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Baseline IPv6 Performance Testing with IxChariot

IxChariot

Contents

IXIA

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This Test Plan Primer contains a general outline for testing a particular technology. Not all the capabilities of Ixia technology have been exposed in this document. Please feel free to contact us if additional capabilities are required.

Overview

IPv6 and its set of well-documented benefits (see Ixia's IPv6 White Paper – http://www.ixiacom.com/library/white_papers/wp_display.php?skey=ipv6) have driven an increasing number of operating system and network equipment vendors to offer IPv6 support in their product lines that previously supported only IPv4. Today, market segments such as National Research Networks (NRNs) and connected university campuses, and federal and government organizations, have deployed nationwide IPv6 networks. In addition, engineering organizations, as well as service providers, working on IPv6 applications or appliances, now require IPv6 capabilities in new product acquisitions.

From a testing perspective, the transition to IPv6 implies that both the entire network and its underlying components have to be stress-tested to meet the forecast amount of IPv6 traffic. The increasing availability of IPv6 applications on user systems will create the expectation that these new applications offer the same performance as any of their IPv4 predecessors.

From an overall deployment perspective, many equipment vendors and enterprises advocate an IPv6 transition strategy that begins from the edges of the network and moves in toward the core. Such a strategy has the benefits of better visibility of deployment costs, while providing a unique perspective on the needs of applications migrating to IPv6.

IxChariot is the industry-standard test tool to assist companies with their pre-deployment tests and transition to IPv6. Its wide range of IPv6 test capabilities can provide an exact impact assessment for the deployment of IPv6-based applications across dual-stack and, later on, native IPv6 environments. The test cases in this document provide an outline of some of the key capabilities in IxChariot suited for IPv6 testing, and are based on a popular Layer 3 dual stack switches that are common in the edge networks of many larger organizations.

The following test cases are presented below:

- Dual-stack IPv4/IPv6 throughput (baseline test)
- IPv6 Triple Play test
- IPv6 Internet traffic emulation
- IPv6 Internet traffic emulation with stateless IPv6 IMIX traffic for additional network congestion
- IPv6 Internet traffic emulation with IPv6 Ping of Death attack against the DUT

Setup

IxChariot natively supports IPv6 both in the test network and in the management network, thus providing the flexibility to shift from the paradigm of using IPv4 in the management network and IPv6 in the test network.
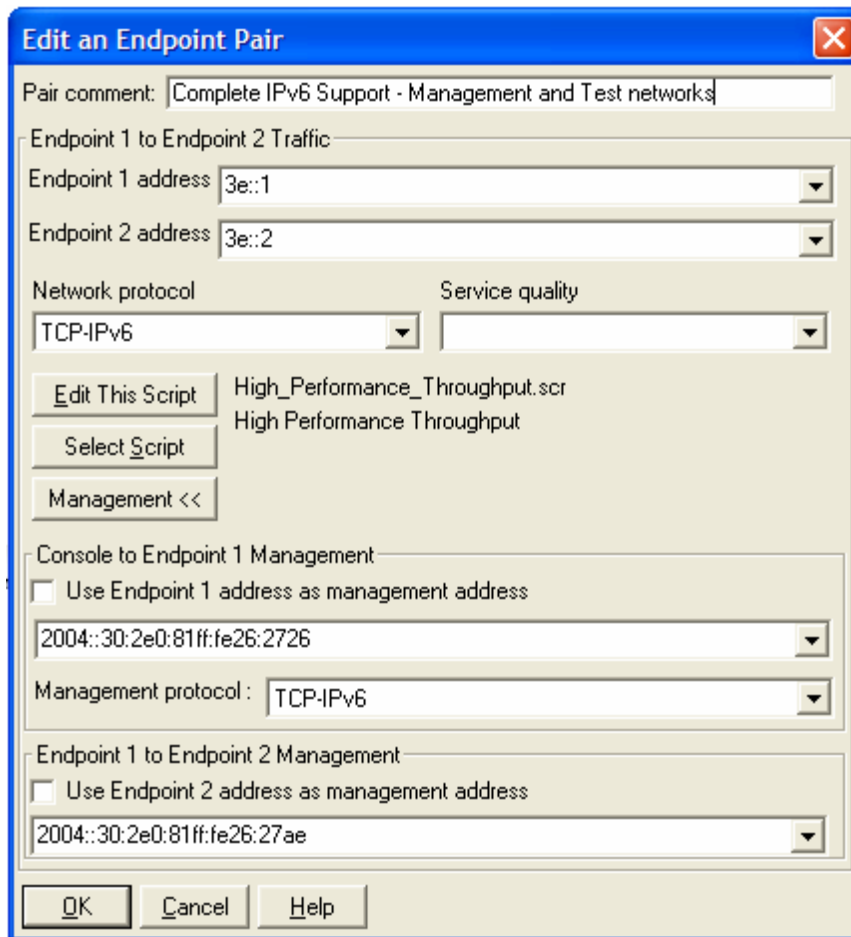
Figure 1: IPv6 Endpoint Pair setup dialog

The test network needs to support IPv6 multicast, IPv6 QoS mechanisms, and IPv6 routing in order to run the tests that are presented in this test plan. In some cases, additional background traffic may need to be generated in the background using other test applications.

1. Dual Stack IPv4/IPv6 Performance Verification

1.1 Objective

IPv4 and IPv6 hosts are expected to coexist for a substantial time during the steady migration from IPv4 to IPv6, and the development of transition strategies, tools, and mechanisms has been part of the IPv6 technology since its inception. From a testing perspective, this means that a basic dual-stack IPv4/IPv6 performance test should be considered as a first step in creating a baseline not only for all future IPv6 tests but also as a way to understand any performance differences that may exist in the device when forwarding IPv4 traffic versus IPv6 traffic. This is important since many devices offer hardware-based acceleration for IPv4; however, they either do not offer this option for IPv6 or offer it only with greatly reduced performance.

Therefore, the objective of this test is to determine and characterize any throughput differences that may exist in the network and specific Device Under Test (DUT) when forwarding IPv4 and

IPv6 traffic.

