MPLS Fast Reroute Time

Agilent Technologies RouterTester
Application Note

As the Internet evolves to become an alternative to the existing telephony network for real-time and delay sensitive traffic, carrier class routers reliability in the emerging Internet becomes ever more important. One aspect of this reliability is the ability of the network to robustly handle link or equipment failures cleanly. SONET equipment in the telephony network has handled this in the past using redundant rings. In the emerging Internet a scheme is required to provide a similar level of reliability without requiring redundant links and potentially without SONET equipment. This is where the MPLS "Fast Reroute" feature comes in.

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Multiprotocol Label Switching "fast reroute" feature

MPLS Fast Reroute provides a mechanism for automatically rerouting traffic on an LSP if a node or link in the LSP fails. Fast rerouting is accomplished by pre-computing and pre-establishing a number of "protection LSPs" between the source and destination routers. Each link or node in an MPLS network can be protected via a protection LSP. This LSP provides an alternative path (detour) for the data being sent through primary LSPs that pass through the link or node should there be a failure. The LSP acts as a temporary tunnel through which all of the affected LSPs can be routed. The fail-over mechanisms are triggered by physical link or routing events that indicate that the link or node is down. In theory, a router should be able to reroute packets immediately after receiving the event. Ideally there should be no packet loss or interrupted services during the switchover. As shown in figure 1, protection LSPs is to safeguard the LSP between router A and router E. Each protection LSP might traverse through one or more LSRs that are not shown in the figure.

Service Providers are concerned with making their networks as robust and reliable as possible. Router and switch vendors will try and differentiate themselves based on how effective their fast reroute behavior is.

It is extremely important that the flow of labeled traffic is not disrupted when an LSP is being rerouted. Labeled traffic must be successfully transferred across a new LSP with minimal increase in latency or packet loss
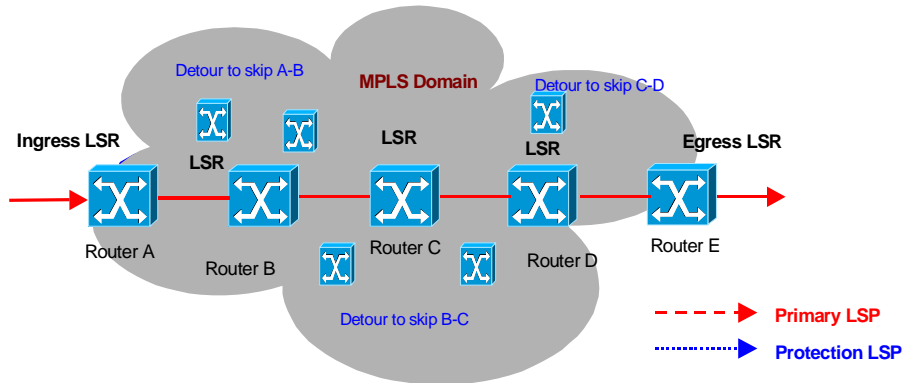

Figure 1: Detours established for an LSP using fast reroute

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Fast reroute time test

The Agilent Technologies RouterTester generates RSVP-TE signaling messages that support the establishment of LSP tunnels. RouterTester has the ability to simulate link or router failure. RouterTester also simulates a complete OSPF network topology behind the SUT.

In the following section we will examine how RouterTester measures the performance of the SUT during the RSVP-TE LSP tunnel fast reroute process, including the reroute time and packet loss.

Procedure: The SUT establishes a primary LSP to a simulated router (behind RouterTester port 1A), as shown in figure 2. The SUT sends an RSVP PATH message to the simulated router and in response to the PATH messages, port 1A sends an RSVP RESV messages to the SUT. At the same time as the primary LSP tunnel is being established, the fast-reroute feature on the SUT automatically opens a 'protection' LSP through a different interface connecting to an alternative egress simulated router (RouterTester port 1B in this case).

A second simulated router (RouterTester port 2A) then generates data traffic to the SUT, which in turn forwards packets through the primary LSP tunnel. Port 1A verifies receiving the packets with the correct labels. To exercise the fast re-route features, a link failure is initiated on the primary LSP tunnel. The SUT performs the fast reroute process and directs the traffic flow to the backup LSP tunnel. RouterTester measures the time it takes the router to redirect the traffic, and whether any packets were loss in this transition.

Test Challenges

Based on the complexity of the MPLS fast reroute feature, a number of test challenges come to light. When a link or router failure occurs on the primary LSP tunnel, routers should reroute the data traffic over to the protection LSP tunnel. High performance routers are expected to perform this process-intense calculation with no packet loss while maintaining wire rate throughput for forwarding traffic.

It is also important that the reroute time should be minimal with the data traffic being moved seamlessly to the backup LSP tunnel. The reroute time is the time it takes the router to reroute traffic to the backup LSP tunnel. The reroute time and the packet loss, if any, should be measured during the reroute process.

