

User-centred technical guidelines for real-time human communication services: Requirements and derivation

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Abstract

This paper presents a guideline derivation procedure intended to maximise uptake of test data for real-time person-to-person communication services. Example guidelines are provided for multimedia conferencing, videoconferencing, avatar telephony, audio telephony and real-time text. The full set of 60 guidelines is available as an ETSI report. It is argued that the structured approach described might be generalised beyond the source work of real-time human communication to be usefully applied to other areas of human factors knowledge.

Key words: Guidelines, Human Factors, Quality of Service, Multimedia conferencing, Videoconferencing, Avatar telephony, Audio telephony, Real-time text

1. Introduction

Although real-time distance communication between people is a fundamental component of the vision for the information society, the successful introduction of real-time person-to-person communication services is complicated because there are different services that may be more or less appropriate for different communication situations. Telephony, videoconferencing, multimedia conferencing (videoconferencing with shared data) and recent developments in real-time text and avatar-telephony present a range of technical variables associated with terminal, network and media protocol characteristics. There is a large and expanding range of standards and platforms for audio and video communication. Amid this complexity the developers of systems and services need to be able to make informed decisions about alternatives and configurations so that it suits intended end-users and their communication goals.

Well designed end-user tests can provide the data required about the suitability of systems. These end-user tests may involve different research designs (e.g., laboratory experiments, field studies, focus group studies) and for uptake of these data by developers of systems and services test results should be translated into guidance appropriate for the communications industry. This paper proposes an approach to maximising uptake of test data by potential guideline users that was developed in the EC 5th Framework Programme Project Eye-2-Eye (Brooks et al., 2003). Requirements for the guidelines are introduced, followed by a description of the guideline derivation process and example guidelines.

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2. Requirements for guidelines

Requirements for guidelines concern scientific requirements for the manner in which data are collected and translated. There are also the requirements of the intended guideline users. Each of these areas is treated in turn below.

2.1 Scientific requirements

In addition to general requirements for valid and reliable user tests, special methodological issues for user-tests with real-time person-to-person communication services are discussed elsewhere [Heiestad et al. (2003); Heim et al. (2003)]. Of different current concern are requirements due to the complexity of communicating knowledge of human factors and human-computer interaction. As summarised in Table 1, reviews by Hammes et al. (1999) and Hestnes et al. (2003) have identified a number of requirements on which guidelines should be based. The main conclusions are that guideline development should be systematic and make explicit what is (and is not) known on a particular guideline topic. A structured, semi-formal format for guidelines should enable precision and the ability to back-track and update according to the empirical source. However, a rule-based approach should combine with plain text approaches to provide descriptions of such aspects as background references and confidence in the guideline.

Table 1. Requirements for guidelines identified from previous work

Requirement	Key source
Enhance selection of guideline(s) and translation to applied setting	Arnfeld & Rosbottom (1998); Tetzlaff & Schwartz (1991); Mosier & Smith (1986)
Increase understanding with correct terminology and inclusion of definitions	Scapin (1990)
Avoid tendency for examples to misrepresent or exclude focus on original advice	Tetzlaff & Schwartz (1991); Thvtrup & Nielsen (1991)
Make validity and justification clear	Arnfeld & Rosbottom (1998); Thovtrup & Nielsen (1991)
Specify scope and context of guidelines	Mosier & Smith (1986); Potosnak (1988); Arnfeld & Rosbottom (1998)
Enhance decisions about the trade-off and priorities of guidelines	Mosier & Smith (1986); Potosnak (1988); Newman & Lamming (1995)
Increase explicitness and trust by using a rule-based format with probability that a prescription holds	Denley et al. (1992)
Combine merits of Plain text & Rule-based format	Hammes et al (1999)

2.2 User requirements

It is possible to identify specific audiences for 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 organisations and who have various requirements for information content (e.g., what questions need answers?) and format (e.g., how should information be presented?).

