Vincent Roca
Franck Rousseau (Eds.)

LNCS 3311

Interactive Multimedia and Next Generation Networks

Second International Workshop on Multimedia Interactive Protocols and Systems, MIPS 2004 Grenoble, France, November 2004, Proceedings

Springer

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Grenoble, France, November 16-19, 2004
Proceedings

Springer

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Library of Congress Control Number: 2004115079

CR Subject Classification (1998): H.5.1, C.2, H.4, H.5, H.3, D.2

ISSN 0302-9743
ISBN 3-540-23928-6 Springer Berlin Heidelberg New York

Springer is a part of Springer Science+Business Media

springeronline.com

Printed in Germany

Typesetting: Camera-ready by author, data conversion by PTP-Berlin, Protago-TeX-Production GmbH
Printed on acid-free paper SPIN: 11354420 06/3142 5 4 3 2 1 0

Lecture Notes in Computer Science 3311

Preface

Interactive Distributed Multimedia Systems (IDMS) and Protocols for Multimedia Systems (PROMS) have been two successful series of international events bringing together researchers, developers and practitioners from academia and industry in all areas of multimedia systems. These two workshops successfully merged in 2003 and now constitute the MIPS workshop.

After the outstanding MIPS 2003 workshop, organized in Naples, Italy, by Giorgio Ventre and Roberto Canonico, from the University of Naples Federico II, MIPS 2004 moved to Grenoble, France. Following the great tradition, MIPS 2004 was intended to contribute to scientific, strategic and practical advances in the area of distributed multimedia applications, protocols and intelligent management tools, with emphasis on their provision over novel network architectures. This is undoubtedly a rather broad area, which is confirmed by the large range of topics that were addressed in the submitted (and accepted) papers.

This year the Call for Papers attracted 74 submissions, essentially from Europe and Asia, plus a few contributions from North America, the Middle East, and Africa, for a total of 20 countries. We would like to express our warmest gratitude to all the authors, without whom organizing this event would have been impossible!

Thanks to the outstanding work of the Program Committee and the additional reviewers, 20 full-sized papers and 5 additional short papers were finally accepted, which was not an easy task. Like MIPS 2003, MIPS 2004 remained a highly selective event (33% acceptance ratio, including the short papers) which is the best warrant of a good program quality. Additionally, all accepted papers were carefully shepherded by some members of the Program Committee, in order to warrant a high quality to the papers included in this proceedings. We want to warmly acknowledge the hard and never sufficiently rewarded work done by the Program Committee, the additional reviewers, and the shepherds. Thanks to all of you!

The 25 selected papers were organized into 9 single-track sessions: VoIP and audio transport, video encoding (I and II), multi-source multimedia, multicasting and broadcasting, scheduling schemes, content management, multimedia services and, last but not least, security. This rich program was nonetheless coherent, and many (if not most) papers were written with transmission and networking aspects in mind, which remains, historically, an important field of interest of many contributors and members of the Steering and Program Committees.

The MIPS 2004 workshop featured two half-day, outstanding tutorials. The first one was given by Prof. Vera Goebel and Thomas Plageman, from Oslo University, and was entitled "Data Stream Management Systems (DSMS): Concepts, Prototypes, and Applications." The fundamental difference with a classical database system is the data stream model. Instead of processing a query over a persistent set of data that is stored in advance on disk, queries are performed in

DSMSs over a data stream, with data elements that arrive dynamically and are only available for a limited time period.

The second tutorial was given by Rod Walsh, Toni Paila and Harsh Meta, three leading industrial experts very active in several international standardization organizations, and working at Nokia Corporation, Finland. Their tutorial, entitled "Advances in Mass Media Delivery to Mobiles," gave a state of the art of the current standardization efforts surrounding the area of Mass Media Delivery for mobile devices, in particular at the IETF, 3GPP and DVB. We would like to thank these five tutorial authors for their work and believe that these two tutorials perfectly complemented MIPS technical program.

Finally we would like to express our gratitude to all organizations and companies that supported MIPS 2004 in one way or another: first of all, the INRIA institute that accepted all the financial risks, and managed many technical details thanks to the inestimable help of Daniele Herzog. We would also like to thank the IMAG institute as well as the INPG for their technical and financial support. France Télécom R&D and STMicroelectronics also had a major impact on this event, both from a financial and human aspect. Finally we would like to thank ACM for the confidence they expressed in the quality of this workshop.

We hope all participants really appreciated this workshop and found it useful.

November 2004 Vincent Roca and Franck Rousseau

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MIPS 2004 was organized by INRIA (Institut National de Recherches en Informatique et en Automatique), IMAG (Informatique et Mathematiques Appliquées de Grenoble), and INPG (Institut National Polytechniques de Grenoble), in cooperation with the ACM-SIGCOMM and ACM-SIGMM Special Interest Groups.

