need for multimedia conferencing</i>	Multimedia conferencing with high quality for managerial work tasks supports a real need for this type of communication
<b>Group multimedia conferencing</b>	Principle	<i>Multimedia conferencing is preferred for group meetings</i>	Multimedia conferencing is chosen for point-to-point group management meetings (compared with videoconferencing, audioconferencing and audio-telephony)

## 6 Conclusions and recommendations for future work

Conclusions are drawn regarding the approach to guideline development taken for this report and recommendations for future work in this area in order to enhance the guideline set and the way they might be presented and made usable by different types of guideline users.

### 6.1 Guideline approach

It has been found possible to apply a structured approach to:

- extract key information from laboratory, field and previous literature results and expert opinion to produce intermediate guidelines (annex C);
- rate intermediate guidelines for their importance and main guideline users (annex D);
- extract and group guidelines for presentation (clause 5).

This structured approach does appear to increase greater explicitness of both how much is known and is not known about particular empirical results on fitness-for-purpose. This both helps identify the main knowledge that can be acted upon by industry and the knowledge gaps that could be addressed in the future.

## 6.2 Interest for potential guideline users

### 6.2.1 Ability to address knowledge requirements

In clause 4.1 it is suggested that knowledge in the form of guidelines should particularly attempt to address:

- 1. the configuration and quality of different communication media;
- 2. the selection between different communication media;
- 3. acceptability of different communication media;
- 4. future applications for real-time human communication services.

The extent to which the guidelines developed from the Eye-2-Eye project data can address each of these areas is considered below.

*Configuration and quality of different communication media* is addressed in terms of:

- three different videoconferencing configurations (in "face-to-face video conferencing", "remote inspection" and "small screen mobile");
- desktop videoconferencing compared with dedicated video conferencing rooms and group conferencing
- symmetry/asymmetry in users' roles and tasks;
- the specific Network QoS parameters of delay and packet loss;
- the terminal characteristics of audio frequency bandwidth, video frame rate and resolution, audio and video delay, screen size;
- the quality implied in a certain audio or video protocol.

*Selection between different communication media* is addressed by guidelines that:

- present comparisons of two or more communication services, with a statement of which service is best in respect to a particular attribute;
- address end-user preference and choice, where preference concerns what potential end-users say they would use and choice concerns what end-users actually choose.

*Acceptability of different communication media* is addressed in terms of guidelines that:

- state when end-users will and will not use a certain service;
- assume a threshold for acceptability of a certain configuration.

The guidelines may be used to address *future applications for real-time human communication services*. In particular, as the guidelines are based on services using text, audio, animated graphics, video and data, then they may be applicable to other services that have not been taken into account but which may use similar media. Also, it should be possible to apply the guidelines to find new market areas. For example, knowledge of a specific user group or characteristic (e.g. age, profession, role and/or relation to communication partner) may identify certain service attributes that are very appropriate for a specific market segment (e.g., elderly persons).

### 6.2.2 Mix and value of guidelines providing advice or principles

Whereas human factors guidelines often present "advice", the majority of the guidelines presented in the current report present "principles". In order to offer prescriptive advice, sufficient details of the context should be known and/or the knowledge contained in the guideline should be clearly generalisable across contexts. For example, guidelines on call set-up control and the control of the user interface are able to be prescriptive when there is typically either one best procedure or a very limited set of optimal procedures that can be recommended.

Guidelines on real-time conversation are expected to be more often expressed as "principle" than "advice" because there shall be additional features of a design situation that shall determine the prescription that a particular piece of knowledge shall imply. Therefore, it will quite often be necessary for the guideline user to decide on the appropriate design prescription given the knowledge contained in a guideline and given the context of the design situation. For example, if it is known that generally users interrupt each other less with audioconferencing than with videoconferencing, there are contexts when users will value interruptions as a relatively more positive feature (such as informal conversation between friends and family) and other contexts when it will be a more negative communication behaviour (such as a formal business situation). Other examples are whether it is positive or negative that communication tends to be shorter with a particular type of communication service and when one communication partner is given advantage over the other by use of a particular communication service.

The application of the knowledge contained in the guidelines is, therefore, expected to often remain a context-dependent and subjective process based on informed judgement. The aim of guidelines that provide principles is that they offer information that may be useful to intended guideline users to enable more informed judgement than might otherwise be the case.

## 6.3 Enhancement of the guideline set

The objective of developing guidelines on real-time human communication services is a relatively novel idea that was initiated by the EC 4<sup>th</sup> Framework Programme project Vis-à-Vis [3] and extended by the EC 5<sup>th</sup> Framework Programme project Eye-2-Eye [1]. For this reason the guidelines derived to date are rather new and there has been limited opportunity to examine the validity, reliability, usability and utility of these guidelines. Also, a relatively small number of results from other previous published work has been included. Special user groups (e.g., lip reading and sign language users) would benefit from further work including more results from other services and research on their special needs.

A process by which the guidelines could be developed would include the extension of consultation with industry beyond that of the case studies summarized in annex B to:

- validate the guidelines created with a larger sample of potential guideline users;
- refine the guideline set based on a broader knowledge of industry requirements;
- identify additional guidelines from existing data of high value to network operators, service providers, equipment manufacturers;
- identify priorities for new guideline data according new developments affecting real-time human communication systems (e.g., broadband and IPv6 based services, technical parameters and applications);
- develop the guideline presentation formats for ease of use and uptake by network operators, service providers and equipment manufacturers.

The last point on developing guideline presentation formats and ease of use is discussed further below.

## 6.4 Enhancement of the guideline presentation

In addition to the need to develop principles and advice it is necessary to make it available in a way that is usable for key persons in network operator, service provider and equipment manufacturer organizations. The optimum presentation of guidelines is a complex issue. In addition to the "paper based" approach utilized in the current report, recently acquired knowledge of guideline user requirements indicates the need to support at least two styles of information acquisition. These two styles can be described "Lean back and think" and "Lean forward and explore":

- "Lean back and think" guideline users can be supported by a human presenter who is very knowledgeable in the guideline origins and rationales and who is in turn supported by a slide-show presentation package (e.g., using Microsoft PowerPoint) that contains the key messages (figure 5);
- "Lean forward and explore" guideline users can be supported by a software implementation that allows exploration of details of guidelines (figure 6).

These two distinct working styles may be a requirement for the same individual at different stages of their work activity.