Measuring the effectiveness of a gigabit/terabit router's reroute process requires a tester that can generate and support MPLS signaling protocol (RSVP-TE or CR-LDP) to establish LSP tunnels. Data traffic must be sent across the same interface as signaling messages in order to exercise the LSP functionality and operation on the router. Also, to successfully measure the reroute time requires the ability to simulate link or router failure along the LSP tunnel path.

The operation of MPLS protocols such as RSVP-TE and CR-LDP relies on the internal gateway routing protocol (IGP). Hence, support for at least one of the IGP protocols (such as Open Shortest Path First (OSPF), or intermediate-system-to-intermediate-system (IS-IS)) and the ability to accurately simulate IGP topology is necessary in order to effectively test the MPLS capabilities and features of high performance gigabit/terabit routers.

IGP topology simulation is the ability to emulate a complete network behind the SUT to create 'multi-hop' LSP tunnels (see figure 2), which places more stress on the router than a single-hop LSP tunnel.

5 easy steps to achieve fast reroute time test:

1. After an OSPF topology is simulated behind RouterTester ports 1A and 1B (as shown in figure 2 and 3). (Note figure 4 shows how to connect port 1B to the simulated 'destination' router). The SUT signals establishment of the primary LSP tunnel to port 1A by sending an RSVP PATH message. Port 1A sends an RSVP RESV message back to the SUT. A sample configuration for Cisco and Juniper routers that accommodates the test is shown in figure 6.

2. The SUT is configured with the fast reroute option enabled. The SUT signals the establishment of a 'protection' LSP as a backup to the primary LSP. The SUT sends an RSVP PATH message to port 1B. Figure 5 shows how to enable both port 1A and 1B to establish RSVP session with the SUT.

3. Port 2A sends IP data traffic to the SUT, which in turn pushes labels and forwards the packets on the primary LSP tunnel and Port 1A verifies receiving the packets with the correct labels.

4. A link/router failure is initiated on RouterTester port 1A. The SUT performs the fast reroute process and redirects data traffic to port 1B (the backup LSP tunnel).

5. Performance metrics for traffic arriving at port 1A and 1B are compared to measure how quickly the router redirects traffic to the backup LSP tunnel
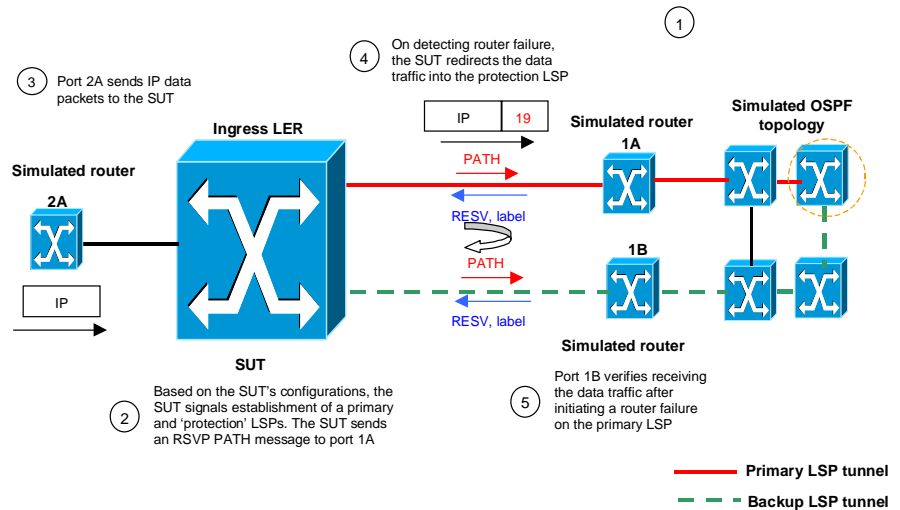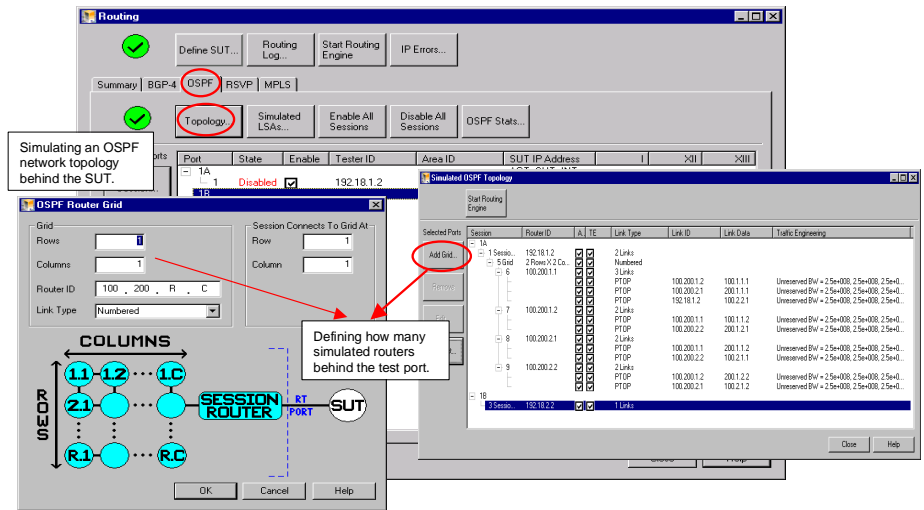
Figure 2: Fast reroute time test scenario