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Minimising *Perceived* Latency in Audio-Conferencing Systems over Application-Level Multicast

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Abstract. In this paper, we propose a scalable and dynamically-adapting application-level multicast (ALM) routing protocol, designed specifically for audio-conferencing systems over the Internet.
Currently proposed ALM protocols try to optimise delay for the whole group of participating nodes during construction and maintenance of an overlay network which, when using standard packet flooding, can result in a number of the participants experiencing unacceptably-high latencies, unsuitable for real-time audio communication; whereas we propose to dynamically prioritise routing for those participants who are currently *in* conversation (i.e. those who require the lowest latencies in order to react to conversational cues) and allow higher latencies for participants who simply listen to the conversation without taking an active part in it in that particular moment in time.
Thus, we aim to provide low *perceived* latency for *all* of the audio-conference participants without any support from the underlying network.

1 Introduction

As a result of improvements in computer hardware, research into voice-over-IP (VoIP) technologies, and increased network bandwidth available to the home, point-to-point audio communication can more-or-less be achieved over the Internet, provided that network delay and packet loss do not exceed their tolerable thresholds (see section 2.1).

Group audio communication, on the other hand, has proven more challenging in the way of deployment, scalability, and of communication-channel quality: network-level multicast was proposed over a decade ago [6] as a solution for efficient, large-scale group communication over the Internet, but wide-scale deployment of the service has since been hampered due to various technical and administrative issues that surround it [4]. In response to the lack of a group-communication service in the network, various application-level techniques have been proposed [7].

In application-level multicast (ALM), many-to-many communication is achieved through using overlay trees in one of three ways: (1) a sender floods

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data to their subtree through their children and also sends data to the tree root, who, in turn, floods the data to the rest of the group through its children; (2) a sender floods data to the group through their children and through their tree parent such that data flow is bi-directional on tree links [2]; or (3) several trees are built, rooted at each source, allowing data to be flooded to the whole group by each source as does a single source in one-to-many communication [4].

ALM has been proposed as a solution for audio conferencing [4], however, as an ALM group grows in size there is, inevitably, an increased imbalance in the degrees of latency (end-to-end delay) experienced by different, communicating node pairs within the group such that, and with regard to studies into user tolerance of latency in audio systems [9], a significant number of participant pairs will begin to experience difficulty in communicating with each other due to excessive latency in the audio channel.

In this paper, we consider a dynamic ALM-routing approach over standard flooding as a way to minimise the *perceived* latency experienced by audio-conference participants, drawing from patterns in conversation and from a user's perception of audio-channel quality.

The remainder of this paper is organised as follows: firstly, in section 2, we describe related work which has influenced our design rationale; next, in section 3, we present, in a preliminary study, our own observations of turn-taking in actual samples of conversation, before, in section 4, describing the proposed application-level network audio-conferencing routing protocol (ALNAC). In section 5, we present, through simulation, the effects of the proposed routing protocol on the group and the underlying network. Finally, in section 6 we give concluding remarks on the paper and describe future directions of the presented work.

2 Related Work

In this section, we describe two areas of particular relevance to the proposed work, namely: Internet packet-audio transmission and conversation analysis — the study of conversation.

2.1 Internet Packet-Audio Transmission

In packet-switched networks, audio transmissions are typically subjected to several latency components: sampling, packetisation, pre-processing (silence-suppression and compression), network transmission, network propagation, uncompression, and finally, playout buffering; with network-propagation delay being typically the least-predictable and most-dominant component for audio transmission over the Internet.

An abundance of studies into user tolerance of round-trip latency in audio-communication systems has been conducted and generally agrees upon the following levels of tolerance: excellent, 0–300 ms; good, 300–600 ms; poor, 600–700 ms; and quality becomes unacceptable for round-trip latencies in excess of 700 ms [9].

As latency increases, it is miss-interpreted by the user as extended pause in speech, causing confusion when they fail to get immediate responses from the other user(s); this, in turn, results in their eventual loss of synchronisation with the conversation.

2.2 Conversation Analysis

Conversation analysis is the study of verbal communication between people, with an emphasis on how that communication is structured and on how it is affected by social or cultural settings [10].

An area of conversation analysis of particular relevance to this work is the study of *turn taking*: the basic form of organisation in conversation. In conversation, people naturally organise their spoken contributions (utterances) into turns, where each person silently waits, listening to the current speaker, for their turn to speak [10]. It is also worth noting that overlapping speech occurs rarely in conversation, since one person must remain silent to effectively listen to what another person is saying.

A person will typically wait for a duration of time after the current speaker becomes silent before taking their turn to speak: typically, the pause is one second for Anglo-Saxon English speakers [11].

A large part of verbal communication, among any number of participants, consists of turns that are somehow related to each other, known as *adjacency pairs* [10].

This organisation of conversation turns into adjacency pairs naturally leads to a degree of localisation, where, over a given interval of time, a small proportion of the participants present exchange turns with one another. Figure 1 gives an example of everyday conversation, illustrating localisation of interest through nested adjacency pairs. This localisation property forms the basis of our work.

Neil: Would you like to go out tonight, Jane? (question)
  Jane: Where to? (response and question)
    Neil: The cinema. (response)
      Jane: What film is on tonight? (response and question)
        Neil: "Big", with Tom Hanks. (response)
  Jane: Sounds good, would you like that, Issac? (re-routed to another person)
    Issac: Yes. (response)
  Jane: Yes, I would like that, Neil, if Issac is coming too. (response)
Neil: Right then, lets get ready! (non–adjacency-pair)

Fig. 1. An example of nested adjacency pairs, leading to localisation of interest in natural conversation.