

Chapter 11

Facilitating Open Source Software and Standards to Assemble a Platform for Networked Music Performance

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ABSTRACT

This chapter presents our efforts towards developing a Networked Music Performance (NMP) system by tailoring and re-using open source software components. The chapter builds on the assumption that NMP and videoconferencing systems share common properties for real-time bidirectional media interaction. It is acknowledged that although NMP is a form of videoconferencing, it is a lot more demanding with respect to efficient distribution of network resources allowing fast and reliable communication of audio and video streams. Initially, an overview of NMP research is provided and the design criteria of NMP system development are clearly delineated. Following, the chapter describes the network protocols involved in videoconferencing. Then, a number of relevant open source software initiatives implementing these protocols are presented and compared for their suitability for NMP system development. Finally, the chapter describes a baseline NMP platform that can serve as a testbed for further research on distributed ensemble performance and remote musical interactions.

INTRODUCTION

Teleconferencing and Voice over IP (VoIP) technologies have a history of more than thirty years now and are being widely used for an abundance of daily communication activities including project meetings, social gatherings, e-learning and so on. They are possibly the most prominent type of groupware in computer supported cooperative work. Besides proprietary software offering synchronous audio and

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video communication (e.g. Skype, Google Talk, MSN, XLite, Polycom software), there are currently a number of open source software initiatives that are available to facilitate in synchronous collaboration among remotely located peers. For example BareSIP, Linphone, Jitsi and sipML5 are some of the currently available soft-phones, while Asterisk and FreeSWITCH present some examples of VoIP servers widely offered under open source licenses.

This chapter focuses on a distinct category of teleconferencing applications, that of Networked Music Performance (NMP). NMP allows remotely located musicians to engage in synchronous music performances using computer networks and dedicated software tools. NMP systems are inherently related to teleconferencing systems, as they are a form of groupware helping musicians to collaborate on developing a musical work. In contrast to conventional teleconferencing, NMP aims at supporting artistic and hence emotional expression. This fact demands for a severely different development methodology that can ensure uninterrupted communication both with respect to technical efficiencies of the communication platform, as well as in terms of the collaboration affordances offered to music performers.

For instance in teleconferencing, delay requirements are dictated by the needs of speech-based human interaction, and are of the order of 150 ms (Wu et al. 2007). Compared to teleconferencing, studies of ensemble performance (Driessen et al. 2011; Chew et al. 2005; Chafe et al. 2004; Schuett 2002), dictate a significantly lower threshold of latency tolerance, which is of the order of 30 ms. This latency threshold is known as *Ensemble Performance Threshold* (EPT). Furthermore, high fidelity audio requirements demand for excessive network bandwidth availability as well as complete elimination of distortions owing to network packet loss. For example in telephony, speech signals are sampled at the rate of 8 kHz with 8 bits per sample, while music quality is generally considered unacceptable when sampled at a rate below 44.1kHz, corresponding to ten times more information in the case of monophonic audio encoded using with 16 bits per sample.

Nevertheless despite these differences, teleconferencing technologies present some interesting features that are not commonly available in existing software infrastructures for NMP. For example, signalling communication protocols, such as the Session Initiation Protocol (SIP), alleviate from a number of problems, including network port and firewall configuration, which may be particularly burdensome when attempting to establish an NMP link. Signalling messages serve the purpose of easing user contact by automatically configuring various connection parameters that are seamless to users. For example, signalling alleviates from the need of knowing each other's IP address and available network ports, overcoming firewall issues such as NAT traversal and automatically configuring media codec parameters. As a result, signalling allows offering user functionalities such as maintaining a list of contacts, showing the availability status of other users (e.g., online, busy, etc.) and initiating audio-visual communications without the need for sophisticated technical configurations. Signalling is mostly used in videoconferencing systems, but has also been considered in the context of NMP research (e.g. Lazzaro & Wawrzynek 2001). On the other hand, it is important to acknowledge that user functionalities offered by signalling protocols have significantly contributed to the widespread use of teleconferencing software in our daily lives.

The objective of this chapter is to investigate the perspective of tailoring open source software components (i.e. both clients and servers) for teleconferencing applications, so as to accommodate the requirements of NMP. The remaining part of this chapter is structured as follows: The next section presents a short overview of early experimental attempts and current progress in NMP research. The section that follows discusses fundamental issues that need to be taken into consideration when developing a NMP system. This concerns software applications, architectural topologies and issues that are inherently related to computer network communications. Then, the subsequent section provides an overview of

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