1.2 Input Parameters

The primary input parameters for this test include:

- IPv4 and IPv6 addresses configured on the test ports running the Performance Endpoints to create two pairs – Pair 1 for IPv4 and Pair 2 for IPv6
- IxChariot script – High Performance Throughput
- Network protocol – TCP and TCP IPv6 respectively
- Run Option was set to a fixed duration of one minute

1.3 Test Methodology

Multiple NIC cards can be used to match ports on the DUT. For a single ingress/egress port pair, two pairs are defined (one for each IP version), and then executed with run options set to a fixed time.

Test Execution (Endpoint 1 to Endpoint 2)

Group/ Pair	Endpoint 1	Endpoint 2	Network Protocol	Service Quality	Script/Stream Name
All Pairs					
Pair 1	172.21.4.4	172.22.4.4	TCP		High_Performance_Throughput.scr
Pair 2	2000:21::4	2000:22::4	TCP-IPv6		High_Performance_Throughput.scr

Throughput

Group/ Pair	Average (Mbps)	Minimum (Mbps)	Maximum (Mbps)	Throughput 95% Confidence Interval	Measured Time (secs)
All Pairs	265.158	19.935	265.781		
Pair 1	246.943	238.095	265.781	0.547	59.285
Pair 2	20.693	19.935	21.511	0.252	57.991
Totals:	265.158	19.935	265.781		

Figure 2. Baseline IPv4/IPv6 throughput performance test results through a Layer 3 switch

IxChariot displays the throughput results in a variety of ways (e.g., max, min, average), as well as displaying results as datagram statistics, such as Bytes Sent and Received by E1. As can be seen in the excerpt from the IxChariot HTML report above, pair 1 (i.e., IPv4) shows significantly better performance than pair 2 (i.e., IPv6), thus indicating that the DUT offers better throughput for IPv4 than for IPv6 traffic.

Note: IxChariot measures the throughput associated with packet payload, ignoring headers. This metric is referred to as "Goodput" in RFC 2647.

2. IPv6 Triple Play Test

2.1 Objective

Today, IP networks are rapidly integrating network resources to deploy Triple Play services across the existing network infrastructure. As a result of the urgent requirements of such deployment, emerging IPv6 networks must be able to handle the transport of voice, video, and data traffic seamlessly.

The basic aim of this test is to generate IPv6 video and voice traffic separately to create a baseline performance metric of these applications running through the network independently, and then to layer the voice and video traffic together with data to create realistic Triple Play load.

The data traffic used in this test is a standard internet mix, with HTTP and FTP traffic mixed with Internet Instant Messaging scripts (MSN) and P2P (Bit Torrent) search and download, all moving between the same two points on the network.

2.2 Input Parameters

The Input Parameters to this test include the following:
- Setting up IPv6 addresses on the test ports and the DUT. In this case, all pairs are set up to use the same IPv6 addresses for E1 and E2 (i.e., 3E::1 for E1 and 3E::2 for E2).
- IxChariot scripts that generate a mix of traffic already discussed
  - Setting up 20 pairs of MPEG-2 video in each direction
  - Setting up 10 pairs of G.711U-based VoIP calls in each direction
  - Eight pairs of data traffic representing
    - DNS requests and responses
    - FTP download
    - HTTP download
    - MSN Instant Messaging (login and chat)
    - P2P Bit Torrent traffic (search and download)
    - Mail downloads using a POP3 server.

2.3 Test Methodology

The test is divided into 3 separate sections:
- The first assess the performance of VoIP (RTP/IPv6) traffic
- The second analyzes the performance of bi-directional voice calls (RTP/IPv6) and MPEG-2 encoded video (UDP/IPv6) stream
- The third assesses network performance using a combination of data, voice, and video traffic carried over the same network

The test duration may be expanded if test result accuracy indicators, such as Relative Precision, indicate that too few timing records were generated for any specific pair. In general, IxChariot users should aim for a Relative Precision value of less than 10 in all tests.

Note: The Relative Precision is obtained by calculating the 95% confidence interval of the Measured Time for each timing record, and dividing it by the average Measured Time. This number

is then converted to a percentage.

2.3 (a) VoIP Baseline Test
This -test consists of passing 10 bi-directional pairs of G.711u encoded VoIP at 64 Kbps per stream. Begin this test with a fixed duration of one minute. The anticipated result is for all VoIP traffic to pass through the network without any significant impairment.
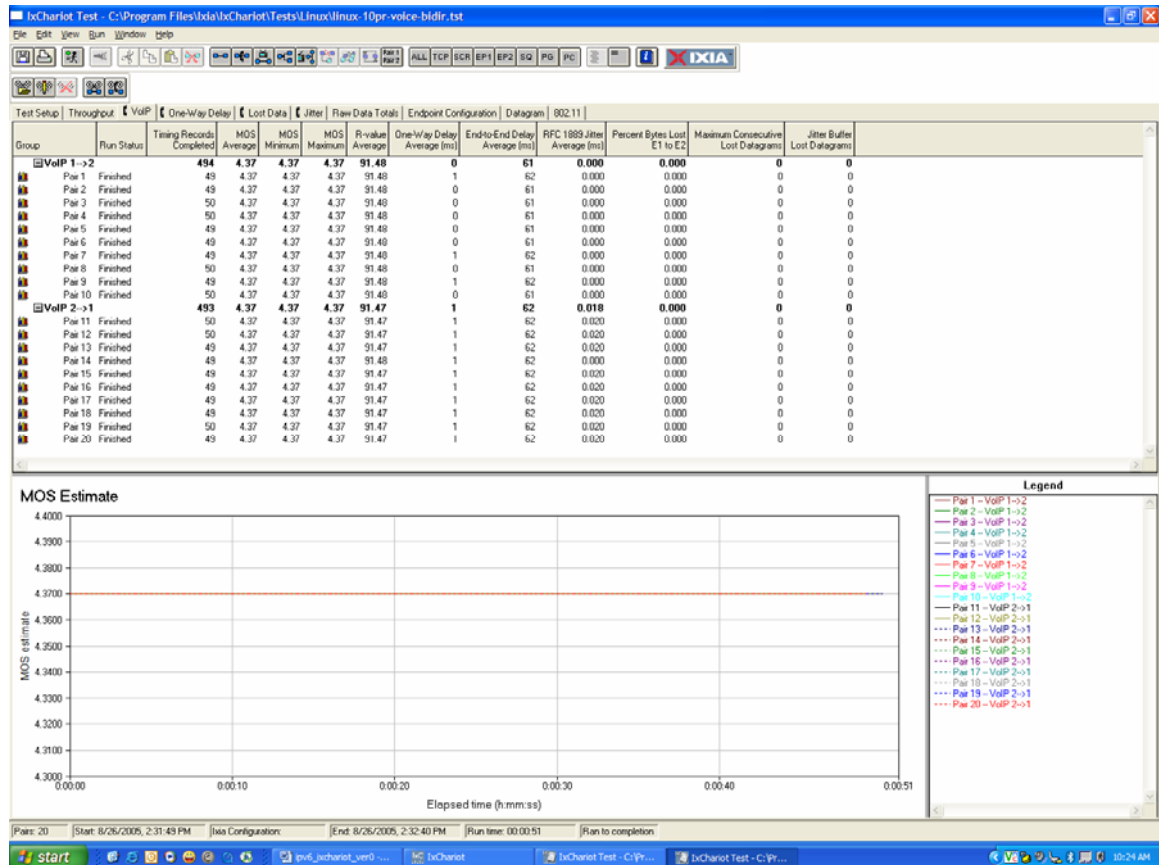
Figure 3. Baseline test G.711u VoIP/IPv6 throughput performance test results

