The Multimedia Multicast Channel *

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Abstract. The Multimedia Multicast Channel is a dissemination-oriented communication abstraction providing a service analogous to that of a cable television broadcast channel. A source transmits multimedia information such as video and audio streams onto a channel, and a varying number of receivers "tune in" to the channel to receive a selected set of the streams. To support heterogeneity, each receiver may tailor the selected streams to meet individual needs through the use of filters. The design encourages a very loose coupling between the source and the receivers, promoting open-loop control for the underlying network protocols.

1 Introduction

The Multimedia Multicast Channel (MMC) is a programming abstraction which supports dissemination-oriented communication [4]. The abstraction is analogous to that of a cable television channel: a source transmits onto a specific channel, and receivers which have subscribed to that channel receive media streams (e.g. audio and video) without explicit interactions with the source.

The MMC communication paradigm is a major departure from more traditional ones, in that a source and a set of receivers are very loosely coupled in their control and data exchange interactions. In general, the source's main concern is to push various media streams onto a channel, without emphasis on where they end up (i.e. who the actual receivers are), and how they are used (i.e. what specific receivers will extract from any or all of the streams). A receiver's main concern is what to extract from a channel, which is viewed as offering multiple media streams, some or all of which are of interest.

Perhaps the most unique feature of this communication paradigm is in how it addresses heterogeneity, in particular that it is not unusual for the forms of the

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media streams, generated by the source and required by the different receivers, to be quite different. For example, the source may generate HDTV-quality video and CD-quality audio, whereas some receivers can only use NTSC video and its associated audio, while other receivers can use only audio and no video. Indeed, every receiver may have very different and independent requirements. Therefore, it is expected that the receivers will individually tailor, to a high degree, what streams are actually received. These streams may be a subset of the source streams, or new ones computed from the source streams. The use of component coding at the source to facilitate tailoring is encouraged.

We believe this communication paradigm is highly appropriate for multimedia distribution services required by a large class of multimedia multipoint applications. A prime example is "video distribution" [20, 21, 14], as in cable television systems where a single source generates video (and associated audio) distributed to a large set of receivers who generally have little or no interaction with the source. Another application is video conferencing [3, 10, 24], where each member is both a source and receiver. This application would require a separate MMC per source to support base-level audio-video distribution. However, video conferencing also requires other control mechanisms which are outside the scope of what is provided by the MMC.

More generally, one can distinguish between higher-level application-specific control mechanisms such as floor-control and voting, and lower-level media-oriented control mechanisms such as modifying the resolution, granularity, or intensity of a media stream, and mixing or synchronizing multiple media streams. Media-oriented control does not imply (explicit) control between source and receivers, and is generally useful in most multimedia applications. Consequently, the MMC supports media-oriented control through its filter mechanism. All other required control, particularly application-specific control between source and receivers, is expected to be provided by the application itself (e.g. through the use of libraries/toolkits).

In this paper, we describe the architecture of the MMC. The paper is organized as follows. Section 2 contains a description of MMC concepts. Section 3 describes the programming interface, and Section 4 contains an example of its usage. Section 5 contains a discussion on underlying network support issues, such as how to take advantage of hierarchical coding, and why open-loop control is important for efficiency. In Section 6, we review related work. Finally, in Section 7 we present conclusions.

2 Concepts

Four goals motivate the design of the MMC:

1. dissemination-oriented communication: that which a source sends is transported to multiple receivers.
2. loose-coupling between source and receivers: a channel's source and receivers need not know each others' identities. The channel is the only common object