

**Distributed Algorithms and Protocols for Scalable Internet
Telephony**

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ABSTRACT

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Internet telephony service is defined as the provision of real-time, interactive, multimedia telecommunications services between human users, using the public Internet.

The most difficult problem in providing Internet telephony is to overcome the increased jitter, delay, and loss (as compared to circuit-switched networks) suffered by voice. Past work has separately investigated Forward Error Correction (FEC) and playout buffer adaptation mechanisms to resolve these problems. We show that these mechanisms must be considered jointly. We propose and simulate a number of algorithms for integrating FEC into playout buffer adaptation schemes, and show that they are superior to non-integrated algorithms.

Receiving feedback about network transport quality is essential for supporting adaptive applications. We examine the issues surrounding scalability of transport feedback in large scale multicast groups. We present, analyze, and simulate a class of algorithms termed reconsideration, which support congestion controlled feedback in highly dynamic groups, and then show how the memory requirements of our algorithms can be reduced.

We consider signaling protocols for providing call establishment, management, features, and applications. After an analysis of existing Internet telephony signaling protocols, we propose a new protocol, the Session Initiation Protocol (SIP), which overcomes the limitations of existing protocols. We describe an implementation of this protocol in software, and discuss applications we have built with it.

We consider interconnection with the telephone network, and focus on the problem of

discovery of telephony gateways. We show that this is a subset of a broader wide area service discovery problem. After reviewing existing protocols for resource discovery (and finding them lacking for wide area applications), we present a scalable protocol for wide area service discovery, which is ideal for discovery of gateways, amongst other resources.

Finally, we consider the problem of a service architecture for Internet telephony, which provides features and complex applications to users. We review the service architectures that have been presented in the literature. We then propose our architecture, the application component architecture, which combines the best aspects of existing work. We show how this architecture can be used to provide several complex applications.