Figure 5: Guideline presentation package for "lean back and think" result users

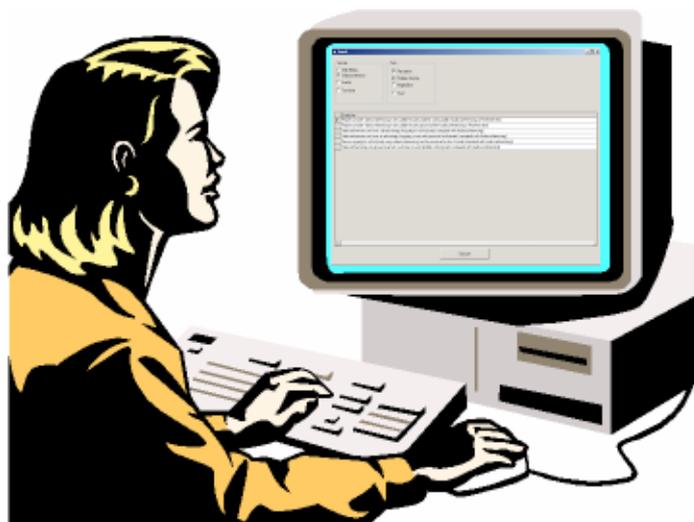


Figure 6: Guideline presentation tool for "lean forward and explore" result users

## 6.5 Requirement for tutorial support

Intended guideline users include strategic planners, research and development directors, sales persons, customer support and conference meeting facilitators. Many of these latter job roles experience a high turnover of personnel, with new people having a high learning requirement. All guideline users must deal with an increasingly wide and rapidly developing technological area. It therefore seems sensible that the use of the guidelines is supported by tutorial information that includes explanations of the concepts and technologies involved.

A human presenter is able to respond to specific questions of clarification. However, for some intended users the information should be accessible to the guideline users for the unpredictable times that they shall need it most. Consequently, a web-based access and tutorial system is a potentially important extension to the development of the guidelines. This system should make it possible to navigate between the guidelines, find those that are relevant and understand their rationale, strength and generality. In addition, in order for a guideline user to be able to take full advantage of the principles and advice it is necessary to provide base knowledge of real-time human communication services.

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## Annex A: Review of previous work

### A.1 Guideline methodology

Reviews of the general problem area of communicating knowledge of human factors in the form of guidelines [13, 2] identified six main requirements on which the intermediate guidelines used for generating the general guidelines presented in clause 5. These are summarized in table 2. The resulting intermediate guidelines are described in annex C.

**Table 2. Main requirements for an intermediate guideline format identified from previous work**

Requirement	Source
Enhance selection of guideline(s) and translation to applied setting	[14]; [15]; [16]
Increase understanding with examples (but avoid tendency to misrepresent or exclude focus on original advice) correct terminology and inclusion of definitions	[15]; [17] [18]
Make validity and justification clear	[14]; [17]
Specify scope and context of guidelines	[16]; [19]; [14]
Enhance decisions about the trade-off and priorities of guidelines	[16]; [19]; [20]
Combine merits of Plain text, Examples, Reference to research, Rule-based, Semi-formal If-Then format	[13]
Enable Extraction of main results for guideline users	[2]

### A.2 Test methodology

In order to generate the empirical data for the guidelines it was necessary to design user tests for both laboratory and field conditions. The Eye-2-Eye user tests drew on previous work and in particular ITU-T Recommendation P.910 [21] on subjective video quality assessment methods for multimedia applications, ITU-T Recommendation P.920 [22] on interactive test methods for audio-visual communications and ETSI EG 201 472 [23] regarding usability evaluation for the design of telecommunication systems, services and terminals. In addition, the laboratory tests incorporated an existing laboratory task for negotiation [24] and joint problem solving [25].

To a large extent it was necessary to design new test methodologies for the laboratory tests in order to meet the following criteria:

- interactive real-time communication between two persons;
- non-artificial tasks relevant to actual or expected users of videoconferencing (negotiation, persuasion, joint problem solving, remote inspection);
- combined collection of objective and subjective data (e.g., task outcome, communication process, user opinion).

The evaluation methodologies and test tools developed by EC IST project Eye-2-Eye are documented elsewhere [24].

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## Annex B: Guideline user requirements

### B.1 Results of guideline user interviews

It is possible to identify specific audiences for the guidelines who have real business needs for enhanced real-time communication products and services. These are people with specific roles in network operator, equipment manufacturer and service provider organizations and who have various requirements for:

- information content (e.g., what questions need answers?);
- information format (e.g., how should information be presented?).

Case studies with industry representatives have indicated the need for user-based information for different communication services [2], including:

- differences between communication media;
- different implications for Quality of Service for a particular service and network;
- information on potential new applications and uses of services and products.

From a guideline user perspective there appear to be three main aims for the development of user-based technical guidelines:

- producing guidelines on the most relevant and important issues from a guideline user perspective;
- producing guidelines that are clear in their level of coverage and dependability;
- producing guidelines with short and powerful messages.

A summary of information and format requirements identified from potential guideline users is presented in table 3 and table 4 respectively.

In order to meet the content and format requirements there are two main operational requirements placed on guideline development:

- **Collect relevant empirical data for translation into guidelines.** This was a key topic for the Eye-2-Eye laboratory experiments [5] and field study [6];
- **Enable extraction of main advice for users.** In a complex area with a large number of potential variables and outcomes there is a potential for a very large number of guidelines. The particular focus and need of an individual guideline user shall dictate that not all guidelines are required by an individual guideline user, especially at a particular point in time. Also, it is possible that a number of guidelines might be usefully grouped to present a higher-level guideline. For example, a higher-level guideline may provide some more general advice. To enable extraction of main advice for some guideline users it is necessary that the original guidelines promote grouping, re-interpretation and consistency checking. The original guidelines should represent a core level of knowledge from which the potential for clustering and deriving new "meta-knowledge" is promoted.

