# ITR: Scalable Edge Router for Differentiated Services Networks

## Project Summary

The proliferation of multimedia applications and high speed networks increase the demand for high quality of service (QoS) and congestion control in the Internet. Poor network performance by excessive delays and losses experienced by the users' applications are not acceptable. Internet security lapses have cost U.S. corporations 5.7 percent of their annual revenue, as reported by economist Frank Bernhard from University of California at Davis [15]. To improve the QoS, we focus on congestion and unfairness in network resource allocation problem. Proper traffic conditioning (marking, shaping) with unresponsive flow control can solve the congestion and unfairness problem. Continuous monitoring of network activity is required to maintain confidence in the security of networks with QoS support. These solutions have to be scalable otherwise it will not be deployable in the heterogeneous Internet.

This research studies and designs coordinated traffic conditioning, network monitoring, flow control, and provisioning the network properly to meet the demands for data and multimedia traffic in various applications. Proper network provisioning plays a vital role to provide QoS by the providers as promised to the users. We propose to design edge routers component to monitor the network from any service level agreement (SLA) violation and bandwidth theft attack. Users can inject excessive and illegitimate traffic from several different entry points to create distributed denial of service (DoS) attacks. This network monitoring scheme involves only edge routers. The conditioner and flow control components alleviate the congestion and unfairness in the resources allocation problem. The edge routers share the congestion information with upstream routers to save resources wastage in the downstream domains. Designing a scalable edge router is a challenging research task because all of the components of an edge router should not use excessive per-flow information and can not involve core routers. We follow this principle in designing edge routers to achieve scalability. We propose to solve the following research problems and evaluate them using analytical models as well as through a series of experiments.

1. For the edge router, we determine the optimal traffic assignments rate for each traffic class and weight assignments at the queue to maximize the profit for the service provider of a network domain. Proper provisioning is necessary to provide service level agreement bounds such as throughput, delay, and loss for each user.

2. To ensure all flows are getting their share of SLA, the flows of a network domain needs to be monitored for possible SLA violation and bandwidth theft attack. We define and employ throughput, delay, packet loss, and security as QoS parameters for the design of an edge-to-edge SLA monitoring scheme to detect service violations and attacks especially denial of service (DoS) attacks.

3. The traffic conditioners at the edge routers should intelligently mark and shape packets differentially based on the class parameters and according to network state. Our conditioner will use flow characteristics to provide better resource utilization and improve the application level quality of service.

4. We design edge routers that detect and regulate unresponsive flows that cause poor performance for adaptive flows such as TCP, which retreats during congestion. The ingress (entry) edge routers propagate the congestion information to the egress (exit) routers of previous upstream network domain to reduce the resource wastage at the downstream network due to undelivered packets.

Th adaptive and scalable edge routers have promise in providing high data throughput, low delay and loss for current and emerging multimedia applications such as IP Telephony, media services distribution over the Internet. Using simulation, we plan to evaluate the edge router for data extensive applications such as large FTP and delay sensitive applications such as Telnet and WWW traffic. An important part of this work involves prototyping, simulation, experimental studies, and collaboration with Nortel Networks, IBM, CISCO, and Internet Engineering Task Force (IETF) to shape the direction of protocol standards in this area.