Stress Testing the Data Plane with the RouterTester 900 Application

Application Note

High traffic loads place heavy demands on both the hardware and software components of a Layer-2 device. Before deployment, its interfaces, switching fabric, memory, buffering and scheduling mechanisms, and Address Resolution Protocol (ARP) tables must be thoroughly stressed to ensure the device can switch traffic from its input buffers to the appropriate output queues at full line rate.

This application note shows how to use RouterTester 900 to define and generate up to 32,768 streams per port to help you stress a Layer-2 device’s data plane. You can build any type of Layer-2 to Layer-7 Protocol Data Unit (PDU) and receive per-port or per-stream statistics on the test traffic to help identify problems with your device quickly and easily.
**Testing with RouterTester 900**

Agilent’s RouterTester 900 system offers a powerful and versatile platform to address the evolving test needs of enterprise, metro/edge and core routing and switching devices. Using a new concept called a *stream group*, the versatile PDU builder makes it easy to build streams of Layer-2 to Layer-7 Protocol Data Units (PDUs) containing multiple encapsulations and even proprietary formats. With the PDU builder, you can define a packet length distribution and common header type, then edit any field, including the payload. You can also set a field modifier to vary a header field’s values, creating a separate flow or measurable stream for each one.

The scalability of RouterTester 900 has also expanded. Your test can now include 256 test ports per system, with 15 traffic profiles and up to 1023 – 4095 stream groups per port, depending on the port type. In total, RouterTester 900 can generate and measure statistics on 32,768 streams per port, using either four separate measurements over 32,768 streams or twelve measurements over 4,096 streams.

**Data plane stress test**

This application note describes how to stress your Layer-2 device with data traffic.

**Test configuration**

As shown in the illustration below, a source test port sends thousands of Ethernet streams containing the full range of VLAN IDs to a destination test port through the system under test (SUT). The traffic load is increased while performance statistics are observed and saved in comma separated value (.csv) format to a log file.

This test in this application note uses two test ports on a Gigabit Ethernet interface but you can easily add multiple GbE destination test ports and create 32,768 streams on each one. Because RouterTester 900 can generate and measure Layer-2 or Layer-3 traffic with equal facility, you can also adapt this test to stress test a router’s data plane. Tips for running the test with variations such as these occur throughout the note.

**Test summary**

The following steps provide a quick overview of the illustrated tutorial in this application note.

**Step 1: Select test modules and ports.** Configure two test ports on a Gigabit Ethernet interface.

**Step 2: “Teach” SUT the addresses of simulated hosts.** On the destination test port, use the new PDU builder to define an Ethernet stream containing a range of source MAC addresses to simulate hosts behind the port, then send the traffic from the destination test port to the source test port to teach the SUT the addresses.

**Step 3: Define traffic on the first test port.** On the source test port, define eight stream groups containing encapsulated Layer-2 traffic. For each stream group, use a field modifier to create a separate stream for each possible VLAN ID, generating a total of 32,678 streams. You can also vary frame lengths or specify the value of any field, including the fields of packets encapsulated within the Ethernet frame.

**Step 4: Set the traffic profile properties.** Define each traffic profile as constant or bursty, set the offered load, and specify the number of packets to send (e.g., continuous stream, n packets, or just one packet).

**Step 5: Set up the statistics to view.** Configure the destination test port to display a range of port- and stream-level performance measurements.

**Step 6: Start traffic and measurements.** Send traffic from the source test port to the range of MAC addresses simulated behind the destination test port while you view real-time performance measurements in table, line graph, or bar chart format.

**Step 7: Increase the offered load.** Move RouterTester 900’s dynamic slider bar to increase the offered load while the test is in progress, then monitor the effect on the SUT’s performance.

**Step 8: Stop the test.** If you are sending traffic in Continuous mode, you must manually stop the test.

**Step 9: Save the test configuration.** You can save any part of the test configuration as an XML file, including the profiles and streams you have defined.
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Traffic containing a range of source MAC addresses is sent from the destination test port to the source test port to teach the SUT the MAC addresses. Layer-2 streams encompassing the full range of VLAN IDs are then sent from the source test port to the range of addresses simulated behind the destination test port while the SUT’s performance is observed.

Step 1: Select test modules and ports

1. On the Port Selection dialog, select the interface you want to use for the test.
2. Enable two ports.
3. Apply selections and close dialog.

Tip
You can use any Ethernet interface for this test, or use one port on two separate interfaces.
Step 2: “Teach” SUT the addresses of simulated hosts

Although the Link light is red, you do not have to configure the link layer to do Layer-2 testing. Resolving MAC and IP addresses with Address Resolution Protocol (ARP) is only necessary when testing routers at the IP level.

4. In the Main View Traffic area, select the second test port.

5. Right click on Profile 1 and select New StreamGroup.

6. Double click on StreamGroup 1 to open the StreamGroup Properties dialog.
Enable stream-level statistics on the first test port.

Select Layer 2 Frame.

At the General tab, ensure that the stream group and insertion of the test payload are enabled.

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For detailed information about this dialog, click the Help button.

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At the Packet Template tab, expand the Ethernet header.

Right click on the source address and select Increment.