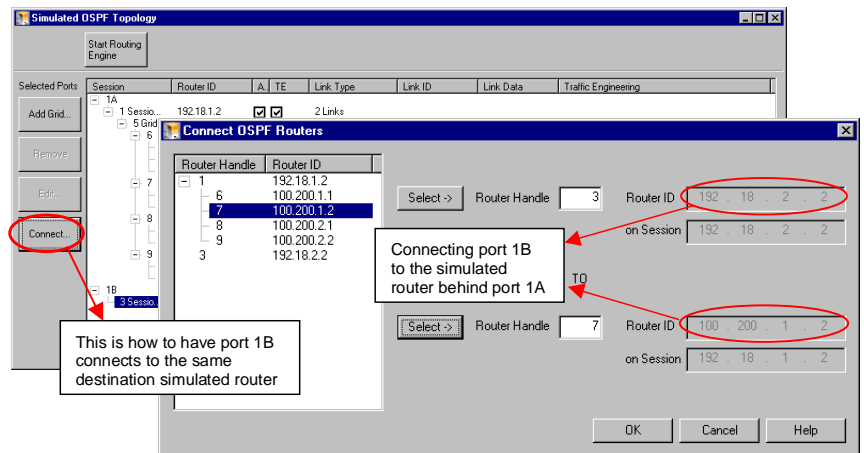**Figure 3:** Adding a simulated OSPF network topology.

Figure 4: How to get port 1B to connect to the same destination simulated router as port 1A

Figure 5: Adding RSVP sessions
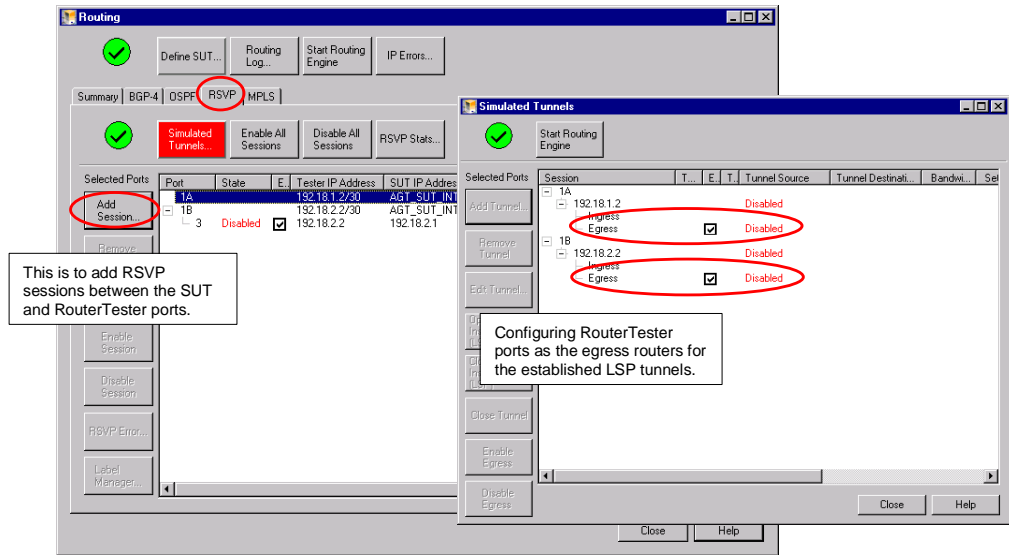
```
protocols{
      rsvp{
             interface so-0/0/0;
      }
      mpls{
             label-switched-path to_rt_1A{
                    to 100.200.1.2;
                    fast-reroute;
             }
      interface all;
      }
`
```

```
!
interface Tunnel1
 ip unnumbered Loopback0
 no ip directed-broadcast
 tunnel destination 100.200.1.2
 tunnel mode mpls traffic-eng
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 7 7
 tunnel mpls traffic-eng bandwidth  100
 tunnel mpls traffic-eng path-option 1 explicit name to-1A
 tunnel mpls traffic-eng fast-reroute
```

Figure 6: Sample configuration for Juniper and Cisco routers

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Agilent IP Routing Test Solution

Agilent's IP Routing Test Solution product family includes Agilent QA Robot and Agilent RouterTester and the test software that runs on these platforms. The QA Robot provides all basic IP routing test capabilities, plus conformance, stress and functional testing. The RouterTester is enhanced with wire-speed traffic generation that enables comprehensive performance metrics and integrated routing protocol support..

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