A Characterization of Multi-Party Interactive Multimedia Applications

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Abstract

This document tries to define and characterize a class of applications called Multi-Party Interactive Multimedia (MIM), for which many examples are given. This class includes applications such as CSCW, teleconferencing, and remote education; its consideration in this report is based on the observation that MIM applications are both important and representative for the area of high-performance real-time communication. Purely functional criteria are used to capture the MIM class, i.e. ones that are not related to any particular way of implementation. Thus, future directions are sketched that give some indications on what a network architecture will need to provide, in order to effectively support such applications.

1 Introduction

Among real-time multimedia applications, those requiring (and providing) interaction among a number of parties via a combination of communication media are of great interest to the network research community, because of their particular network support requirements. These applications, which may be called multi-party interactive multimedia (MIM) [8], ask for the availability of a communication system able to efficiently support the amount of data transfer they need, and do so with a client-specified quality of service (QoS). A last but not less important requirement is to provide the clients of such applications with a clear and simple interface to access the services offered by the network, to hide the internal architecture and mechanisms of the communication subsystem. Such services should be specifiable in purely functional terms, i.e. without reference to any particular implementation.

Other proposals have been presented in the literature for the classification of MIM applications from the viewpoint of the support they require from the communication subsystem [2, 7, 9, 10, 11, 13, 14]. In this report we propose a different approach to such classification based on the identification of a set of basic functional characteristics that this class of multimedia applications exhibits. We start from examples in the area of interpersonal communication, to extract a set of attributes we believe to be the most significant for the support of these examples by means of computer-based tools. We focussed our attention on those attributes related to the logical aspects of how the information exchange happens, and were not associated with any assumption on possible implementations over a real-time communication network. However, throughout the report we keep the eventual support by a reasonable network architecture in mind. Starting with a classification based on these attributes, we analyze the scale issue and then present the services that designers and users of MIM will require from a real-time communication system. Finally, we give a brief description of the mechanisms that real-time network protocols should provide to offer such services.

2 Definition of Terms

Due to their origin from interpersonal communication models, multi-party interactive applications have been, in general, rather vaguely defined. To avoid confusion, we start by defining some fundamental terms that will be extensively used in the rest of the paper. The proposed terminology has been derived from the one usually adopted for the definition and characterization of typical patterns in the area of interpersonal communication.

- *Conference*: Even though the term *conference* is generally associated to a specific type of multiparty interaction, we will interchangeably use both terms *MIM application* and *conference* to identify applications involving a number of participants exchanging multimedia data under real-time constraints.

- *Participant*: The parties involved in a conference are called *participants*. Each participant is an addressable network entity related to the conference in at least one point in time. A participant typically is a human being; however, we believe that our classification might be extended to consider also non-human participants, as is the case of some multimedia applications such as teleprogramming [5] and multimedia database access [12]. A basic criterion could be that the participants involved are assumed to be subject to real-time constraints, and are, in some sense, "interactive". Involvement in a conference is understood here in a rather general sense; e.g., it includes related activities taking place either before the conference's starting time or after its conclusion.

- *Role*: The participants relate to the conference by taking certain roles. Each role represents a contribution to the conference itself, its organization, or its management. In our opinion, four basic roles can be distinguished:

  Organizer (or Initiator): A participant who initiates/establishes the conference, decides on invitations, reserves in advance the resources needed to run the conference, specifies security and accessibility requirements, specifies the quality of service requirements (harmonizing them to the characteristics of the expected participants), and is responsible for paying the bill.

  Manager (or Chair): A participant who *runs* the conference, decides admission of late comers, moderates the discussion, makes decisions about the possible restructuring of the conference after admissions and departures, and closes the conference.

  Receiver: A participant who can access the multimedia data produced within the conference.

  Sender: A participant who can produce part of the multimedia data that may be consumed by the receiving participants of the conference.

  Note that a role can be shared by multiple participants. For example, in some case all participants (or a subset) can take the manager's role, effectively making the conference management fully (or partially) distributed.

- *Role Association*: A participant may qualify for multiple roles. In principle, participants may request or give up a role at any point in time. A participant is defined to have a certain role, even if it is not actually playing that particular role all the time. The classification we propose is related to whether a participant is to be allowed to assume a role during its lifetime. If it is, proper communication support must be provided by the network. Of course, certain restrictions might apply, depending on the application's characteristics. For example, the number of participants assuming a certain role and the dynamics of role association may be limited by rules or agreements, explicitly or implicitly accepted by the participants themselves.

- *Media*: Conferences are based on participants communicating through the use of a number of media. To clarify the scope of this document, the following are the media being considered here:

  Motion Video

  Audio

  Still Images

  Image Streams

  Traditional Data, possibly to be distinguished further into:

    Low-Bandwidth, Interactive

    High-Bandwidth, Bulk-Transfer

3 Towards a Functional Characterization of MIM

Multimedia applications, and particularly MIM, show an inherent complexity, derived from the different media they include and the large number of participants they might involve. To define a functional characterization of MIM, we first need a better understanding of the models of interpersonal communication these applications should be able to support.

Below, a classification is proposed for some typical examples of social and professional communication and interaction, based on their attributes that are primarily related to the functional aspects of the information exchange:

- *Model of Interaction*: This issue relates to how interaction may occur among participants. Depending on the ability of a participant to produce and transmit multimedia data, we can identify three different kinds of interactions:

  Dynamic: All the participants are allowed to freely send data without any form of restriction, even though some sort of control is usually implicit for this model of interaction. For example, social (e.g. parliamentary) rules or simply good manners apply to such applications like meetings. However, in this model we assume that no control is enforced by the application. A meeting of executives, a project design session, or an informal gathering of people are typical cases that may be included in this category.

  Static: This is the case when the participants that are allowed to send data are a statically determined subset that will not change through the application's lifetime. As an example, we can consider a public hearing or a musical performance, where only a small number of the participants (i.e. the official speakers and the music players respectively) produce information, while the majority of the attendees can only receive it.

Controlled: The subset of participants allowed to send data can change during the evolution of the application, but such a change is conditioned to the occurrence of conditions or on rules depending on the application itself. In this category fall examples like a course lecture, a seminar, or a