Distributed advance reservation of real-time connections

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Abstract. The ability to reserve real-time connections in advance is essential in all distributed multi-party applications (i.e., applications involving multiple human beings) using a network that controls admissions to provide good quality of service. This paper discusses the requirements of the clients of an advance reservation service, and a distributed design for such a service. The design is described within the context of the Tenet Real-Time Protocol Suite 2, a suite being developed for multi-party communication, which will offer advance reservation capabilities to its clients based on the principles and the mechanisms proposed in the paper. Some simulation results about the performance of these mechanisms are also presented.

1 Introduction

Some of the important multimedia applications of integrated services networks require that advance reservations be possible. The clients who wish to set up multimedia multi-party meetings (i.e., meetings involving multiple human beings) need to schedule those meetings in advance to make sure that all or most of the participants will be able to attend; at the time the meeting is scheduled, they must also be certain that the network connections and the other resources required will be available when needed and for the entire duration of the meeting. Unfortunately, distributed multimedia applications must be supported by real-time communication services, which are to provide the necessary quality-of-service (QoS) guarantees, and these services cannot admit an arbitrary number of connections. Thus, there is no guarantee that the resources for a pre-scheduled meeting will be available at the time the meeting is expected to start, unless they can be reserved in advance. To our knowledge, advance reservation services are not available within any of the existing schemes for real-time communication (see for example [1, 3, 4, 13, 14, 15]).

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This paper presents a scheme for advance reservations of real-time connections. It is organized in the following manner. Section 2 discusses the service requirements for advance reservations. In Section 3, we describe the distributed advance reservations mechanisms we have designed for, and are implementing in, the Tenet Suite 2 [11]. The principles on which our mechanisms are based, however, are easily portable to other approaches and protocols for real-time communication. We also present some simulation results in Section 4.

2 Client requirements

The only true requirement network clients with multi-party applications have, in the area we are investigating here, is that they be allowed to specify in advance their needs in terms of real-time channels, and to obtain a guarantee that the resources for those channels will be available at the future time they have specified. Clients will accept the necessity to reserve channels in advance if they can convince themselves that this is the only way to avoid the risk of partial (or total) rejection of their requests at the time they need to use the network.

The service model in the existing proposals and realizations of real-time communication services, including that in the Tenet Suite 1 [1], assumes that real-time channels are requested (and established) for an indefinite duration. Clients are not asked to specify for how long such channels (to be called immediate channels in the sequel) will be alive, and this non-negligibly simplifies their tasks. The current establishment model, in which channels are to be created immediately (i.e., as soon as possible), coincides with that of a normal telephone call, whose expected duration never has to be specified by the caller.

When advance reservations are introduced into such a service, the provider has to do some planning for future allocations of resources, and this planning would be easier if the expected durations of the channels were known. A limitation of this duration would also allow more clients to reserve channels in advance, thereby increasing the sharing and the utilization of the resources. This modification of the service model for channels reserved in advance (henceforth to be called advance channels) is consistent with the practice of booking other types of facilities, for example, meeting rooms, which may never be reserved for an indefinite amount of time. For this reason, clients should be expected to accept this service model and conform to it without too much difficulty, especially if negotiating an extension of a channel’s duration is sufficiently easy and inexpensive.

The same meeting-room analogy can be used to argue that, if the service provider found it useful to adopt a coarse granularity for time, i.e., to accept