The Packet Template tab contains RouterTester 900’s PDU builder, from which you can define the structure and contents of the PDUs to be transmitted.

Tip

The Packet Template tab contains RouterTester 900’s PDU builder, from which you can define the structure and contents of the PDUs to be transmitted.
Type the beginning source address in the From field, 4096 in the Count field, and the step with which to increment the addresses, then press Enter. The tester will automatically calculate the correct end address in the To field.

Enable VLAN tag.

Select the No option to generate just one stream. Selecting the Yes option would generate a separate stream for each source address.

Ensure the second port is still selected.

Double click on Profile 1 to open the Profile Properties dialog.

Set the mode to single shot and enter 10,000 frames to send.

Close dialog.
21 Press the Start button to start sending traffic from the second test port to the first test port.

22 Check the Tx Test Packets and Rx Test Packets fields in the Measurements Table to verify that traffic was received on the first test port.

23 Stop the test.

24 After the traffic has stopped, disable the stream group by deselecting its check box.

20 Set the mode to Cumulative.
Step 3: Define traffic on the first test port

25 In the Main View Traffic area, select the first test port.

26 Right click on Profile 1 and select New StreamGroup.

Tip

You can define 15 traffic profiles and up to 1023 - 4095 stream groups per port (depending on the port type).

27 Double click on StreamGroup 1 to open the PDU builder’s StreamGroup Properties dialog.
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28. Select Layer 2 Frame and type the length.

29. Enable the stream group and insertion of a test payload.

30. Enable stream-level statistics on the receive port.

For detailed information about this dialog, press the Help button.

Tip

You can repeat the test with other frame sizes, e.g., 128, 256, 512 bytes. You can also randomize, increment, or decrement a specified range of lengths.
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31. At the Packet Template tab, expand the Ethernet header.

32. Right click on the destination address and select Increment.

Tip
You can increment, decrement, or randomize address fields, or specify your own custom list of addresses.

33. Send traffic to the addresses simulated behind the second test port (i.e., the source MAC addresses defined on page 6) by entering the same first address, count, and step, then pressing Enter.

34. Select the No option to generate just one stream.
35 Enable VLAN tag and expand the VLAN header.

36 Right click on VLAN ID and select Increment.

37 Type 0 in the To field, the number of VLAN IDs in the Count field (from 1 to 4096), and the step by which to increment them, then press Enter. The From field will automatically contain the correct value.

38 Select the Yes option to generate separate streams for each VLAN ID.

39 Apply settings and close dialog.
Right click on StreamGroup 1 and select Copy.

With the same profile selected, paste the stream group.

RouterTester 900’s handy duplication short cuts minimize configuration time by allowing you to copy and paste streams, stream groups, and profiles.
Continue pasting until you have eight stream groups, each containing 4096 streams.

Tip

You can shorten this task by selecting and copying more than one stream group at a time. You can also paste to different profiles to manipulate the load separately for each one.
Step 4: Set the traffic profile properties

43 Ensure the first test port is still selected.

44 Double click on Profile 1 to open the Profile Properties dialog.

45 Set the traffic type, mode, and load.
For this test, start with a low traffic load. You can then increase it while the test is running to observe the impact on performance.

46 Apply settings and close dialog.

Tip
You can also select the profile, then move the slider bar at the top of the Main View to set the traffic load.
Step 5: Set up the statistics to view

47 In the Main View’s Results area, click the Measurement Configuration button.

48 On the Measurements tab, select the statistics to view and the format in which to view them (table, line graph, bar chart, log).

You can also choose a predefined selection of measurements from the drop-down list.

49 Keep Cumulative mode selected.
50. At the Ports tab, select the ports on which to view port-level statistics.

51. At the Streams tab, select the streams to log and/or view in the Results area.

Tip

You can log statistics for a maximum of 100 streams and select up to 10 streams to view in the Main View Results area along with the port measurements. RouterTester 900 also provides a special stream-level statistics view in a separate Stream Measurements dialog, as shown on page 19.

To select all streams on the page, right click on the dialog and choose Select All. Using the same menu, you can then add or remove selected streams from the log, and the table, graph, or bar chart display.
52. At the Log tab, enable Logging, then type the log filename and logging frequency (in sampling intervals).

53. Apply settings and close dialog.
Step 6: Start traffic and measurements

54. In the Main View’s toolbar area, click the Start Traffic and Measurements button.

55. Toggle the table, line graph, and bar chart buttons to view measurements in the desired format.
View stream-level statistics in a separate dialog. This dialog is especially useful when you are measuring many streams.

Tip
Use the arrow buttons to page backwards or forwards through the streams.
Step 7: Increase the offered load

58 While the test is still running, increase the offered load by moving the slider bar.

59 View statistics in the Stream Measurements dialog.

57 Select the profile.
Continue increasing the offered load by a specified increment until packet loss or other performance problems are observed.
Step 8: Stop the test

When you have finished recording results, stop sending traffic.
Step 9: Save the test configuration

62 Select Save from the Session menu.

63 Select the directory and name the file.

64 Save the complete session, or select the individual settings you want to keep.

65 Save the configuration file.

Tip: Use the Session>Open menu to reopen the file and restore the test configuration.