iLAB MPLS Interoperability Tests Event

Case Study

About iLabs

iLabs demonstrates the latest solutions to real engineering challenges in a live, vendor-neutral, standard-based arena. One of the focus areas of iLabs spring 2001 was Multiprotocol Label Switching (MPLS). The iLabs is built with the cooperation of vendor companies, and expert engineers in their fields.

How service providers can benefit from iLabs

Open standards such as MPLS provide advanced IP services and capabilities.

iLabs aims to reveal interoperability issues that are key to the deployment of new technologies, such as MPLS.

The Event

iLabs MPLS Interoperability tests event. Networld + Interop Trade Show, Las Vegas, USA, May 8th - May 10th, 2001

The participating vendors

- Cisco
- Juniper
- Foundry
- Extreme
- Riverstone
- Laurel Networks
- Alcatel
- Nortel
- CoSine
- Unishpere

A number of independent test vendors were present at the MPLS iLabs event. This case study focuses on the contributions made by Agilent Technologies.

Objectives of this event

The iLabs MPLS interoperability tests event explored some of the interoperability issues associated with MPLS and demonstrated the latest solutions from leading MPLS vendors.

The tests conducted looked at the following issues:

Do MPLS enabled devices from independent vendors interoperate?

Is it possible to establish RSVP label switched paths (LSPs) through a multi-vendor network?

Can IGP routes be successfully learned and IBGP sessions set up by the edge routers of a multi-vendor network?

If IGP sessions can be successfully established over multi-vendor networks, can RVSP LSPs be established using that information.?

Do MPLS enabled devices from independent vendors interoperate?

The Test Bed

The test bed consisted of interconnected equipment from all participating vendors. The result was a multi-vendor autonomous network topology depicted in Figure 1 below.

Agilent's RouterTester was used to provide RSVP-TE signaling protocol and OSPF-TE routing protocol emulation and test capabilities. Agilent RouterTester was chosen to perform the basic MPLS functionality tests as well as the more complex MPLS traffic engineering tests required for the iLabs tests.

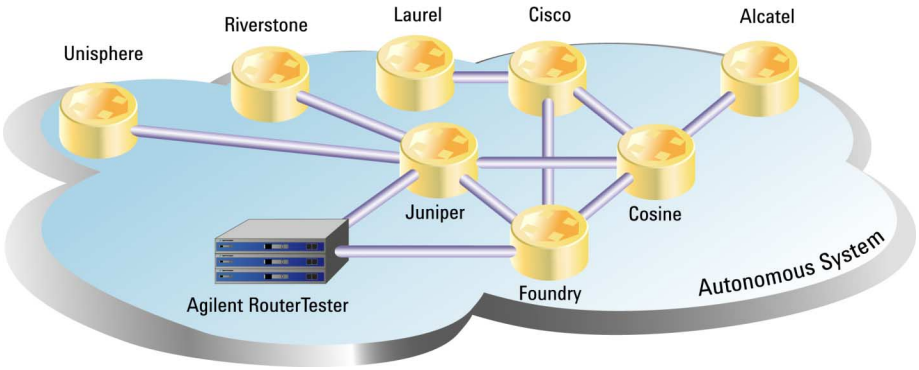


Figure 1: Autonomous network topology depicting iLabs Test Bed connections

Key Tests Scenarios

Over the three day event, numerous test cases were implemented. The remainder of this case study describes the two most prominent tests sessions that were conducted to verify interoperability, and the results of those test.

Test Session 1

RSVP-TE LSP Setup

Description: The aim of this test session was to scrutinize RSVP-TE signaling protocol interoperability by establishing a label switched path (LSP) across the multi-vendor typology.

RouterTester was connected to increasing numbers of independent devices and used to generate and receive RSVP PATH and RESV messages to verify that LSP tunnels had successfully been established across the multi-vendor network.