As expected, the VoIP traffic passed through the network without significant delay, jitter, or packet loss. The throughput for each of the streams is also good. The MOS score is maintained well above 4.0, indicating toll-grade voice quality.

2.3 (b) Video and VoIP Baseline Test
This test consists of adding 20 bi-directional pairs of MPEG-2 encoded video at 15 Mbps to the existing VoIP traffic in section *2.3 (a)*. Begin this test with a fixed duration of one minute.

IxChariot Test - C:\Program Files\Ixia\IxChariot\Tests\Linux\linux-20pr-video-10pr-voice-bidir.tst

File Edit View Run Window Help

Test Setup | Throughput | VoIP | One-Way Delay | Lost Data | Jitter | Raw Data Totals | Endpoint Configuration | Datagram | 802.11 | Video

Group	Run Status	Timing Records Completed	95% Confidence Interval	Average (Mbps)	Minimum (Mbps)	Maximum (Mbps)	Measured Time (sec)	Relative Precision
Video Pairs 1–>2		1,200		294.885	7.479	15.048		
Video Pairs 2–>1		1,200		294.887	14.854	15.032		
VoIP 1–>2		600		0.629	0.031	0.064		
VoIP 2–>1		600		0.629	0.064	0.064		

Throughput

Mbps

16.000
15.030
14.030
13.030
12.030
11.030
10.030
9.030
8.030
7.030
6.030
5.030
4.030
3.030
2.030
1.030
0.030

0:00:00   0:00:10   0:00:20   0:00:30   0:00:40   0:00:50   0:01:02

Elapsed time (h:mm:ss)

Legend

Pair 1 – Video Pairs 1–>2
Pair 2 – Video Pairs 1–>2
Pair 3 – Video Pairs 1–>2
Pair 4 – Video Pairs 1–>2
Pair 5 – Video Pairs 1–>2
Pair 6 – Video Pairs 1–>2
Pair 7 – Video Pairs 1–>2
Pair 8 – Video Pairs 1–>2
Pair 9 – Video Pairs 1–>2
Pair 10 – Video Pairs 1–>2
Pair 11 – Video Pairs 1–>2
Pair 12 – Video Pairs 1–>2
Pair 13 – Video Pairs 1–>2
Pair 14 – Video Pairs 1–>2
Pair 15 – Video Pairs 1–>2
Pair 16 – Video Pairs 1–>2
Pair 17 – Video Pairs 1–>2
Pair 18 – Video Pairs 1–>2
Pair 19 – Video Pairs 1–>2
Pair 20 – Video Pairs 1–>2
Pair 22 – Video Pairs 2–>1
Pair 23 – Video Pairs 2–>1
Pair 24 – Video Pairs 2–>1
Pair 25 – Video Pairs 2–>1
Pair 26 – Video Pairs 2–>1
Pair 27 – Video Pairs 2–>1
Pair 28 – Video Pairs 2–>1
Pair 29 – Video Pairs 2–>1
Pair 30 – Video Pairs 2–>1
Pair 31 – Video Pairs 2–>1
Pair 32 – Video Pairs 2–>1
Pair 33 – Video Pairs 2–>1
Pair 34 – Video Pairs 2–>1
Pair 35 – Video Pairs 2–>1

Pairs: 60 | Start: 8/26/2005, 3:41:06 PM | Ixia Configuration: | End: 8/26/2005, 3:42:08 PM | Run time: 00:01:02 | Ran to completion