The intended guideline users are diverse and include persons from more technical to more financial work areas, and from more design-oriented to management functions. For example, within a network operator organisation the specific work roles include telecommunication service provider, salesperson and network planner. Within an equipment manufacturer the roles include market analyst, development engineer, marketing director and sales person. Case studies with persons in these roles [Hestnes et al. (2003)] have indicated the need for user-based information that addresses the configuration and quality of different

communication media, the selection between different communication media, the acceptability of different communication media and future applications for real-time human communication services. In addition, two distinct ways of presenting guideline material have emerged, in order to support at least two styles of information acquisition: *Lean back and think* and *Lean forward and explore*. *Lean back and think* guideline users should be supported by a human presenter who is knowledgeable in the guideline origins and rationales. A human presenter should in turn be supported by a slide-show presentation package (e.g., using Microsoft™ PowerPoint™) that contains the key messages (Figure 1). *Lean forward and explore* guideline users can be supported by a software implementation that allows exploration of details of guidelines (Figure 2). These two distinct working styles may be a requirement for the same individual at different stages of their work activity.

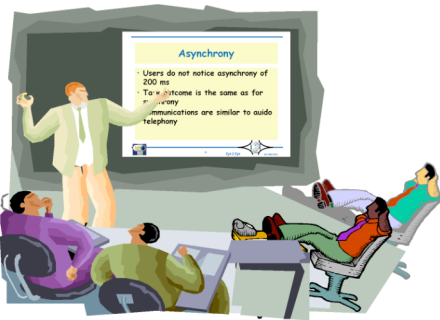


Figure 1. Guideline presentation package for 'lean back and think' result users



Figure 2. Guideline presentation tool for 'lean forward and explore' result users

Requirements for a presentation package and a presentation tool place different implications on guideline content and derivation. *Lean back and think* users require information with short and powerful messages whilst *Lean forward and explore* users require guidelines with sufficient detail and structure for computer-based search and navigation. If possible guidelines should be grouped to present a higher-level guideline more appropriate for a guideline presentation package. To enable extraction of advice and principles for some guideline users it is necessary that detailed original guidelines promote grouping, re-interpretation and consistency checking. The original guidelines should represent a core but intermediate level of knowledge from which the potential for clustering and deriving new 'meta-knowledge' is promoted.

3. A guideline derivation process based on scientific and user requirements

In order to meet both the content and format requirements summarised in Section 2 there are four main operational requirements placed on guideline development:

- Generation of base knowledge (unless sufficient base knowledge already exists)
- Identification of base knowledge units
- Production of semi-formal intermediate guidelines from base knowledge units
- Abstraction from intermediate guidelines to presentation-oriented guidelines.

Figure 3 illustrates these four steps and shows how different outputs serve as main inputs to either a Presentation Package or Presentation Tool. Each step is described in turn below.

