Performance Analysis of MPLS TE Queues for QoS Routing

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Traffic engineering (TE) refers to techniques and processes to route traffic through a network on a path other than that would have been chosen if standard routing methods had been used. Multi-Protocol Label Switching (MPLS) is an advanced forwarding scheme which extend routing with respect to packet forwarding and path controlling. MPLS TE provides a technique, more elegant and efficient than IP source routing, to allow traffic travel down a path different from conventional IGP destination based hop-by-hop routing. The path is pre-determined at tunnel setup time. The tunnel explicit routing capability allows routing flexibility.

In this paper we investigate the idea of creating TE queues for configured MPLS TE tunnels in every router the tunnel traverses. Traffic in TE tunnels can be preferentially treated by a router's queuing and congestion avoidance mechanism. A TE queue, which can be shared by multiple TE tunnels, is to be created at tunnel set up time based on the MPLS labels and bandwidth request associated with the tunnel. The bandwidth reserved for each queue is to be set according to the bandwidth of configured tunnels sharing the same queue. We assume both input queues and output queues are implemented in the router, and tunnels with the same head end will share the same input queue, while tunnels with the same tail end will share the same output queue. When a packet is received, a router will determine whether the packet is label switched and whether the label is assigned for a TE tunnel. The packet forwarded via a tunnel will be sent into the appropriate input TE queue based on the incoming label. The router will consult its label-forwarding database to determine its outgoing label. The packet will then be label switched to the appropriate output interface based on the router's scheduling mechanism for input TE queues, and be put into an appropriate output TE queue based on its outgoing label. Then the packet will be forwarded to the next hop based on the router's scheduling mechanism for output TE queues. Because tunnels are envisioned for high priority and demanding traffic only in this paper, it is recommended TE queues assume scheduling priority over all other non-TE queues.

Simulated and analysis performances of the MPLS switching with TE queues are presented. In this paper we only consider the process from the time packets enter output TE queues to the time they are forwarded to the next hop. We assume that each traffic source can be modeled as a continuous-time Markov process and analyze and simulate the system as a Generalized Processor Sharing (GPS) system. Three cases are considered: (1) all traffic share one queue, (2) all TE traffic share one TE queue and non-TE traffic goes to the non-TE queue, and (3) each TE source traffic goes to its own TE queue and non-TE traffic goes to the non-TE queue. According to our simulation and analytical results, with the selected system parameters, using TE queue leads to lower overflow probabilities for TE tunnel traffic, and using multiple TE queues can further improve the service of TE tunnel traffic. In our future work, more complicate system model and traffic model will be considered by analysis and simulation.