Throughout the following test cases RouterTester was used for the following functions:

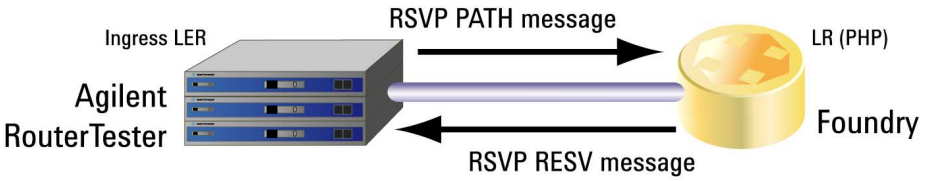
- To emulate an Ingress Router by initiating RSVP PATH messages
- To emulate an Egress Router by responding to RSVP PATH messages with the appropriate RESV messages.
- To generate wire-speed internet scale traffic across the established tunnels
- To capture and analyze real time packets and performance

Test Case 1: One-hop LSP Setup

1A: Verify RSVP RESV Message

Description: Agilent RouterTester was connected to Foundry's router. Simulating an Ingress LER, RouterTester was used to generate a RSVP PATH message and verify the response from Foundry's router.

Result: Foundry's router replied with the correct RESV message indicating that an LSP was established. Note: Foundry's router responded with an 'implicit- null' label value verifying the Penultimate Hop Popping (PHP) concept.

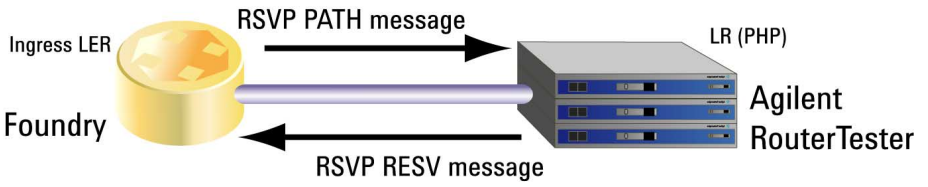


Test Case 1A

1B: Verify RSVP PATH Message

Description: Now simulating an Egress router (LER), RouterTester was connected to Foundry's router. Foundry's router was prompted to initiate an RSVP PATH message to RouterTester which in turn would reply with the correct RSVP RESV message.

Result: Foundry's router initiated the correct RSVP PATH message indicating that an LSP was established.