**Table 3: Typical information requirements derived from interviews and workshops with guideline users**

Information needed	Rationale
New application areas and communication situations (e.g., markets for videoconferencing)	Because this can be used for new products and introduction to new markets
Identify communication situations that gives a high user satisfaction, communication efficiency or preference	Because this could enable identification of new successful markets
About the end-user segment of business end-users (can include their private life)	Because business models are more reliable (e.g., more clear-cut communication activities and demands) Because they are prepared to spend money
General purpose communication situations	Because end-users want to use communication services for 'every kind' of situation
Which communication situations have the strongest requirements for quality	Because this can assist decisions on new services, products and marketing
Thresholds for QoS parameters	Because a "better-than" parameter can be used to shape a communication service
User-based data about QoS	Because this can be used to shape the end-to-end characteristics (including both networks and terminals)
Answer to the question: Is High-quality video (4CIF or TV-quality) much better than CIF quality?	Because new users of videoconferencing often complain that video quality (CIF) is poor
Effects of audio-Video asynchrony (audio immediate, video asynchrony)	Because end-users may have problems with long delay on audio, but current videoconferencing systems provide synchronization as the only or main obvious option
Possible service properties in 3G mobile or 4G mobile networks that will disturb the user communication	Because if a service is interpreted as too poor, the end-users will reject it
End-user preferences and behaviour	Because this can be used for new products and introduction to new markets
Communication efficiency, user satisfaction and user preferences/choices	Because this can be used for new products and introduction to new markets
Answer to the question: Why do so many CEOs use videoconferencing?	Has it to do with trust?
How useful is videoconferencing for conducting business negotiations?	High-end systems are positioned for senior management work activities
How useful is videoconferencing for conducting strategic business discussions?	High-end systems are positioned for senior management work activities
How to design new appropriate services for clients?	Information required by a content provider
How to re-design existing services using distance communication technologies?	Information required by a content provider
What is the cost-benefit of introducing a new service?	Information required by a content provider
What is the cost-benefit when buying a product?	Information required by an equipment manufacturer and potential end-user or end-user representative
Information <i>not</i> needed...	
General private domain end-users	Business models focus on more definable needs of business users
Very specific communication situations	Because end-users want to use communication services for 'every kind' of situation
For videophone systems having the optical axes of camera and monitor coinciding	Because end-users do not report a problem of lack of eye contact

**Table 4: Summary of guideline format requirements obtained from potential guideline users**

Clear definitions for ambiguous concepts
Inclusion of familiar examples of applicability
Access from different perspectives (specific technical parameters, communication goals, communication behaviours)
Emphasize essential properties of empirical results
Provide rank comparisons
Adopt standardization terminology where possible
Thorough rationale or justification of guideline, with reference to experimental results where possible

---

## Annex C: Overview of intermediate guidelines

### C.1 Purpose

The guidelines presented in clause 5 are derived from a set of 118 intermediate guidelines. The intermediate guidelines use a semi-formal format with the aim to:

- be explicit in their level of:
  - coverage of the problem space;
  - consistency in addressing the main information requirements;
  - credibility as prescriptive advice;
- correspond to existing knowledge of literature results, classification or taxonomies;
- address the main requirements for information format (annexes A and B);
- enable extraction of main advice for production of the guidelines in clause 5.

---

### C.2 Format

The format of the intermediate guidelines is developed from previous work on a fitness-for-purpose guideline format [13]. The attributes have been selected and refined from [13] and by internal evaluations by the Eye-2-Eye consortium. Some sub-attributes of the Communication Situation are developed from an evaluation taxonomy for networked multimedia applications [27].

The format has three components:

- core attributes;
- additional attributes;
- other format elements.

Each component is summarized clause C.2.1.

#### C.2.1 Core attributes of the intermediate guideline format

The core structure is shown in figure 7 and the core attributes are presented in figure 8. Each attribute is described in turn in the following clauses.

IF	Communication Situation
USING	Service Prescription
WITH	Technical Parameters
THEN	User Behaviour

**Figure 7: Core structure of the Intermediate guideline Format**

IF	Communication Situation	Task	<ul style="list-style-type: none"> <li>General type of task</li> <li>Specific type of task</li> <li>Telepresence vs Teledata</li> <li>Task symmetry</li> <li>Duration</li> <li>Situation Formality</li> <li>Social vs. Cognitive</li> <li>Difficulty</li> <li>Urgency</li> <li>Emotiveness</li> <li>Attention</li> </ul>
		Motive	<ul style="list-style-type: none"> <li>Extrinsic or Intrinsic goal</li> <li>Create trust</li> <li>Form impression</li> </ul>
		Setting	<ul style="list-style-type: none"> <li>Geographical remoteness</li> <li>Background noise</li> </ul>
		User	<ul style="list-style-type: none"> <li>Group</li> <li>Age</li> <li>Relation to partner</li> <li>Relation grouping</li> <li>Knowledge of other</li> <li>Background experience</li> <li>Common ground</li> <li>Roles</li> <li>Pair's frequency of communication</li> <li>Personal involvement</li> </ul>
USING	Service Prescription		<ul style="list-style-type: none"> <li>Real-time Text</li> <li>Telephone</li> <li>Audio conference (loud speaking)</li> <li>Avatar-phone</li> <li>Videoconferencing</li> <li>Multimedia conferencing</li> </ul>
WITH	Technical Parameters		<ul style="list-style-type: none"> <li>Bandwidth</li> <li>Packet size</li> <li>Delay</li> <li>Packet loss</li> <li>Burst packet loss</li> <li>Frame-rate</li> <li>Resolution</li> <li>Monitor size</li> <li>Protocol (audio)</li> <li>Protocol (video)</li> <li>Other(s)</li> <li>Resolution (data)</li> <li>Frame-rate (data)</li> <li>Connection time</li> </ul>
THEN	User Behaviour		<ul style="list-style-type: none"> <li>Task effectiveness</li> <li>Task efficiency</li> <li>User satisfaction</li> <li>Impression of task performed</li> <li>Service (Medium) preference</li> <li>Impression of communication partner</li> </ul>

**Figure 8: Core attributes and [sub]sub-attributes**

### C.2.1.1 Communication situation

The communication situation is defined by the following sub-attributes (table 5).

**Table 5: Sub-attributes of Communication Situation**

<b>Sub-attribute</b>	<b>Definition</b>
General type of task	The aim of the communication stated at its most general level appropriate for all the parties concerned
Specific type of task	The type of communication stated at its most specific level if appropriate, such as the name of an experimental task performed in a laboratory
Telepresence Vs Teledata	Telepresence: a task involving communication with or awareness of other users. Teledata: a task involving communication with video, graphics and/or audio which represents data rather than the presence of other users
Task symmetry	The extent to which the parties in communication are less or more equal with respect to expertise or control of the interaction.
Duration	Length of time of the communication task
Situation Formality	Relative amount of ceremonious or conventional communication versus casual or unconstrained communication
Social vs. Cognitive	The extent to which the task involves a strong social component (e.g., negotiation, acquaintance relations) or requires the exchange of complex information (e.g., problem solving)
Difficulty	The extent to which a task is difficult or complex versus simple or routine
Urgency	The extent to which a task is particularly urgent or under particular time pressure
Emotiveness	The extent to which a task has a strong emotional content
Attention	The extent to which the task does (foreground) or does not (background) require the full attention of the parties in the communication
Extrinsic or Intrinsic goal	The extent to which a communication goal has an objective and observable outcome (extrinsic) or a communication goal is subjective and personally experienced, with the participants communicating for its own sake rather than to achieve some objective task
Create trust	The extent to which the task requires that confidence in the truth is created between the communication partners
Form impression	The extent to which the task requires that the communication partners perceive characteristics of each other, such as personality and intelligence
Geographical remoteness	The extent to which the communication parties are physically dispersed and separated
Background noise	Self-explanatory
User Group	Self-explanatory
Age	Self-explanatory
Relation to partner	The overall strength of the pre-existing personal relation between the communication parties
Relation grouping	The main category for the type of relationship between the communication parties
Knowledge of other	The overall strength of the pre-existing personal knowledge that the communication parties have of each other
Background experience	The overall strength of pre-existing experience held by the communication parties that is relevant to the task (experience of the communication service and goal task requirements)
Common ground	The extent to which the communication parties have the same understanding of the goal and context of the communication and the concepts involved
Roles	The main category for the type of any asymmetric relation between the communication parties
Pair's frequency of communication	Self-explanatory
Personal involvement	The extent to which the communication parties are committed to the outcome of the task or perform the task more on behalf of another party than themselves