Figure 4. Baseline test for G.711u VoIP and MPEG-2 encoded Video / IPv6 throughput performance test results
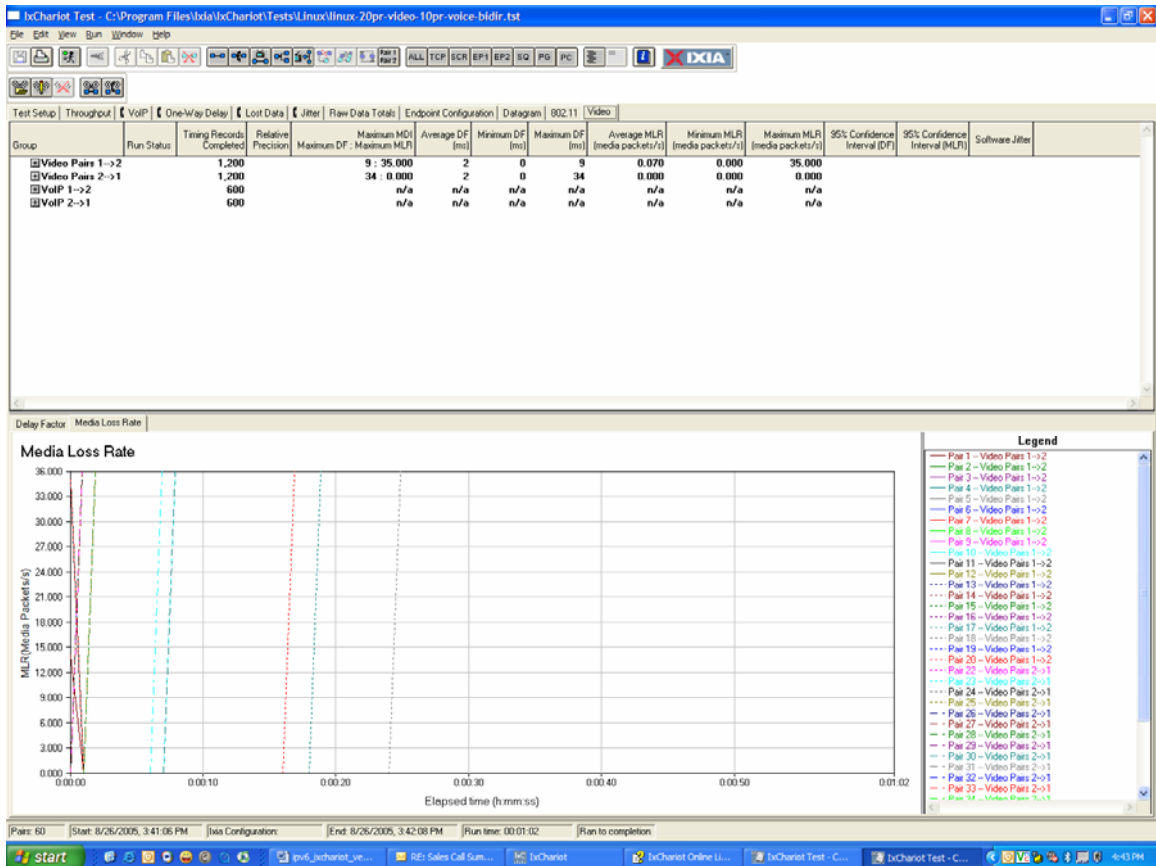
Figure 5. Baseline delay for MPEG-2 encoded Video / IPv6 Media Loss Rate test results

2.3 (c) Triple Play Traffic Test

In this final test, we will primarily add TCP based data traffic. Thus, as TCP uses up all available bandwidth (i.e., there is no bandwidth limitation on the TCP traffic), the test will likely demonstrate network performance degradation, resulting in lost data or increased delay and jitter, which negatively impacts the quality of the VoIP and video traffic.

Figure 6. Triple play test for G.711u VoIP, MPEG-2 encoded Video and Internet Mix of Data / IPv6

IxChariot Test - C:\Program Files\Ixia\IxChariot\Tests\Linux\linux-20pr-video-10pr-voice-bidir-with-data.tst

File Edit View Run Window Help

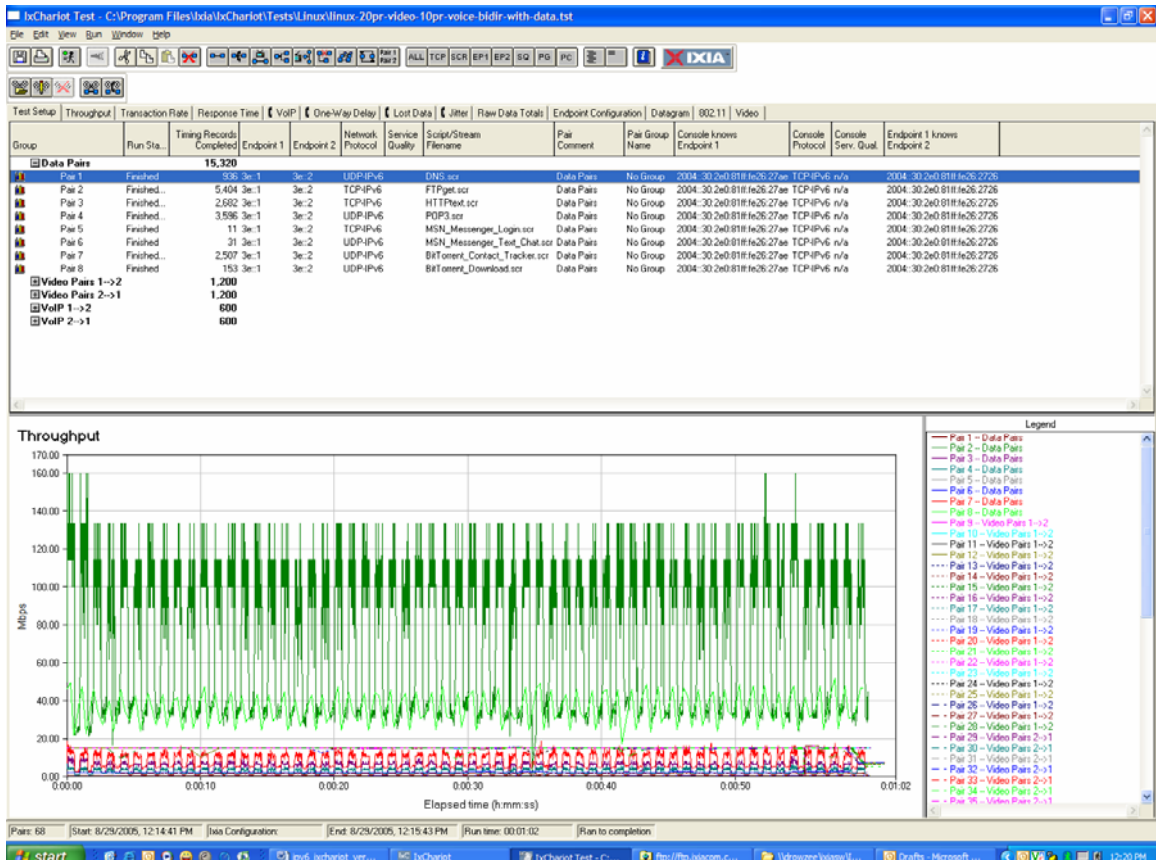Test Setup | Throughput | Transaction Rate | Response Time | VoIP | One-Way Delay | Lost Data | Jitter | Raw Data Totals | Endpoint Configuration | Datagram | 802.11 | Video

