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SIP-based Qos support architecture and session management in a combined IntServ and DiffServ networks ☆

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Abstract

With the development of next-generation convergence networks, the Internet needs to support new network architecture and session management methods that can support various applications requiring differentiated traffic processing and high quality of services, instead of the conventional best-effort service. In next-generation networks based on all-IP, it is expected that SIP will play an important role in session establishment between end-to-end user terminals. Accordingly, this paper proposes a new QoS support SIP-based network architecture that integrates SIP clients, QoS-enabled SIP servers, and policy-based network management in a combined IntServ and DiffServ networks. To control the network access of users and manage network resources, the use of policy servers and QoS extended SIP signaling is presented. Numerical analysis is then used to derive the session establishment delay for the proposed signaling scenarios. Simulations under various environments show appropriate parameter ranges in terms of the server capacity and number of users for the required delay bounds.

Keywords: SIP; QoS; Policy-based network; IntServ; DiffServ; RSVP

1. Introduction

The Internet is currently being extending from a traditional simple network for voice or message services to an integrated service network providing multimedia services, such as voice and image, video streaming, and web-applications. Thus, next-generation all-IP-based networks need a new type of network structure that can support various applications requiring differentiated traffic processing and high quality of service (QoS) among end-to-end user terminals. In addition, a new session establishment signaling method is needed for access control in accordance with the service level agreement (SLA) and for resource reservation to guarantee seamless QoS connections.

Session Initiation Protocol (SIP) [1] is an important and evolving protocol, which provides text-based signaling that can be easily adapted to establish, maintain, change, and tear-down multimedia sessions between two end-points or more, and has recently received a lot of attention from the Internet Engineering Task Force (IETF), making it a promising signaling protocol for present day and future IP-based wired and wireless multimedia services. However, many problems still remain as regards providing services for multimedia applications. Quality of service is an essential technology that should be supported over networks. As such, there is much interest in the Internet community on how to automate the process of resource allocation at the time of subscription, during the call setup process, or at the data transfer time. Two architectural models for IP QoS have already been proposed by the IETF [2]: Integrated Services (IntServ) and Differentiated Services (DiffServ). The IntServ model includes the definition of a signaling mechanism and admission control framework. The QoS clients use an RSVP (Resource Reservation Protocol) to express their QoS requests to the network. The network is then able to properly fulfill the QoS requests using a

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clearly defined admission control framework. Yet, the scalability issues related to the IntServ model mean the DiffServ model is preferable for the development of IP QoS in core networks. In the DiffServ architecture, networks differentiate the QoS per class based on suitable per hop behavior (PHB), rather than per flow as in IntServ. Currently, the resource handling in DiffServ is based on a semi-static assignment of resources to a QoS client according to long-term agreements (e.g., SLA) between the customer and the network provider or based on a dynamic reconfiguration using a bandwidth broker (BB).

Accordingly, based on the goal of providing a seamless inter-operation between the user's QoS demands, the call setup SIP signaling protocol, the policy-based network management schemes, the network's resource and QoS management models, and the router configuration, this paper proposes a new SIP-based network architecture that can integrate the call setup SIP signaling with the IntServ RSVP protocol in the access network and the DiffServ PHB in the core network. In addition, a policy-based network (PBN) architecture is also proposed with local and core policy servers that are closely coupled with the QoS-enabled SIP signaling and IntServ/DiffServ QoS model. Finally, for QoS session management, including session establishment and QoS renegotiation, an extended QoS support Session Description Protocol (SDP) is presented.

The rest of this paper is organized as follows: Section 2 presents a general outline of the SIP protocol and the previously proposed network structure for session establishment and session management. Section 3 then outlines the proposed QoS support extended SIP-based network architecture and session establishment methods, while Section 4 provides various signaling scenarios including new SDP attributes and syntax for the proposed QoS support SIP and policy server-based network structure. Section 5 derives the delay bound for the proposed method using a numerical analysis, and some final conclusions are given in Section 6.

2. Related work

Since the IntServ model provides more strict guarantees for bandwidth reservations for a single flow, it would seem to be the best reference model for IP telephony services. Therefore, there has been some consideration of the interaction of QoS signaling (i.e., RSVP) and the SIP protocol in previous literature. In [3], RSVP-enabled SIP terminals start an RSVP-based bandwidth reservation during an SIP call setup. All routers in networks are IntServ-aware and perform per flow bandwidth reservation and packet scheduling. Fig. 1 shows the SIP/RSVP signaling procedure for a call setup between two SIP/RSVP-aware user agents, which includes mechanisms, called preconditions, that must be met before session establishment has been completed. [3] provides the first well-defined proposal to integrate Internet QoS and SIP signaling, yet the main disadvantage of this approach is that it suffers from a scalability problem. Meanwhile, [4] proposes a network based on SIP over MPLS (Multi-Protocol Label Switching), where a network architecture that adopts the SIP protocol as the signaling to set up a call and MPLS as the core network forwarding mechanism is identified. In [5], a network architecture is proposed for an IP-based access network for residential users that effectively integrates SIP signaling, RSVP, QoS policy management, and AAA (authentication, authorization, and accounting) mechanisms using a COPS (Common Open Policy Service) [6] protocol.

To reduce the signaling complexity of client terminals, Papalilo et. al. proposed an extended SIP for QoS support [7] in which they eliminated the need for QoS support at the user terminal. As such, all the QoS related functions are moved to the SIP servers that control both the call setup

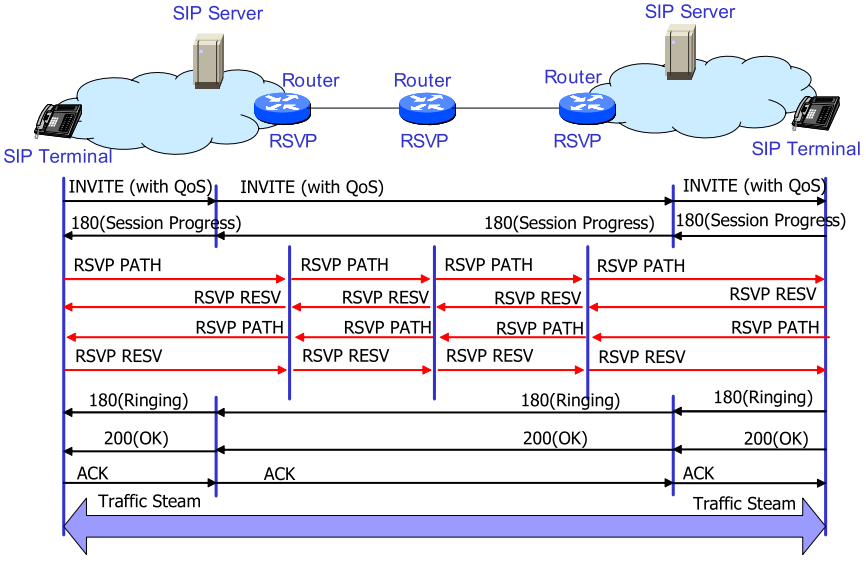

Fig. 1. SIP/RSVP network architecture and call setup signaling flow.