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A HARDWARE SIGNALING PARADIGM FOR FINE-GRAINED RESOURCE RESERVATION

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ABSTRACT

Current implementation of real time service quality within converged IP networks is mainly accomplished by over-provisioning of bandwidth with limited definition of traffic classes on a network wide basis possibly enhanced by quasi-static provisioning of network elements using traffic engineering. Per-flow on-demand resource reservation is mostly unavailable in large packet networks. Examples are establishments of switched VC using PNNI signaling in ATM and establishment of LSPs using RSVP signaling in MPLS supported networks. Management complexities and limited scalability slow down this trend. While per-flow reservation is a conceptually straightforward QoS solution it is usually looked at as an impractical, non-scalable and even a higher cost solution.

Today high-end routers and switches can handle traffic volumes of many hundreds gigabit and even terabits per seconds, which can be translated to millions of simultaneous voice and video connections. However, current-signaling technologies will enable to handle only several hundreds connections that can be translated to only few thousands simultaneous short lived connections. Clearly, today call establishment mechanisms cannot scale to support per-flow reservation that is conceptually a simple QoS solution. In order to solve this limitation, there is an on-going effort to reduce the required reservation rate by developing complex hierarchical aggregation schemes and multiplexing concepts. This limits the use of connection establishment signaling to aggregate traffic engineering, which is hard to define, understand and manage and may fail to provide a required QoS solution.

This work (based on unpublished thesis [1]) is first to examine the possible solution of the above scalability problems for IP signaling by implementing them in hardware. We present a novel design termed "Keep-It-Simple" Signaling (*KISS*) which is optimized for hardware signaling of unicast connections which dominate the present world of real time services. We show, that backbone routers, can process by hardware *KISS* messages to improve their connection establishment capabilities to a level where fine grain user application-initiated resource reservations is feasible. Such hardware signaling may deliver the missing component to fulfill full QoS support in large IP networks.

1. INTRODUCTION

Despite a tremendous growth in Internet traffic, capacity and services, QoS support is still missing in the global Internet and is highly limited at smaller installments like corporate WANs. Therefore, high-quality real time services such as voice and video conferencing, VOD and real time Webcast are not currently deployed in large scale. Traditional network technologies offer few distinctive services. The IP network architecture offers scalable datagram connectivity, good resource utilization and a reasonable support of few prioritized best effort QoS classes. This fits well the bursty nature of computer communication and data services but is sub-optimal for many potential real-time applications. The circuit-switch telephone network, offers global connectivity as well as real-time QoS capabilities but is inefficient for supporting bursty or short transactions. It presents long connection setup time and a limited number of QoS services. The goal of future converged networks is to introduce a single infrastructure that offers the global connectivity and efficiency of the Internet as well as a rich array of QoS and real-time capabilities starting from established services such as peer to peer telephony, voice and video conferencing, video on demand (VOD) and on-demand bandwidth dialup for access and peer to peer connectivity. A known way to assure that connections quality meets a desired level using limited bandwidth resources is connection based network resource reservation. Given the emerging trend of rich-media, livecast and on-demand high bandwidth services such capabilities may become critical to broadband networks and providers. Current support of real time service quality in converged networks is accomplished by bandwidth over-provisioning and