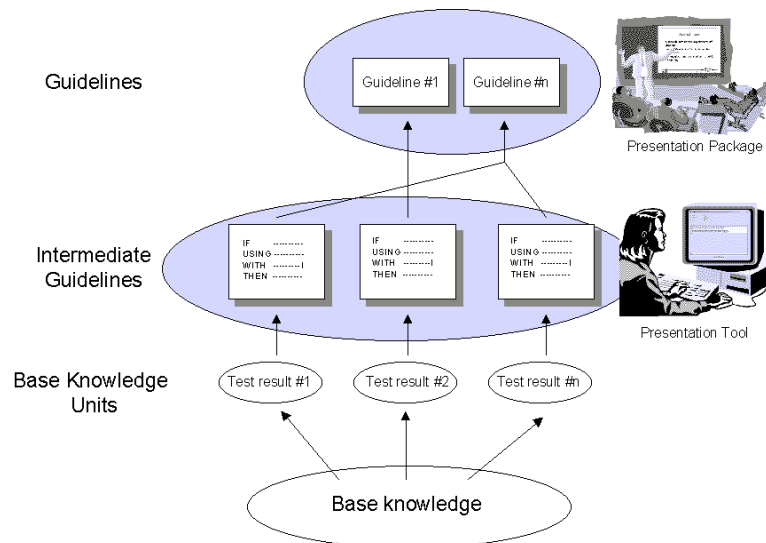


Figure 3. Guideline derivation process

3.1 Generation of base knowledge

Unless sufficient base knowledge already exists for the area to be addressed by guidelines the first step is the generation of data. Whilst a body of research exists on videoconferencing and audio telephony, for the current derivation of guidelines there was a lack of studies providing objective user measures, relevant technical parameters and comparative data with other communication services [Heim et al. (2001)]. Therefore dedicated end-user tests were performed (Figure 4). Baseline studies examined communication services with optimal qualities by examining media preferences in focus groups (N=53) and controlled experiments for persuasion (N=100), negotiated outcome based on trust (N=142) and joint problem-solving (N=82) [Schliemann et al. (2001)]. Subsequent laboratory experiments investigated changes in task type on performance and attitudes with audio-telephony and video-telephony (N=66); task effects on opinion measures such as social presence and person perception (N=44); manipulation of audio-video asynchrony in a problem solving task (N=48); different image sizes in a task involving negotiation (N=48); variation in resolution for small screens and their impact on performance, communication and attitudes with a negotiation task (N=86); impact of delay on performance, communication and attitudes with a negotiation task (N=42); and variation in packet loss and delay in a remote inspection task (N=48) [O'Malley et al. (2002)]. To complement the laboratory tests a field study (N=5) examined user choice for communication services over time and in a real business setting [Følstad et al. (2002)].

3.2 Identification of base knowledge units

Base knowledge units from which detailed intermediate guidelines are produced are at the highest level of granularity sensible, through the representation of single result elements rather than combinations of results. An example base knowledge unit in the case of quantitative data is the result of single statistical test.

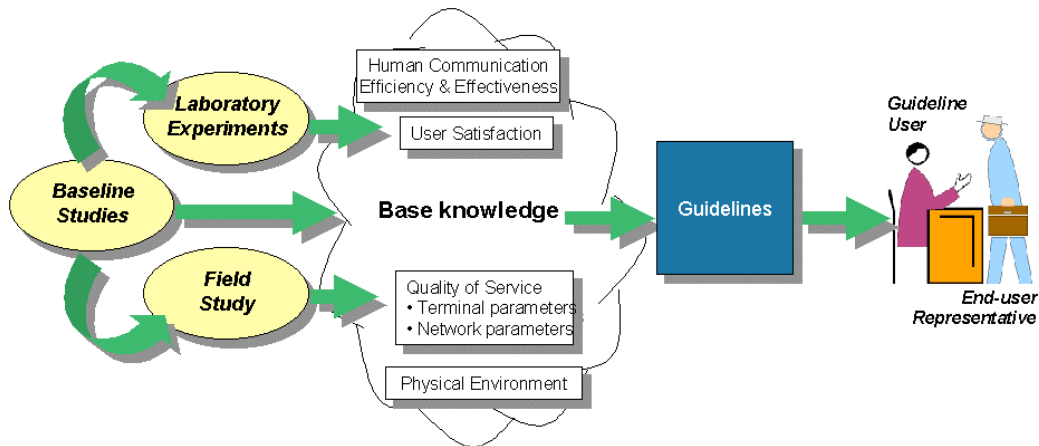


Figure 4. Translation of empirical results from three phases of end-user tests

3.3 Production of an intermediate guideline from each base knowledge unit

The intermediate guidelines use a semi-formal format with the core attributes shown in Figure 5. A full description of the intermediate guideline format is provided by Hestnes et al. (2003) and a detailed summary with example in ETSI (2003).

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

Figure 5. Core structure and attributes of the intermediate guideline format

Each attribute has sub-attributes and sometimes sub-sub-attributes in order to cover the problem space and to correspond to existing knowledge of media effects on communication behaviour. For example, the attribute 'Communication Situation' has the sub-attributes 'Task', 'Motive', 'Setting' and 'User'; and 'Task' is defined by 11 sub-sub-attributes including 'Duration', 'Situation formality', 'Difficulty' and 'Urgency'. Additional free-text attributes include a Rationale (a brief justification of the prescription, with reference to the literature and/or empirical results) and the Probability that the prescription holds (one or more quantitative or qualitative statement, such as the significance of an experimental result).