### C.2.1.2 Service prescription

The sub-attributes are the communication services for data is available. They are summarized in table 6.

**Table 6: Sub-attributes of Service Prescription**

Sub-attribute	Definition
Real-time Text	A service for transmitting alpha-numeric characters in real-time over a telecommunication network
Telephony	A service for transmitting voice signals in real-time over a telecommunication network
Audio conferencing (loud speaking)	A telephone service that does not rely on amplification of the voice signal in very close proximity to the recipient's ear
Avatar telephony	A service for transmitting voice signals in real-time over a telecommunication network in combination with a graphical (human) representation of the speaker
Videoconferencing	A service for transmitting voice and video signals in real-time over a telecommunication network
Multimedia conferencing	A service for transmitting voice, video and data signals in real-time over a telecommunication network

### C.2.1.3 Technical parameters

Technical parameters selected for study within Eye-2-Eye are the network and terminal aspects summarized in table 7.

**Table 7: Sub-attributes of Technical Parameters**

Sub-attribute	Definition
Bandwidth	The range of frequencies which can safely be conveyed in a communication channel
Packet loss	A loss of one packet that can be described using a certain statistical model
Burst packet loss	A loss of two or more packets in sequence
Packet size	The magnitude of a relatively small unit of data transmitted over a packet switching network as part of a message transferred from one user to another
Audio delay	The time required for a audio signal generated at the talker's mouth to reach the listener's ear
Video delay	The time between the input of the first pixel of a particular picture at the sending end encoder and the output of the pixel from the decoder at the receiving end
Asynchrony	Audio delay subtracted from Video delay
Frame-rate	The frequency by which a full video frame is updated, sometimes called video temporal resolution or image frequency
Resolution	Resolution of the video image, is sometimes called (video) spatial resolution or picture resolution
Monitor size	The number in inches of the diagonal of the image screen on a screen
Audio protocol	A set of rules defining the way audio information is represented in a network
Video protocol	A set of rules defining the way video information is represented in a network

### C.2.1.4 User behaviour

The sub-attributes are measures of user behaviour as summarized in table 8.

**Table 8: Sub-attributes of User Behaviour**

Sub-attribute	Definition
Task effectiveness	The accuracy and completeness which specified service users can achieve specified goals in particular environments. Operationalized as the extent to which the service is assessed to help get a favorable result for the task.
Task efficiency	The resources expended in relation to the accuracy and completeness of goals achieved. Operationalized as the extent to which the service is assessed to be an efficient communication medium for the task
User satisfaction	The comfort and acceptability of the task performance to the service user. Operationalized as the extent to which the service is assessed to a pleasant communication medium for the task.
Impression of task performed	The extent to which the service users believe they achieved a good result
Service (Medium) preference	The extent to which the service user would chose that service again for the same kind of communication in the future
Impression of communication partner	An overall rating of the communication partner on multiple person-perception characteristics

## C.2.2 Additional attributes of the intermediate guideline format

In addition the core attributes above, there are other attributes which make up the complete intermediate guideline format. These are described in clauses C.2.2.1 to C.2.2.3.

### C.2.2.1 Guideline identifier

The guideline identifier is a unique (alpha-numeric) identifier within the set of guidelines, to enable referencing and navigation.

### C.2.2.2 Guideline title

The guideline title is a short prescriptive title outlining the main triggering attributes and prescriptions.

Where appropriate the guideline title is stated as a principle with the following elements and order:

- 1. Communication service
- 2. Main parameters or quality of the communication service
- 3. Communication task
- 4. Main aspect of user behaviour concerned
- 5. Communication service or medium with which a comparison is made.

Therefore a typical intermediate guideline title has the construction:

*<communication service> with <main technical parameter/quality statement> for <communication task> results in <dependent variable> (compared with <communication service>).*

The guideline title provides the "Justification" element of each general guideline presented in clause 5.

### C.2.2.3 Rationale

The rationale is an extended justification of the prescription contained in the guideline title, with reference to the literature and/or the Eye-2-Eye project empirical results.

### C.2.2.4 Probability

The probability that the prescription holds can be one or more quantitative or qualitative statement. It can refer to inferential statistical evidence based on the significance of an experimental result, an effect size, amount of predictive association and/or confidence level. It can also refer to descriptive statistic evidence, such as a mean and standard deviation or a statement of confidence based on, for example, a percentage or 10-point scale. Additionally, it can refer to textual description of confidence in a result's internal and external validity and consistency within the literature.

## C.2.3 Other format elements

There are the following format elements that are in addition to the attributes.

### C.2.3.1 Example(s)

Example(s) should show guideline application in relevant contexts. They should be aimed at relevance for particular guideline users, as different examples may be more appropriate for different guideline users. The develop of examples is for further study.

### C.2.3.2 See also

This is a guideline cross-reference. It allows for reference to other related guidelines in the set. The cross-references are made on the basis of subjective and objective psychological measures and on technical variables. The cross-reference itself is a reference to the specific guideline identifier(s).

### C.2.3.3 Definitions

The definition cross-reference lists the terms used in the guideline which may be ambiguous and which can be looked up in the list of definitions for further explanation.

## C.2.4 The set of intermediate guidelines

The intermediate guidelines have aimed to extract all of the relevant information from the results of the Eye-2-Eye baseline tests, field study and laboratory experiments. In addition, some intermediate guidelines have been produced from previous knowledge existing in published literature or as expert opinion. These additional guidelines illustrate the potential for generation of guidelines from previous as well as new knowledge.

