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**Hans-Jörg Zuberbühler**

# Quality Aspects of Multimodal Communication:

User Perception and Acceptance Thresholds

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*für Ruth und Maxine*

## Foreword

The last decades have seen important changes in the telecommunication market, starting with traditional telephony to multimedia communication, for example by means of the World Wide Web. Network providers are faced with the task of providing network capacity for constantly increasing usage-quality expectations for a new range of applications ranging from multimedia messaging to multipoint videoconferencing. To meet the new demands, the trend in public network systems is changing from circuit-switched technologies to packet-switched technologies. On the one hand this change is related to network capacity gain, and on the other hand to the fact that packet-switching better matches the characteristics of computer generated data. In order to avoid network efficiency trade-offs by lower network predictability, providers must know how to optimize the dataflow avoiding a decrease in the Quality of Service (QoS). The results presented in the following chapters are part of a bigger project regarding QoS, which was carried out in cooperation with the Institute of Hygiene and Applied Physiology (Ergonomics) and the Institute for Computer Engineering and Network Laboratory.

The increase in use of Voice-over-IP and videoconferencing applications shows that the question of accepted thresholds for transmission delays is a central one. The work of the author addresses the question, under which condition delays are perceivable and unacceptable. He stresses these issues from two applied points of view; first in the context of pure human-computer interaction, and second in the context of human-human interaction by means of a computer network.

This research report is split into two sections: 1) a theoretical introduction, and 2) an experimental section. The theoretical part introduces the reader to the background, scope and aims of the investigation and offers a thorough overview of relevant aspects of communication theory, technical definitions, and relevant neural and cognitive theories of time perception as well.

The first experimental part presents the results of two experiments belonging to the human-computer interaction condition. That is, the threshold of a relative delay between auditory and visual information, and the threshold of an absolute delay between a vocal trigger and the disappearance of a visual stimulus in one condition, and an absolute delay between a mouse trigger and the disappearance of a visual stimulus. The second experimental part deals with three experiments belonging to the human-human interaction

condition by means of an experimental computer network. Thresholds of perception and acceptance of absolute delays were measured for simulated real life conditions, showing that the degree of complexity of human-human interaction greatly influences both threshold measures.

The work contributes to three important QoS-aspects. The author has put effort into the development of a model addressing psychosocial aspects of communication beyond the technical aspects. He has adapted an experimental method called best-PEST - well established in controlled laboratory experiments - to more applied conditions. The adaptive best-PEST method has been verified to add value not only to human-computer interaction but also human-human interaction. Lastly, the reader will find a set of tables containing validated thresholds for different kinds of information delays in the context of human-computer and human-human interaction, respectively.

Zürich, August 2003 Sissel Guttormsen Schär Helmut Krueger

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Zürich, August 2003 Hans-Jörg Zuberbühler

*Quid est ergo 'tempus'? Si nemo ex me quaerat, scio;*
*si quaerenti explicare velim, nescio.*

*What is time then? If nobody asks me, I know; but if I were desirous to explain it to one that should ask me, I know not.*

AUGUSTINUS 354 – 430 A.C.

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