3.4 Abstraction of guidelines from intermediate guidelines

The process of deriving presentation-oriented guidelines from intermediate guidelines involves:

- Ranking the importance of each **intermediate guideline** from the perspective of an intended guideline user. Each intermediate guideline is given a rank score between 5 (high importance) and 1 (low importance) and a rationale for the ranking that states for which type of guideline user it is important and why
- Selecting intermediate guidelines that achieve a rank score of 3 or above
- Grouping selected intermediate guidelines to form a **guideline** for presentation
- Grouping guidelines according to topics to aid presentation and navigation.

4 Example guidelines

The process described in Section 3 has been used to translate and combine research results from the Eye-2-Eye laboratory, field and focus group studies into 118 intermediate guidelines

and 60 guidelines that cover 22 topics such as asynchrony, packet loss, screen size, screen resolution and delay [ETSI (2003)]. Each guideline includes a text-based interpretation that is intended to be concise and easy to read, a justification provided as an argument for the guideline and a categorisation of the guideline as providing either a fundamental or general truth (Principle) or a recommendation of action (Advice). An example is provided below for each communication service.

4.1 Example for multimedia conferencing

Topic	Principle or Advice	Guideline	Justification
High Quality desktop multimedia conferencing	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)

4.2 Example for videoconferencing

Topic	Principle or Advice	Guideline	Justification
Influence of delay on a negotiation task	Principle	<i>Increased delay does not change the outcome of communication</i>	Videoconferencing with 650ms delay for negotiation can have no significant difference in negotiation outcomes (compared to videoconferencing with a delay of 200ms)

4.3 Example for avatar-telephony

Topic	Principle or Advice	Guideline	Justification
Communication outcome	Principle	<i>Avatar-telephony produces the same outcome as mobile videoconferencing</i>	Avatar-telephony with poor audio and good graphics and 3.5" screen for negotiation has no significant difference in task outcome (compared with videoconferencing with 3.5" screen)

4.4 Example for audio-telephony/conferencing

Topic	Principle or Advice	Guideline	Justification
Service selection	Advice	<i>Low quality audiotelephony with fast call set-up is preferred over high quality audioconferencing with 7 second call set-up</i>	Audio-telephony with fast call set-up is preferred for managerial work tasks (compared with audio-conferencing with high-quality and 7 second call set-up) See also Call set-up time

4.5 Example for real-time text

Topic	Principle or Advice	Guideline	Justification
Persuasion with personal involvement	Principle	<i>Real-time text can give better results than audioconferencing when trying to persuade with personal involvement</i>	Audio conferencing with 7kHz bandwidth for persuasion can have a disadvantage if arguing a case with personal involvement (compared with Real-time text)

5. Discussion and conclusions

It has been argued that guideline development should be based on a systematic collection of essential data from user-tests. The development approach includes a semi-formal format for detailed intermediate guidelines and a ranking mechanism of importance from which higher-level guidelines can be extracted to support different presentation modes for different guideline users. Case studies with potential guideline users have shown that presentations by

human specialists and a searchable database of guidelines are preferable to paper-based guides.

It has been found possible to apply the structured approach to different types of user-tests. Tests with over 50 persons in focus group studies, five persons in a field study and over 700 persons in laboratory experiments have resulted in approximately 110 detailed intermediate guidelines for a Presentation Tool from which 60 guidelines are abstracted for presentation via paper guides and a slide-show package to support human-presenters. It is possible to add to the Eye-2-Eye test results with existing knowledge from other relevant research or with new empirical studies. Use of the attributes and sub-attributes of the intermediate guideline format could facilitate a higher level of consistency in the design and reporting of future empirical studies in addition to their improved communication to industry through guidelines.

The four-step approach described appears suited beyond the current focus of real-time person-to-person communication services to other empirically based derivation of guidelines. The distinction between 'detailed intermediate guidelines' and 'presentation-oriented guidelines' may be a useful distinction to meet the needs of other potential users of user-centred knowledge, such as the traditional distinction between guidelines for human factors specialists and non-human factors specialists. Although the attributes of the intermediate guideline format were derived specially for the current work on real-time person-to-person communication, the core attributes appear generic to telecommunications and only minor adjustments of sub-attributes are probably necessary for application to other products and services. However, this is for further study.

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