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Architecture Design of P2PSIP System

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P2PSIP (Peer-to-Peer Session Initiation Protocol) is proposed to construct fully distributed signaling architecture for multimedia communication systems. Instead of centralized SIP servers, P2PSIP overlays utilize distributed and dynamic nodes to support location and storage services. So far various design alternatives of overlay architectures have been proposed to describe the mechanism about how the user nodes are connected together to form an application layer topology.

However, there appears to have been little research work on comprehensively comparing the performance properties of various P2PSIP architectures, and no study has been made to investigate how to select appropriate overlay architecture according to application requirements. In this paper, we investigate various P2PSIP architectures and compare their features mainly from the perspective of application performance. The query latency of overlay and call setup delay of SIP sessions are modeled as significant performance considerations for selection of suitable architecture for different usage scenarios.

First, we comprehensively analyze implementations of P2PSIP architecture. Four typical P2PSIP architectures are described in detail: pure DHT, DHT-based SIP server farm, P2PSIP overlay formed by super nodes, and hierarchical P2PSIP overlay. Furthermore, we classify the nodes into peer and client according to their roles in the architecture. Then the performance model of query latency and call setup delay for P2PSIP overlay architectures is proposed. Several parameters to present features of the overlay architectures are defined. The analysis primarily focuses on the impact of possibility of packet loss caused by link error or network congestion and churn of overlay. Finally, an event-driven chord-based simulation to evaluate query latency and call setup delay for different P2PSIP architectures is developed.

An analytical model and simulation showed that the average call setup delay is less than ten seconds for all the architectures, which could satisfy the requirements of multimedia session establishments in most cases. We advocate that the super node or hierarchical architecture might be appropriate options rather than pure DHT in terms of latency performance in heterogeneous network environments. The server farm approach is good at management as well as performance, which might be the best option for systems supported by service providers.

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