Group	Run Status	Timing Records Completed	Relative Precision	Maximum MDI Maximum DF : Maximum MLR	Average DF [ms]	Minimum DF [ms]	Maximum DF [ms]	Average MLR [media packets/s]	Minimum MLR [media packets/s]	Maximum MLR [media packets/s]	95% Confidence Interval (DF)	95% Confidence Interval (MLR)	Software Jitter
Data Pairs		18,759		n/a	n/a	n/a	n/a	n/a	n/a	n/a			
Video Pairs 1-->2		1,200		116 : 2,157.438	2	0	116	6.789	0.000	2,157.438			
Video Pairs 2-->1		1,200		221 : 1,877.296	5	2	221	2.206	0.000	1,877.296			
VoIP 1-->2		600		n/a	n/a	n/a	n/a	n/a	n/a	n/a			
VoIP 2-->1		600		n/a	n/a	n/a	n/a	n/a	n/a	n/a			

Delay Factor | Media Loss Rate

Delay Factor

Pairs: 68   Start: 8/26/2005, 4:16:35 PM   Ixia Configuration: End: 8/26/2005, 4:17:37 PM   Run time: 00:01:02   Ran to completion
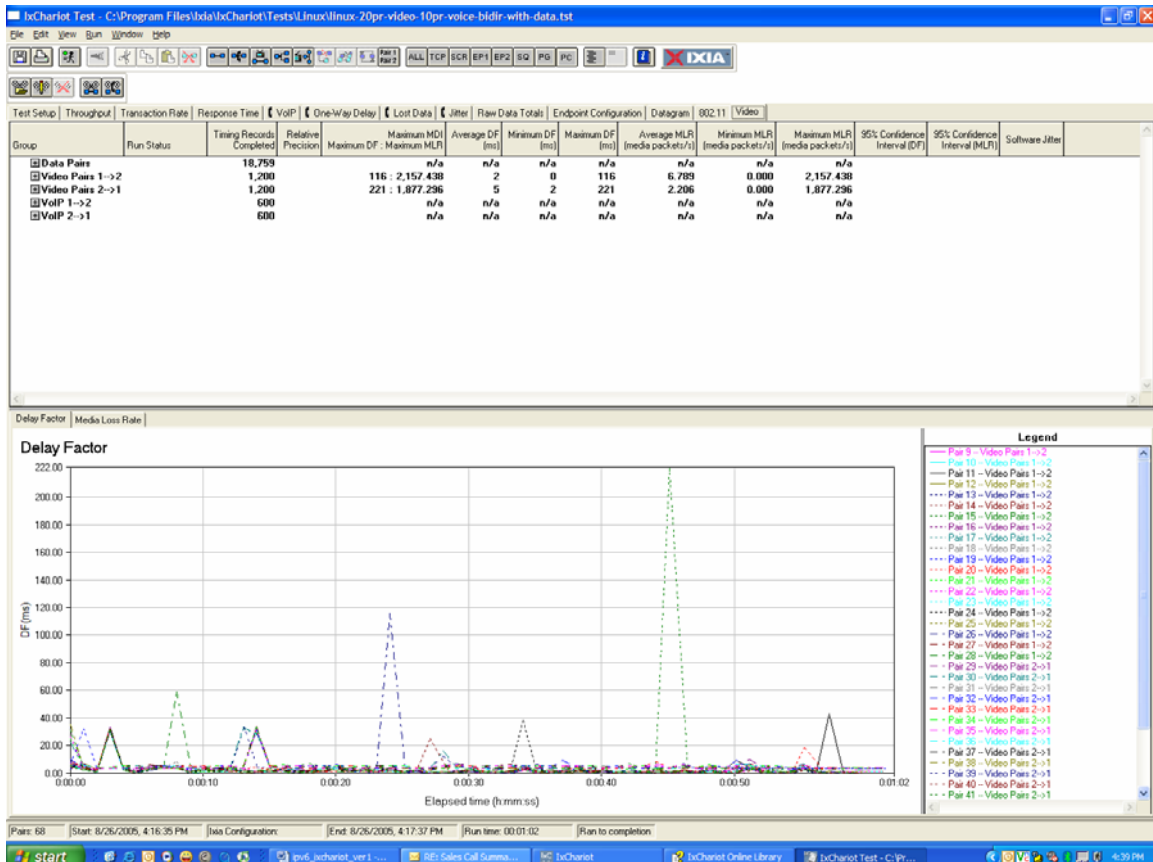
Figure 7. Increased packet losses and delays on the video traffic.

Similar to results in Figure 7 for video, packet loss increases, and VoIP traffic encounters delays.

3. IPv6 Internet Traffic Performance Test

3.1 Objective

Today, few applications natively support IPv6, which means that as networks migrate to IPv6, network users will typically continue to use existing applications to accomplish the same business and productivity goals independent of the underlying IP version that currently operates in their network. From a testing perspective, this means that the same application traffic that is normally generated over an IPv4 network will now be sent across a new set of IPv6 devices. These traffic generating applications can be divided into two main categories – Internet and enterprise application traffic.

The basic aim of this test is to see how existing context-based streams are handled by the DUT, and to assess the performance of standard Internet traffic, i.e., HTTP, FTP, Peer-to-peer traffic, Instant Messaging, Email, encapsulated in IPv6 packets.

This test is conducted under load that is generated as backgrounds traffic using Ixia Hardware Performance Pairs and is measured in terms of percentage of line rate. The background traffic is a mixture of IPv4 and IPv6 traffic (e.g., Internet Mix, VoIP, etc.) passing through the DUT.