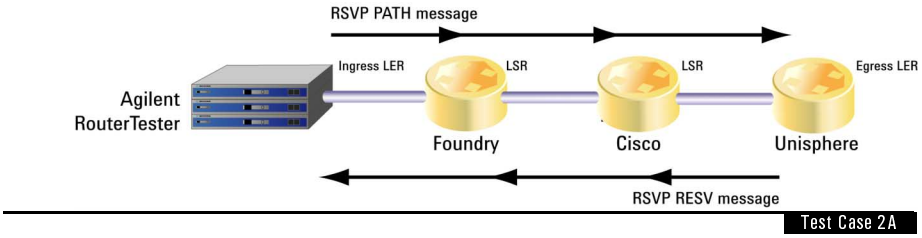


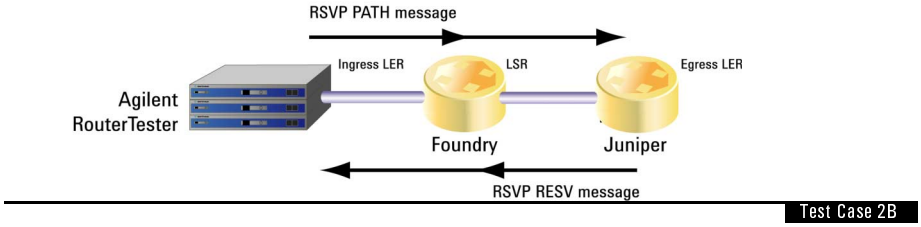
Test Case 1B

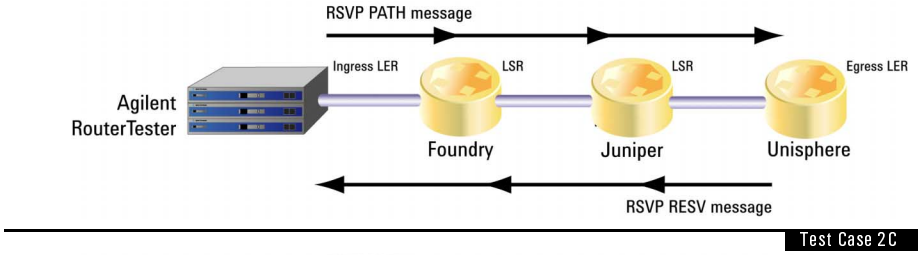
Test Case 2

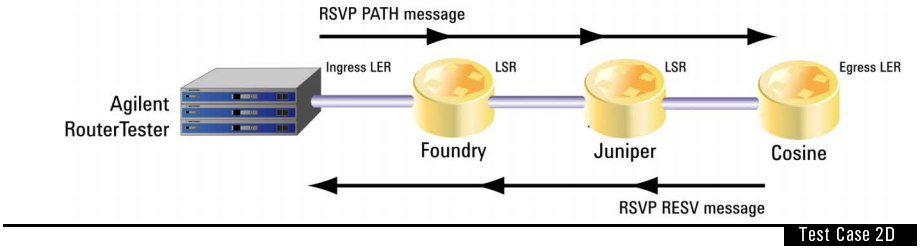
Description: RouterTester was then used to initiate RSVP PATH messages over a variety of topologies in order to prompt the Egress router to reply with the appropriate RSVP RESV message. Each intermediate router would need to 'push' and 'pop' correct label values in order to establish the RSVP LSP. Traffic was then generated over that LSP to verify functionality.

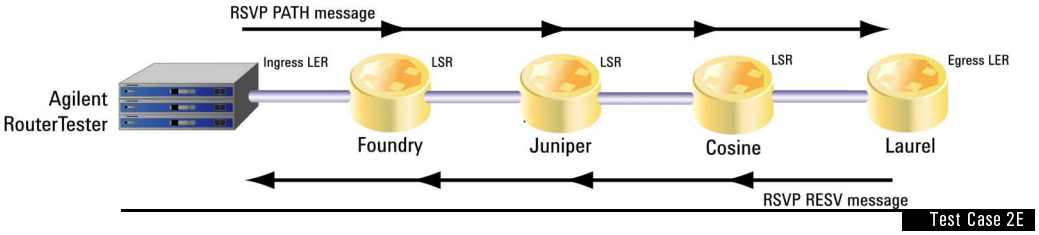
Result: In all of the instances depicted below the correct RSVP RESV messages were received by RouterTester and an LSP was successfully established across the network.

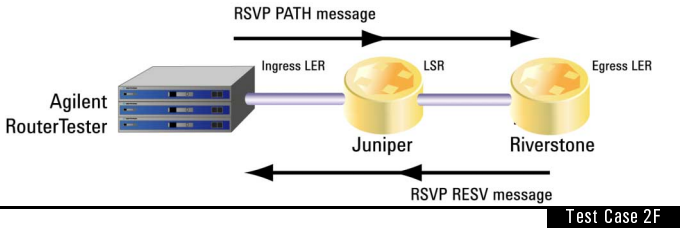


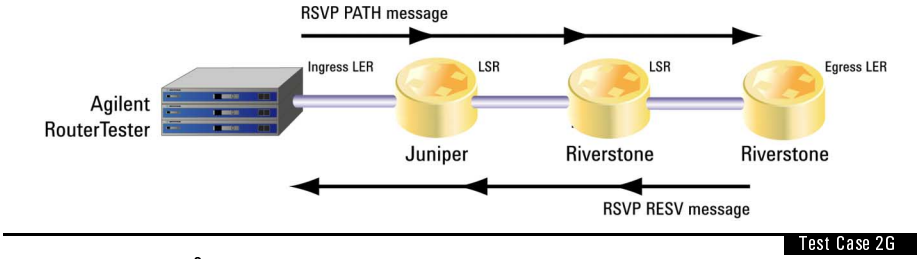












Test Session 2

More complex MPLS TE testing

The aim of the second key scenario was to verify correct interaction between BGP routing protocols and MPLS protocols in a multi-vendor device.

Specifically, this test confirms that edge routers can learn BGP routes, I-BGP sessions can be established and that RSVP LSPs can be successfully mapped using those sessions.

BGP (next-hop) LSP test

Description: This test used two RouterTester ports— the first port to simulated an autonomous system adjacent to the test bed, and the second to send traffic to the advertised BGP routes.

First, 10,000 BGP routes were advertised from the first test port to an edge router on the test bed to cause the other edge devices to establish I-BGP sessions and exchange the BGP information.

Next, RouterTester generated an RSVP PATH message into the test bed to establish an LSP utilising the correct I-BGP sessions and RSVP RESV information.

Throughout this test case RouterTester was used for the following functions:

- To simulate an autonomous network and generate 10,000 BGP routes into the test bed
- To generate wire-speed internet scale traffic
- To inject OSPF-TE routes into the network (test bed)
- To capture and analyze real-time packets and performance

Results: I-BGP session were successfully established across independent vendors and BGP routes learned by all edge devices (see figure two below).