Currently there are 118 intermediate guidelines. The intermediate guideline set is summarized by a contents page containing:

- Guideline number;
- Guideline title;
- Rating of importance of each guideline;
- Summary rationale for importance rating, with identification where possible of the main expected user of the guideline.

The complete set of current intermediate guidelines can be obtained in electronic format from [www.eye-to-eye.org](http://www.eye-to-eye.org). The current report provides:

- the principles applied for extraction of the intermediate guidelines are outlined;
- an example of one intermediate guideline (showing the entire guideline format);
- the titles of all current intermediate guidelines.

### C.2.4.1 Principles applied for extraction of guidelines from empirical data

Even with the availability of the intermediate guideline format to structure the extraction of guidelines the decision of which data should be represented as an intermediate guideline remains partly subjective. However, to reduce the level of subjectivity the extraction of guidelines was based on the following principles:

- *Granularity*. Intermediate guidelines should be at the highest level of granularity sensible, through the representation of single result elements rather than combinations of results. Examples of a single result element are the result of single statistical test (in the case of quantitative data) and a single series of tests on related dependent variables (e.g., measures of communication process or task outcome).
- *Reciprocity*. Intermediate guidelines should represent results separately for each relevant communication service whenever sensible.
- *Non-judgemental expression*. The title or attributes of an intermediate guideline should present a result at a factual level. For example, a guideline should not state an inference that is beyond that appropriate by the interpretation of a test statistic. However, the considered judgement of the result provider may be appropriate for inclusion in the Rationale description of a guideline and descriptions of Probability (e.g., assessment of internal and external validity of a result). The judgement of the guideline authors is only appropriate inclusion in description of Probability (e.g., assessment of internal and external validity of a result).

### C.2.4.2 An example intermediate guideline

Table 9 illustrates the contents page of the intermediate guideline set, showing the first 15 guidelines. It shows the intermediate guideline title and number.

Taking as an example Intermediate guideline #12, the complete guideline is presented in figure 9 and figure 10 according to the format described in this annex . The intermediate guideline is split into two figures only in order to aid presentation in the current report.

**Table 9: Abstract of Contents of Intermediate guideline Set that lists the first 12 guidelines**

Intermediate guideline Number	Title
#1	In videoconferencing with asynchrony of 200 ms people do not notice the asynchrony
#2	Videoconferencing with 200 ms asynchrony for joint problem solving can lead to communications similar to telephony
#3	Videoconferencing with 200 ms asynchrony for joint problem solving may not significantly affect task outcome compared with videoconferencing with synchrony)
#4	Videoconferencing with 3,5 inch screen for negotiation may not have a significantly negative affect on task outcome (compared with a 29 inch screen)
#5	Videoconferencing with 3,5 inch screen for negotiation may not have a significantly negative affect on communicative process (compared with a 29 inch screen)
#6	Videoconferencing with 3,5 inch screen for negotiation can reduce feelings of social presence between communicators (compared with a 29 inch screen)
#7	Videoconferencing with 3,5 inch screen for negotiation may not lead to significantly different dialogue content (compared with a 29 inch screen)
#8	Videoconferencing with 3,5 inch screen and QCIF resolution for negotiation can result in no significant difference in task outcome ( compared with videoconferencing with 3,5 inch screen and CIF resolution)
#9	Videoconferencing with 3,5 inch screen and QCIF resolution for negotiation can result in no significant difference in communicative process (compared with videoconferencing with 3,5 inch screen and CIF resolution)
#10	Videoconferencing with 650 ms delay for sales negotiation can improve results for the seller (compared with videoconferencing with no delay)
#11	Videoconferencing with 650 ms delay for sales negotiation can reduce results for the buyer (compared with videoconferencing with no delay)
#12	Videoconferencing with 650 ms delay for negotiation can lead to shorter communication (compared with videoconferencing with no delay)

	Attribute	Sub-attribute	Sub-sub-attribute	Value
	Guideline identifier			D3 PB6,56,87,88-92,96-7 VC
	Guideline title			Videoconferencing with 650 ms delay for negotiation can lead to shorter communication (compared with videoconferencing with no delay)
IF	Communication Situation	Task	General type of task	Negotiation
			Specific type of task	Acquiring a Company Task
			Telepresence Vs Teledata	Telepresence
			Task symmetry	Asymmetric
			Duration	Medium mean = 5.15, Sd.dev = 2.76, n = 10 (11 point scale, 0-10, 0 = informal, 10 = formal)
			Situation Formality	Cognitive
			Social vs. Cognitive	mean = 4.05, Sd.dev = 2.52, n = 10 (11 point scale, 0-10, 0 = not difficult, 10 = difficult)
			Difficulty	Low-Medium
			Urgency	Low
			Emotiveness	Foreground
			Attention	Extrinsic
		Motive	Extrinsic or Intrinsic goal	mean = 7.20, Sd.dev = 2.14, n = 20 (11 point scale, 0-10, 0 = did not need trust, 10 = needed trust)
			Create trust	mean = 7.40, Sd.dev = 2.33, n = 20 (11 point scale, 0-10, 0 = did not need to form impression, 10 = needed to form impression)
		Setting	Form impression	
			Geographical remoteness	
			Background noise	Low
		User	Group	University students and staff
			Age	Mean = 25, Range 18-48
			Relation to partner	None
			Relation grouping	None
			Knowledge of other	None
			Background experience	Medium-low mean = 2.10, Sd.dev = 2.22, n = 20 (11 point scale, 0-10, 0 = no shared information, 10 = all information shared)
			Common ground	Negotiation: Buyer and Seller
			Roles	
			Pair's frequency of communication	Never mean = 5.80, Sd.dev = 2.65, n = 20 (11 point scale, 0-10, 0 = not involved, 10 = involved)
AND	Service Prescription		Personal involvement	
USING	Technical Parameters		Videoconferencing	
			Bandwidth	3Mbps
			Packet size	
			Delay (audio and video)	650 ms
			Packet loss	0
			Burst packet loss	
				<b>25fps</b>
			Frame-rate	
			Resolution	CIF
			Monitor size	29 inch
			Protocol (audio)	G.722
			Protocol (video)	H.263
THEN	User Behaviour			
			Task effectiveness (subjective)	mean = 5.90, Sd.dev = 2.31, n = 20 (11 point scale, 0-10, 0 = unfavorable result, 10 = favorable result)
			Task efficiency (subjective)	mean = 7.00, Sd.dev = 2.20, n = 20 (11 point scale, 0-10, 0 = inefficient, 10 = efficient)
			User satisfaction	mean = 5.95, Sd.dev = 2.82, n = 20 (11 point scale, 0-10, 0 = unpleasant, 10 = pleasant)
			Impression of task performed	mean = 5.50, Sd.dev = 2.21, n = 20 (11 point scale, 0-10, 0 = poor result, 10 = good result)
			Service (Medium) preference	mean = 6.10, Sd.dev = 2.77, n = 20 (11 point scale, 0-10, 0 = not prefer, 10 = prefer this medium)