3.2 Input Parameters

The primary input parameters for this test include:

- IPv6 addresses configured on the test ports, running the Performance Endpoints to create the test pairs. In this case, the test pairs are set up to use the same IPv6 addresses for E1 and E2 (i.e., 3E::1 for E1 and 3E::2 for E2).
- IxChariot scripts should reflect a combination of common Internet application scripts using both TCP-IPv6 and UDP-IPv6 as the underlying protocols. Scripts used in this test case include:
  - HTTPtext, HTTPgif
  - FTPget, FTPput
  - MSN Messenger Login, MSN Messenger Text Chat
  - POP3
  - Bit Torrent scripts
- Network protocol – TCP and UDP for IPv6 respectively, depending on the script type
- E1 Setup addresses and E1 – E2 setup addresses are all IPv6
- The Run Option was set to a fixed duration of one minute

3.3 Test Methodology

Begin this test with a fixed duration of one minute. Expand the test duration if test result accuracy indicators, such as Relative Precision, indicate that too few timing records were generated for this specific pair. In general, IxChariot users should aim for a Relative Precision value of less than 10 in all tests.
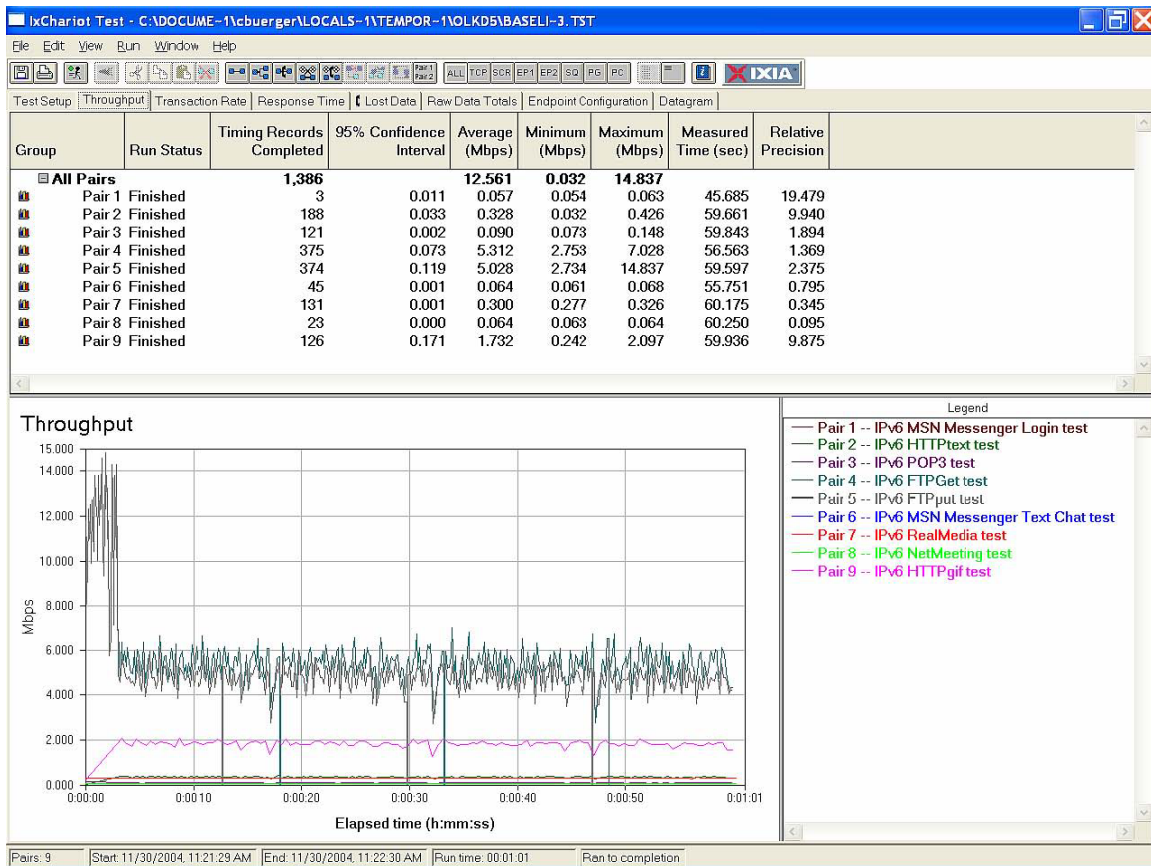
Figure 8. IPv6 Internet performance test results through a Layer 3 switch

As illustrated in the results above, the performance of the switch when forwarding a limited amount of Internet application traffic is adequate. However, the test duration for this test should be extended since pair 1 only completed three timing records, thus creating a Relative Precision of more than 10.

4. IPv6 Internet Traffic Emulation with Stateless IPv6 IMIX Traffic for Additional Network Congestion

4.1 Objective

The objective of the test is to determine the behavior of the DUT when generating stateless IPv6 background traffic (IMIX) at a percentage of GigE line rate while running a set of Internet application scripts with IxChariot. The application scripts can be regular data transfer types that are typically TCP-based, or traffic that is more delay, jitter, and loss sensitive, such as those that are streaming applications, and where delivery is generally provided using UDP.

In the first part of the test, it is easy to see the effect that increasing load has on TCP-based transactions of the DUT, whether the load is IPv4 or IPv6. The second part of the test looks at the effect of the same on load on UDP-based streaming applications.

