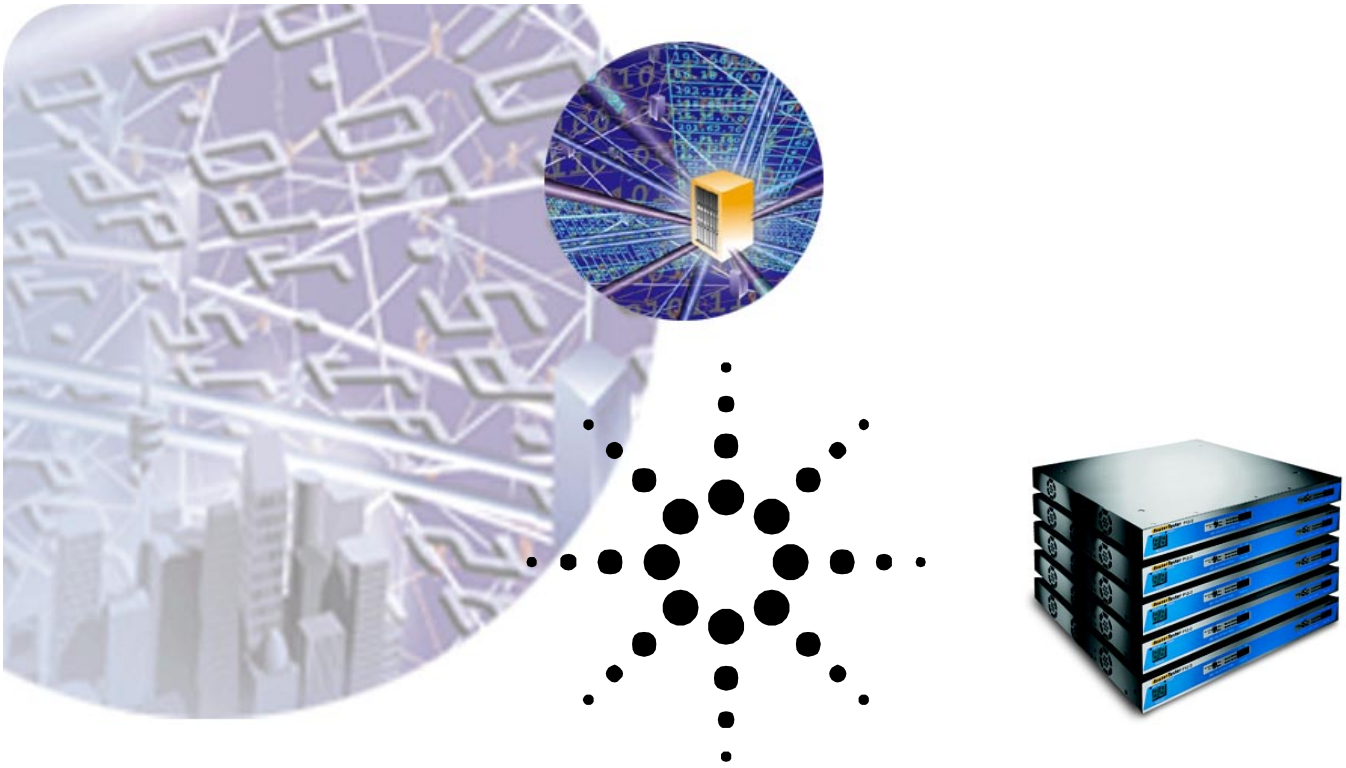

Multi Protocol Label Switching

Agilent Technologies RouterTester Application Note

Introduction

Multi Protocol Label Switching (MPLS) is a connection-oriented technology that offers unique traffic engineering capabilities that can improve network usage. As shown in Figure 1, under conventional routing, IP traffic follows the 'shortest hop' path through a network. In this scenario, best effort traffic tends to congregate upon a small number of links, causing subsets of network resources to become over-utilized while others remain underutilized. MPLS can be used to improve IP routing efficiency by moving traffic flows away from the shortest path determined by conventional routing, and onto less congested paths through the network.

MPLS adds a label with explicit switching information to each packet, enabling the packet to be switched along a pre-defined "label switched path" (LSP) through an MPLS network. Intermediate routers along this LSP are called Label Switch Routers (LSRs). Throughout the interior of the MPLS domain, LSRs use the labels attached to packets to make forwarding decisions, usually without recourse to the original packet headers. LSRs maintain a forwarding table that maps incoming

label prefixes to outgoing ports. As shown in Figure 1, at each LSR along the LSP, the label is used to forward the packet to the next hop. Labels are unique per individual link, and thus need to be mapped (or "swapped") at each node within the MPLS network. In order to transmit a labeled packet on a particular data link, an LSR must support an encoding technique which, given a label stack and a network layer packet, produces a labeled packet.