Figure 9: Intermediate guideline Example (Part 1 of 2)

BECAUSE Rationale	<p>As audio-video signals are delayed, the negotiations become more like audio-only negotiations. This effect is similar for communicative processes, with the exception of interruptions. In other words, there are fewer turns and words, and turns are shorter with a delay. There was a significant difference between the delay conditions in terms of the number of seller words per turn (<math>F[1,17] = 9.095, p &lt; 0.01</math>). There was a significant difference between the delay conditions in terms of the total number of words per turn (<math>Z = -2.531, p &lt; 0.05</math>). Independent t-tests showed significantly greater numbers of turns in the baseline video conditions (no delay) than for the 200 ms delay (<math>t(17) = 2.669, p &lt; 0.05</math>) and the 650 ms delay conditions (<math>t(16) = 2.255, p &lt; 0.05</math>). Mann-Whitney U tests showed significantly greater numbers of interruptions of the buyer (<math>Z = -2.374, p &lt; 0.05</math>), seller (<math>Z = -2.374, p &lt; 0.05</math>) and total number of interruptions (<math>Z = -2.139, p &lt; 0.05</math>) in the 650 ms delay condition compared to baseline audio only condition. In summary, the differences in the task outcome measures suggest that the delay (650 ms) makes participants change their buying and selling strategy so that it becomes more like the strategy used by participants in the audio condition. It may well be that there are two kinds of interruptions going on here – in one case interruptions may signal difficult communication, as when the signal is delayed. In another case, more interruptions may signal more spontaneous and less formal dialogues, as in the Baseline video compared to the Baseline audio. (O'Malley et al., 2002)</p>		
AS	Probability	Level of control Type I error	<p>Laboratory experiment See Rationale Previous research has shown that delay has negative effects on performance and communication in a range of tasks (e.g., O'Connell et al., 1993; O'Malley et al., 1996; Tang and Isaacs, 1993). 48 (24 pairs)</p>
		Consistency within literature Sample size	

Figure 10: Intermediate guideline Example (Part 2 of 2)

### C.2.4.3 Listing of current intermediate guidelines

Table 10 lists the titles of the intermediate guidelines extracted from the laboratory experiments [5].

Table 11 lists the titles of the intermediate guidelines extracted from the field study [6].

Tables 12 and 13 list the titles of the intermediate guidelines extracted from the baseline tests [4].

Table 14 lists the titles of the intermediate guidelines extracted from existing literature and also from expert know-how during the case studies. It illustrates that many more guidelines from existing literature and expert opinion could be developed in this way.

**Table 10: Titles of intermediate guidelines extracted from the Eye-2-Eye laboratory experiments**

No.	Title
#2	Videoconferencing with 200 ms asynchrony for joint problem solving can lead to communications similar to telephony
#3	Videoconferencing with 200 ms asynchrony for joint problem solving may not significantly affect task outcome compared with videoconferencing with synchrony)
#4	Videoconferencing with 3,5 inch screen for negotiation may not have a significantly negative affect on task outcome (compared with a 29 inch screen)
#5	Videoconferencing with 3,5 inch screen for negotiation may not have a significantly negative affect on communicative process (compared with a 29 inch screen)
#6	Videoconferencing with 3,5 inch screen for negotiation can reduce feelings of social presence between communicators (compared with a 29 inch screen)
#7	Videoconferencing with 3,5 inch screen for negotiation may not lead to significantly different dialogue content (compared with a 29 inch screen)
#8	Videoconferencing with 3,5 inch screen and QCIF resolution for negotiation can result in no significant difference in task outcome ( compared with videoconferencing with 3,5 inch screen and CIF resolution)
#9	Videoconferencing with 3,5 inch screen and QCIF resolution for negotiation can result in no significant difference in communicative process (compared with videoconferencing with 3,5 inch screen and CIF resolution)
#10	Videoconferencing with 650 ms delay for sales negotiation can improve results for the seller (compared with videoconferencing with no delay)
#11	Videoconferencing with 650 ms delay for sales negotiation can reduce results for the buyer (compared with videoconferencing with no delay)
#12	Videoconferencing with 650 ms delay for negotiation can lead to shorter communication (compared with videoconferencing with no delay)
#13	Videoconferencing with 650 ms delay for negotiation can have no significant difference in negotiation outcomes (compared to videoconferencing with a delay of 200 ms)
#14	Videoconferencing with 650 ms delay for negotiation can have no significant difference in interruptions (compared to videoconferencing with a delay of 200 ms)
#15	Videoconferencing with 650 ms delay for negotiation can have no significant difference in turn taking (compared to videoconferencing with a delay of 200 ms)
#16	Videoconferencing with 200 ms delay for negotiation can have no significant difference in communication process (compared to audioconferencing)
#17	Remote inspection with 500 ms asynchrony for giving advice on a procedure does not affect task performance (compared with remote inspection with no delay)
#18	Remote inspection with 7 % packet loss for giving advice on a procedure does not affect task performance (compared with remote inspection with no packet loss)
#19	Videoconferencing with high quality for negotiation can increase the amount users say in order to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
#20	Videoconferencing with high quality for negotiation can increase users' interruptions to agree a negotiated outcome (compared with audio conferencing and face-to-face communication)
#21	Avatar-telephony with poor audio and good graphics for negotiation can increase lying by sellers (compared with face-to-face communication)
#22	Avatar-telephony with poor audio and good graphics for negotiation can decrease truth telling by sellers (compared with face-to-face communication)
#23	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation can have no significant difference in task outcome (compared with videoconferencing with 3,5 inch screen)
#24	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation can have no significant difference in task outcome (compared with audio conferencing)
#25	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation can have no significant difference in how users perceive their communication partner (compared with videoconferencing with 3,5 inch screen)
#26	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation does not have a significantly increase task completion time (compared with avatar-telephony with poor audio and good graphics and 17 inch screen)
#27	Avatar-telephony with poor audio and good graphics and 3,5 inch screen for negotiation does not significantly change communication process between users (compared with avatar-telephony with poor audio and good graphics and 17 inch screen)