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4.2 Input Parameters

The primary input parameters for this test include:

- IPv6 addresses configured on Ixia ports running the Performance Endpoints to create some number of pairs
- IxChariot scripts used in the test pairs to reflect a combination of common Internet application scripts using TCP-IPv6 as the underlying protocols. Scripts used in this test case include:
    - HTTP Transaction Scripts
        - HTTPtext,
        - HTTPgif
    - FTP Transaction Scripts
        - FTPget
        - FTPput
    - Instant Messaging Scripts
        - MSN Messenger Login
        - MSN Messenger Text Chat,
    - Email Download Script
        - POP3,
    - Peer-To-Peer Script
        - BitTorrent_Contact_Tracker
        - BitTorrent_Download.
    - Streaming scripts
        - Realmed
        - NetMtgv
        - IP TV streaming audio and video
            - IPTVv,
            - IPTVa
- Network protocol – TCP and UDP (or RTP) for IPv6, depending on the script type. This means that streaming media scripts will use UDP-IPv6 or RTP-IPv6.
- IPv6 Hardware Performance Pair (HPP) setup. In this case, a HPP using the same IP addresses as the standard IxChariot pairs was created by selecting an IPv6 stream type to generate stateless traffic (e.g., IPv6 IMIX). The stream rate was set to a percentage of the line rate of the Ixia port (e.g., 1%).
- E1 Setup addresses
- Run Option was set to a fixed duration of one minute

4.3 Test Methodology

For a single ingress/egress port pair, two pairs are defined (one for each IP version) and then executed with run options set to a fixed time. Compare the results to the test case described in Figure 8. Gradually increase the stream rate percentage.
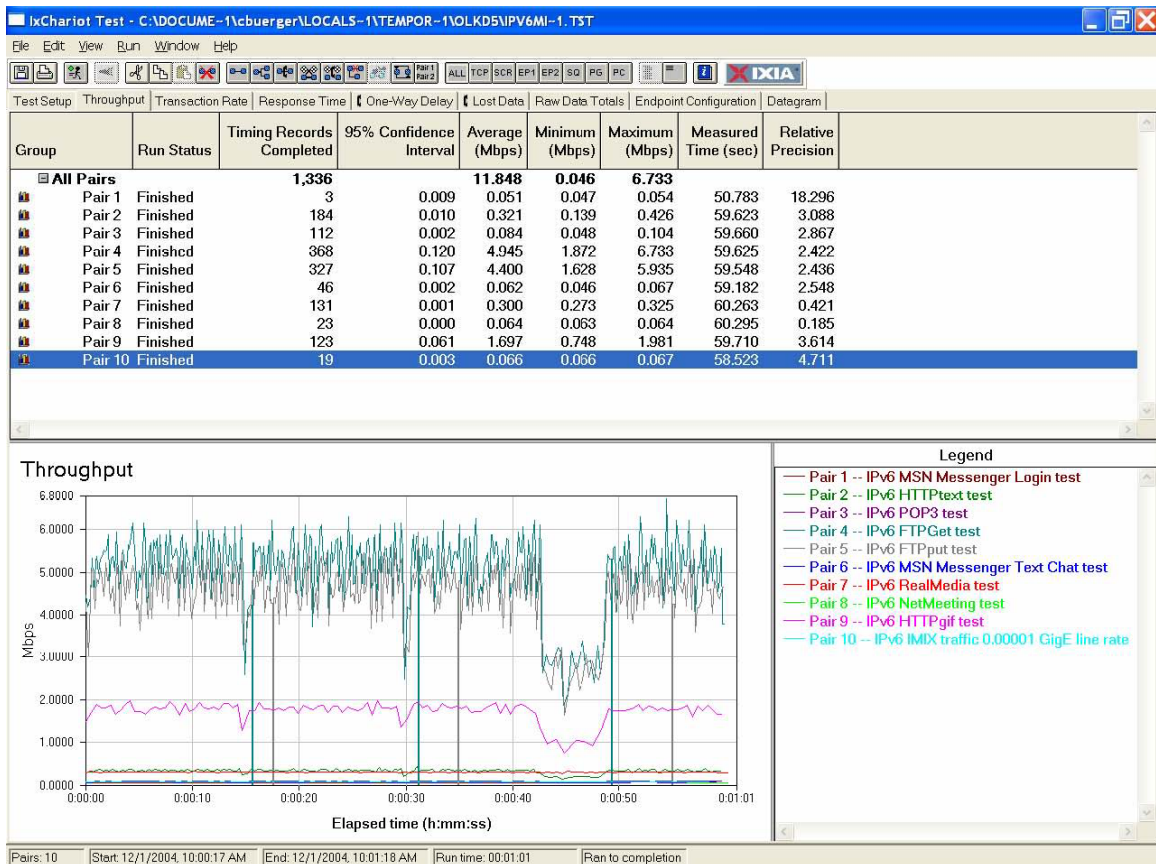
Figure 9. IPv6 Internet performance test results with 1e+05 IPv6 IMIX traffic through a Layer 3 switch

Increasing the IMIX stream rate shows that the Layer 3 switch has disproportionate difficulty in maintaining average throughput. In addition, frequent sudden drops in the overall throughput for each pair can be regularly observed.

Figure 10. IPv6 Internet performance test results with 0.1 IPv6 IMIX traffic through a Layer 3 switch