Unfortunately time did not allow the test to be completed, and it was not verified whether an LSP coule be established.

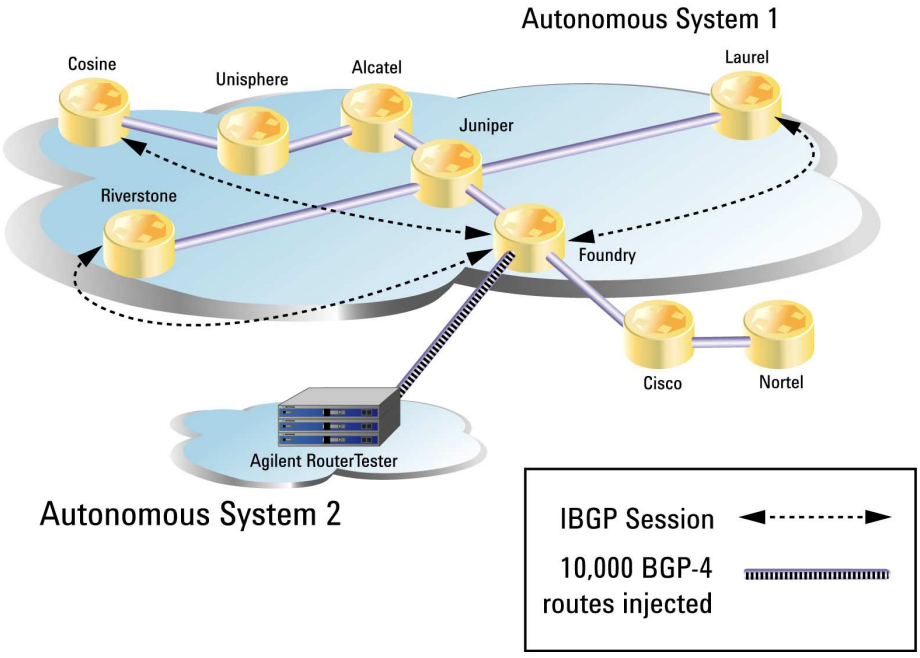


Figure 2: I-BGP Sessions Established

What can we conclude?

Do MPLS devices from independent vendors interoperate?

It does appear that MPLS interoperability has come a long way over the last 12 months. The results of the iLab tests do indicate that at this basic level of functionality these devices do interoperate.

Re-visiting the questions in iLabs objectives

Q. Is it possible to establish RSVP label switched paths (LSPs) through a multi-vendor network?

A. The above tests showed that RSVP LSPs could in fact be established across the multi-vendor topology.

Q. Can IGP routes be successfully learned and IBGP sessions set up by the edge routers of a multi-vendor network?

A. Test session 2 showed that it is possible for the devices used in the test bed to establish IGP sessions in a multi-vendor network.

Q. If IGP sessions can be successfully established over multi-vendor networks, can RVSP LSPs be established using that information?

A. Unfortunately, this question was not answered in this round of tests. Due to the lack of time, this scenario was not completed.

Q. Do MPLS enabled devices from independent vendors interoperate?

A. The tests conducted indicate that MPLS standards are being implemented by the participating vendors in a manner that will interoperate. However these tests are relatively simple and further verification should be under taken prior to announcing ‘true interoperability’.

Testing MPLS

Agilent's RouterTester was the only test product at the iLabs event capable of performing the required MPLS tests.

RouterTester has a comprehensive suite of RSVP and LDP/CR-LDP capabilities that allow NEMs and SPs to verify:

- Simple MPLS Functionality
- Complex MPLS Traffic Engineering Performance
- MPLS VPN implementations
- MPLS implementations at speeds of up to OC-192c/ST-64
- MPLS conformance and interoperability

Agilent's RouterTester is also capable of generating realistic wire-speed traffic, fully integrated with routing and signaling protocols. Its powerful IP analysis capabilities and QuickTest Script Library allow engineers to diagnose performance issues and resolve them fast.

For more information on how Agilent's RouterTester can be used verify the functionality and performance of tomorrow's devices and networks, please email:

IPTest@Agilent.com

Or visit

www.Agilent.com/comms/IPTest