**Table 11: Titles of intermediate guidelines extracted from the Eye-2-Eye field study**

No.	Title
#28	Videoconferencing with high quality from a personal office can become integrated with daily work communications (compared with videoconferencing rooms)
#29	Multimedia conferencing with high quality from a personal office can become integrated into daily work communications (compared with a videoconferencing room)
#30	Multimedia conferencing with high quality for managerial work communication is considered the most useful new service (compared with videoconferencing, audio conferencing and avatar-telephony)
#31	Multimedia conferencing with high quality for managerial work is preferred because of the ability to present information on the screen (compared with videoconferencing, audioconferencing, audio-telephony and avatar-telephony)
#32	Videoconferencing with high quality is perceived to be a good way to conduct a broad range of communication tasks when face-to-face communication is not an option
#33	Videoconferencing with high quality from a personal office for non-urgent and long communication is judged to be an improvement relative to using a telephone
#34	Videoconferencing with high quality from one's own office for managerial work is judged to be an improvement relative to travelling to a dedicated videoconference room
#35	Audio-telephony is regarded the best way to conduct short and urgent communication for managerial work tasks (compared with office-based audio conferencing, video conferencing, multimedia conferencing and avatar telephony)
#36	Videoconferencing with high quality for managerial work tasks is selected more often if the duration of the call is long (compared with audio-telephony)
#37	Audio-telephony for managerial work tasks is selected more often if the duration of the call is short (compared with videoconferencing)
#38	Avatar-telephony with poor audio and good graphics has no managerial communication activity for which it is regarded as suitable
#39	Videoconferencing with high-quality and easy and low-cost access for managerial work tasks does not change the pattern of face-to-face meetings
#40	Multimedia conferencing with high-quality and easy and low-cost access for managerial work tasks does not change the pattern of face-to-face meetings
#41	Multimedia conferencing with high quality for managerial work tasks supports a real need for this type of communication
#42	Videoconferencing with high quality for managerial work tasks can become comfortable to use within weeks or months by people who are not immediately comfortable with videoconferencing
#43	Videoconferencing with high-quality for managerial work tasks can lead to dissatisfaction with low-quality videoconferencing for the same work tasks
#44	Videoconferencing with high-quality for managerial work tasks can lead to non-acceptance of low-quality videoconferencing for the same work tasks
#45	Audio-telephony with fast call set-up is preferred for managerial work tasks (compared with audioconferencing with high-quality and 7 second call set-up)
#46	Users of high and low quality videoconferencing for managerial work tasks do not see a use for avatar-telephony with poorer audio and good graphics
#47	Videoconferencing with high quality is chosen more for group managerial work tasks that involves group processes and active involvement from the participants (compared with audio-telephony)
#48	Videoconferencing with high quality is chosen more for group managerial work tasks that involve planning and task distribution when cost of meeting matters (compared with face-to-face communication)
#49	Videoconferencing with high quality is chosen more for group managerial work tasks that involve planning and task distribution (compared with audio-telephony)
#50	Videoconferencing with high quality for managerial work tasks between colleagues is perceived to be suitable for all communication tasks
#51	Videoconferencing with high quality is preferred for managerial communications that involve a process (compared with audio-telephony, audioconferencing and avatar-telephony)
#52	Audio telephony with 3,1 kHz bandwidth and fast call set-up and call forwarding is chosen more for managerial communication (compared with audioconferencing with 7 kHz bandwidth and 7 second call set-up and no call forwarding)
#53	Multimedia conferencing is chosen for point-to-point group management meetings (compared with videoconferencing, audioconferencing and audio-telephony)

**Table 12: Titles of intermediate guidelines extracted from the Eye-2-Eye baseline tests (Part 1 of 2)**

No.	Title
#54	Real-time text with character-by-character transmission for negotiation can take three-times longer with real-time text to reach consensus for no extra gain (compared with audioconferencing and when face-to-face)
#55	Real-time text with character-by-character transmission for negotiation can take three-times longer with real-time text to reach consensus for no extra gain (compared with Videoconferencing and when face-to-face)
#56	Audio conferencing with 7 kHz bandwidth for negotiation may not lead to a significant difference in time to reach consensus (with efficiency comparable with Videoconferencing and when face-to-face)
#57	Videoconferencing with high quality for negotiation may not lead to a significant difference in time to reach consensus (with efficiency comparable with audioconferencing and when face-to-face)
#58	Real-time text with character-by-character transmission for sales negotiation can lead to sellers lying more to buyers (than when face-to-face)
#59	Audio conferencing with 7 kHz bandwidth for sales negotiation can lead to sellers lying more to buyers (than when face-to-face)
#60	Videoconferencing with high quality for sales negotiation can lead to sellers lying less to buyers (than when using audioconferencing)
#61	Real-time text with character-by-character transmission for sales negotiation can lead to sellers offering the truth less to buyers (than when face-to-face)
#62	Audio conferencing with 7 kHz bandwidth for sales negotiation can lead to sellers offering the truth less to buyers (than when face-to-face)
#63	Videoconferencing with high quality for sales negotiation can lead to sellers offering the truth more to buyers (than when using Real-time text)
#64	Videoconferencing with high quality for sales negotiation can lead to sellers offering the truth more to buyers (than when using audioconferencing)
#65	Real-time text with character-by-character transmission for sales negotiation can lead to sellers telling the truth less (compared with Videoconferencing)
#66	Real-time text with character-by-character transmission for sales negotiation can lead to sellers obtaining a less-favorable outcome (than with Videoconferencing)
#67	Audioconferencing with 7 kHz bandwidth for sales negotiation can lead to sellers telling the truth less (compared with Videoconferencing)
#68	Audioconferencing with 7 kHz bandwidth for sales negotiation can lead to sellers obtaining a less-favorable outcome (than with Videoconferencing)
#69	Videoconferencing with high quality for sales negotiation can lead to sellers telling the truth more (compared with audioconferencing)
#70	Videoconferencing with high quality for sales negotiation can lead to sellers telling the truth more (compared with Real-time text)
#71	Videoconferencing with high quality for sales negotiation can lead to sellers obtaining a more-favorable outcome (than with audioconferencing)
#72	Videoconferencing with high quality for sales negotiation can lead to sellers obtaining a more-favorable outcome (than with Real-time text)
#73	Videoconferencing with high quality for joint problem solving is considered suitable by potential users without direct experience (unlike audioconferencing)
#74	Videoconferencing with high quality for joint problem solving is considered suitable by potential users without direct experience (unlike Real-time text)
#75	Audio conferencing with 7 kHz bandwidth for joint problem solving is not considered suitable by potential users without direct experience
#76	Real-time text with character-by-character transmission for joint problem solving is not considered suitable by potential users without direct experience
#77	Videoconferencing with high quality for persuasion is considered suitable by potential users without direct experience (unlike audioconferencing)
#78	Videoconferencing with high quality for persuasion is considered suitable by potential users without direct experience (unlike Real-time text)
#79	Audio conferencing with 7 kHz bandwidth for persuasion is not considered suitable by potential users without direct experience
#80	Real-time text with character-by-character transmission for persuasion is not considered suitable by potential users without direct experience
#81	Audio conferencing with 7 kHz bandwidth for persuasion can have an advantage if arguing for a third party (compared with Real-time text)
#82	Audio conferencing with 7 kHz bandwidth for persuasion can have an advantage if arguing for a third party (compared with Videoconferencing)