The traffic paths followed by normally routed and labeled traffic are not mutually exclusive; LSRs are responsible for the efficient forwarding of both normally routed and labeled traffic. This means that an LSR will use different forwarding tables depending on whether it is processing a normally routed or labeled packet. MPLS requires LSRs to simultaneously manage multiple forwarding tables (often on each interface), and this management complexity can have a direct impact on a router's ability to forward both labeled and normally routed traffic. MPLS is a relatively new technology, and the label forwarding capabilities and limitations of LSRs routers must be ascertained prior to network deployment.

Testing MPLS Forwarding Using RouterTester

RouterTester tests the MPLS forwarding capabilities of a router by generating wire-speed labeled traffic into the router, and then measuring in real-time the router's ability to efficiently forward traffic from the appropriate output interfaces. By generating normally routed traffic into the router at the same time as the labeled traffic, the router's ability to effectively manage both traffic types can be determined.

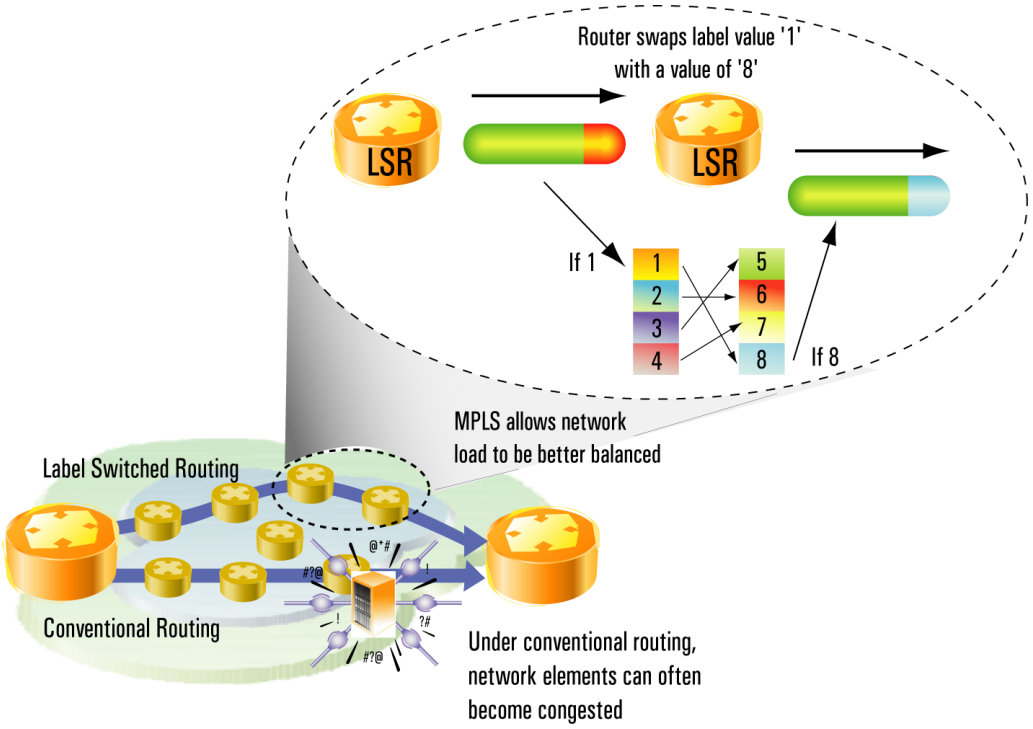

Figure 1: Routing efficiency — label values are individual per link

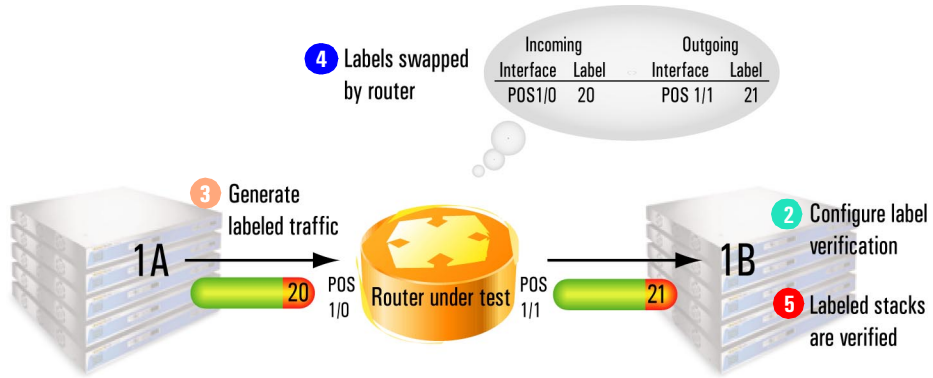

Figure 2: Testing MPLS forwarding capabilities

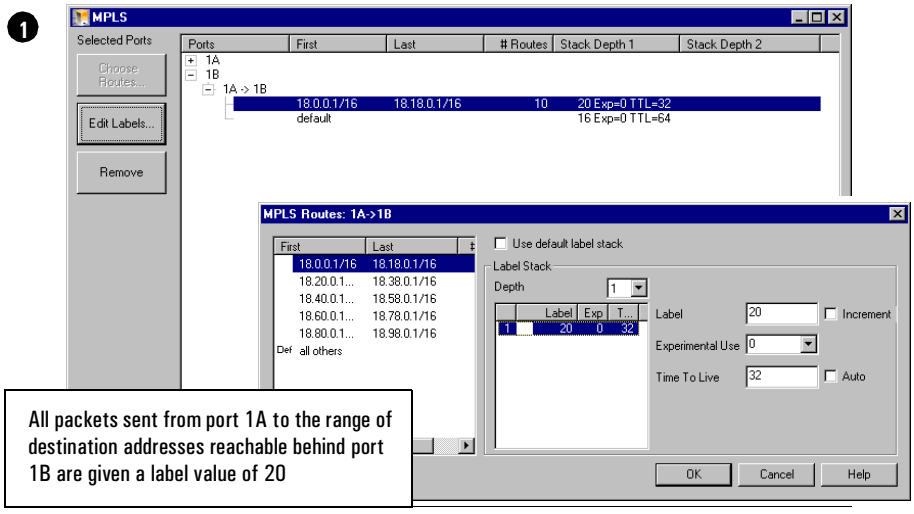

Figure 3: Configure labelled traffic

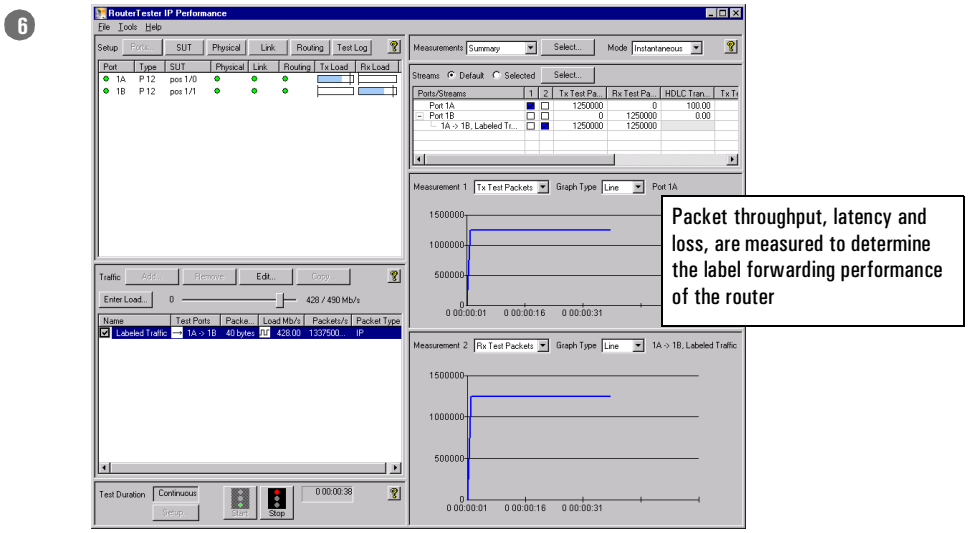

Figure 4: Performance measurements

Basic test steps

1. As shown in Figure 3, traffic being sent from port 1A to port 1B on RouterTester is configured with a label value of 20. (The router is configured to swap label values of 20 to a value of 21.)
2. Port 1B is configured to verify that packets sent from port 1A are received with a label value of 21.
3. Labeled traffic is generated from port 1A to port 1B.
4. The router under test swaps the labels with a value of 20 to a value of 21.
5. Port 1B verifies that the received label stacks are correct by comparing the number of labeled packets (value 21) that were expected to be received (see step 2) with the number of labeled packets (value 21) that are actually received.
6. As shown in Figure 4, throughput, latency and loss metrics for the labeled traffic are measured in real-time, revealing the label forwarding performance capabilities of the router under test.

   By varying the number of labeled streams generated through the router under test, and adding normally routed traffic streams to this test scenerio, the router's ability to simultaneously manage normally routed and labeled traffic can be determined.

Agilent Technologies RouterTester

RouterTester provides true Internet-scale testing through realistic routing protocol support, multi-stream wire-speed traffic generation and real-time analysis, and multi-port scalability. RouterTester is set to grow as the testing needs of the carrier class router industry evolve to meet the challenges of scale and Quality of Service within the Internet.

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