**Table 13: Titles of intermediate guidelines extracted from the Eye-2-Eye baseline tests (Part 2 of 2)**

No.	Title
#83	Audio conferencing with 7 kHz bandwidth for persuasion can have an advantage if arguing for a third party (compared with face-to-face)
#84	Videoconference with high quality for persuasion can have a disadvantage if arguing for a third party (compared with audioconferencing)
#85	Real-time text with character-by-character transmission for persuasion can have a disadvantage if arguing for a third party (compared with audioconferencing)
#86	Videoconferencing with high quality for persuasion can have an advantage if arguing a case with personal involvement (compared with audioconferencing)
#87	Real-time text with character-by-character transmission for persuasion can have an advantage if arguing a case with personal involvement (compared with audioconferencing)
#88	Audio conferencing with 7 kHz bandwidth for persuasion can have a disadvantage if arguing a case with personal involvement (compared with Videoconferencing)
#89	Audio conferencing with 7 kHz bandwidth for persuasion can have a disadvantage if arguing a case with personal involvement (compared with Real-time text)
#90	Audio conferencing with 7 kHz bandwidth for persuasion when arguing for a third party can lead to users being perceived as more formal (compared with Videoconferencing)
#91	Audio conferencing with 7 kHz bandwidth for persuasion when arguing for a third party can lead to users being perceived as more formal (compared with Real-time text)
#92	Audio conferencing with 7 kHz bandwidth for persuasion when arguing for a third party can lead to users being perceived as more formal (compared with face-to-face)
#93	Videoconferencing with high quality for persuasion when persons are arguing for a third party can lead to users being perceived as less formal (compared with audioconferencing)
#94	Real-time text with character-by-character transmission for persuasion when persons are arguing for a third party can lead to users being perceived as less formal (compared with audioconferencing)
#95	Audio conferencing with 7 kHz bandwidth for joint problem solving can lead to a better task outcome (compared with Videoconferencing)
#96	Audio conferencing with 7 kHz bandwidth for joint problem solving can lead to a better task outcome (compared with Real-time text)
#97	Videoconferencing with high quality for joint problem solving can lead to a lower task outcome (compared with audioconferencing)
#98	Real-time text with character-by-character transmission for joint problem solving can lead to a lower task outcome (compared with audioconferencing)

**Table 14: Titles of intermediate guidelines extracted from expert opinion and selected published literature**

No.	Title
#99	Videoconferencing with unknown quality for negotiation and information transfer can allow greater monitoring of the other person's attention (compared with audioconferencing)
#100	Videoconferencing with direct eye-contact for negotiation and decision making does not lead to higher levels of satisfaction or acceptance of the technology (compared to videoconferencing without direct eye contact)
#101	Teledata with high quality for problem solving tasks may be valued more in shared applications than telepresence
#102	Teledata with high quality for negotiation tasks may be valued more in shared applications than telepresence
#103	Videoconferencing with unknown quality for joint problem solving can significantly improve task outcomes when communication ability is stressed (compared with audio only)
#104	Video-conferencing with unknown quality for joint problem solving produces longer and more interrupted dialogues (compared with audioconferencing)
#105	Video-conferencing with unknown quality for joint problem solving shows no significant increase in performance (compared to audioconferencing)
#106	Videoconferencing with 500 ms delay for joint problem solving significantly affects performance (compared with videoconferencing with no delay)
#107	Videoconferencing with 500 ms delay for joint problem solving can lead to more interruptions (compared with videoconferencing with no delay)
#108	Videoconferencing with unknown quality for joint problem solving can lead to more gaze behaviour (compared with face-to-face communication)
#109	Audioconferencing with unknown quality for discussions can make it more difficult for lower status individuals in a business organization to contribute verbally (compared with face-to-face communication)
#110	Audio conferencing with unknown quality for discussions can exaggerate the tendency for high-status members of a business organization to dominate discussions in meetings (compared to face to face communication)
#111	Videoconferencing with high quality for problem solving with low perceived distances between strangers can result in interactions that are more like those between familiar parties (compared to videoconferencing with high perceived distances)
#112	Videoconferencing with high quality with low perceived distances between strangers can result in interactions that are more like face to face with decreased formality (compared to videoconferencing with high perceived distances)
#113	Audio telephony for general communication by elderly people should have background noise kept to a minimum
#114	Audio telephony with receiving amplifiers for general communication by elderly hearing impaired persons can improve communication
#115	Videoconferencing in general conditions does not require the optical axes of camera and monitor coinciding
#116	Videoconferencing in a conference room with non-exact eye contact is reported as satisfactory for general use by users and service providers
#117	Videoconferencing equipment manufacturers and service providers do not provide eye-contact systems on the market as users are not asking for them
#118	Videoconferencing with non-eye contact systems should provide a parallax differences of less than 8 degrees to be within the acceptable range according to the European Standard ETSI ETR 297 [9]

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Annex D:  
Void

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## Annex E: Derivation of general guidelines from intermediate guidelines

### E.1 Summary of derivation process

The guidelines presented in clause 5 were derived from the set of intermediate guidelines described in annex C. This was achieved by the following sequence of analysis:

- Ranking the importance of each **intermediate guideline** from the perspective of an intended guideline user. Each intermediate guideline was given a rank score between 5 (high importance) and 1 (low importance);
- Providing a rationale for the ranking to state for which type of guideline user it is important and why;
- Selecting intermediate guidelines that achieved a rank score of 3 or above;
- Grouping intermediate guidelines to form a **guideline**;
- Grouping guidelines according to an apparent **topic** of relevance to intended guideline users.

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V1.1.1	June 2001	Pre-processed by the ETSI Secretariat <i>editHelp!</i> E-mail: <a href="mailto:edithelp@etsi.org">mailto:edithelp@etsi.org</a>

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## Annex F: Bibliography

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- ITU-T Recommendation SG 12: "End-to-end transmission performance of networks and terminals"
- ITU-T Recommendation SG 16. "Telecommunications Standardization Sector"

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## History

<b>Document history</b>		
V1.1.1	November 2003	Publication