As illustrated in Figure 11 below, care needs to be taken to not increase the line rate percentage beyond the capabilities of the switch because this may cause the pairs emulating TCP and UDP traffic to either timeout or to not complete any timing records within the test duration defined earlier.
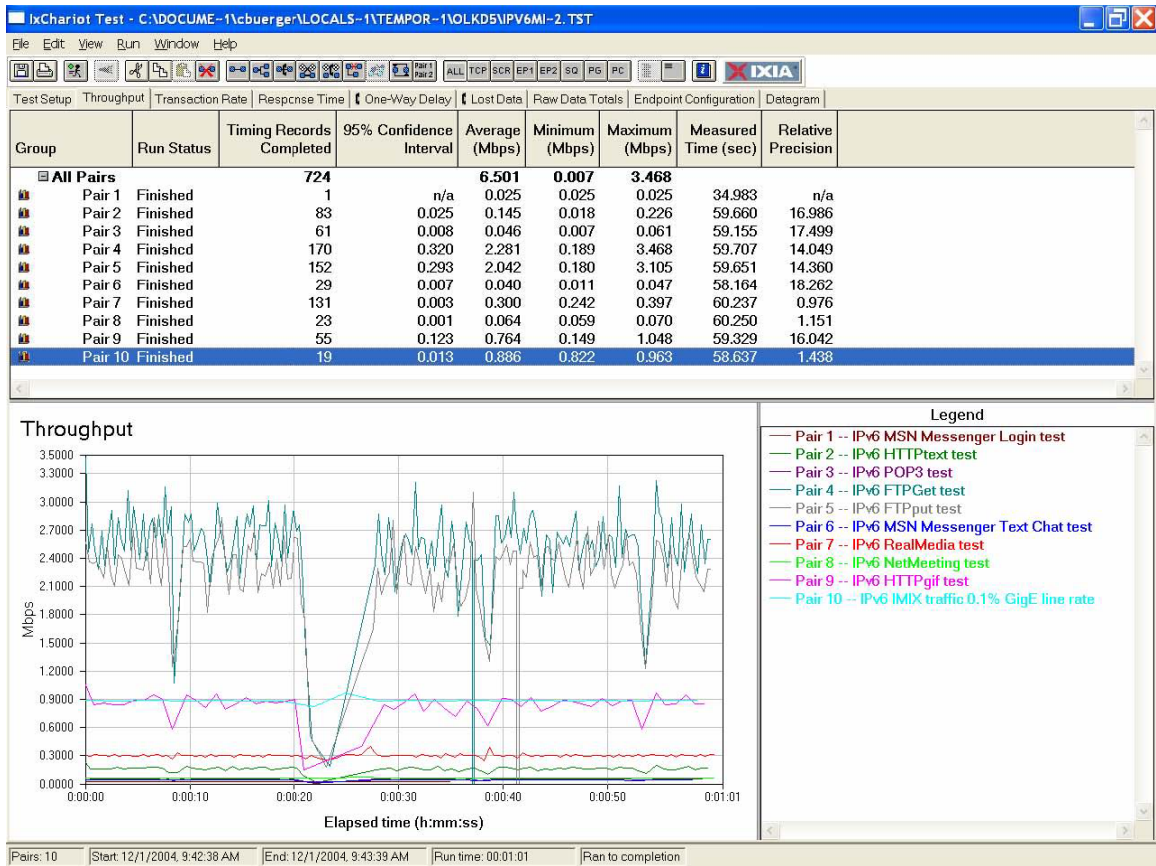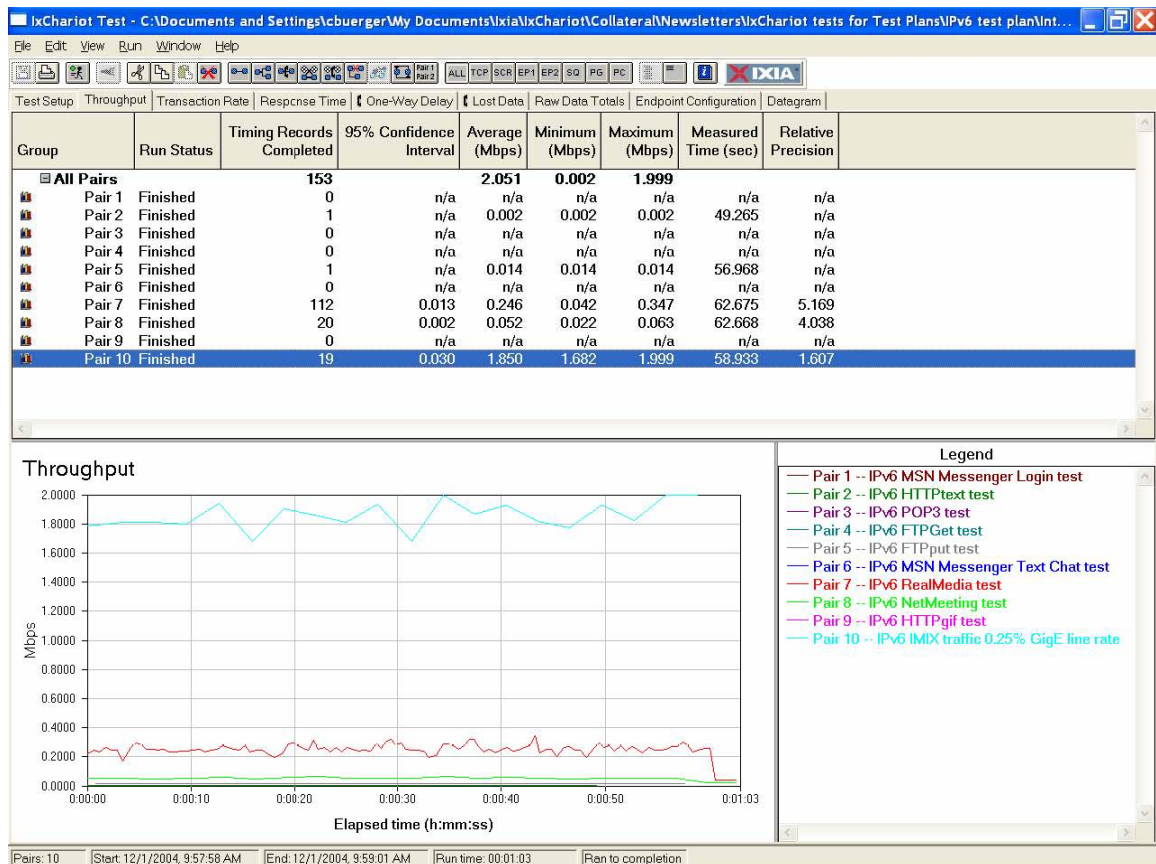
Figure 11. IPv6 Internet performance test results with 0.25% IPv6 IMIX traffic through a Layer 3 switch

5. IPv6 Internet Traffic Performance Test with IPv6 DoS Attack

5.1 Objective

The objective of the test is to determine the behavior of the DUT when running a standard mix of IPv6 application scripts while simultaneously flooding the device with an IPv6 Ping of Death attack. The DDoS attack here is generated using Hardware Performance Pairs; but in general any device capable of generating this sort of attack may be used. Also, the DDoS attack may vary, and other attacks may be used as well.

5.2 Input Parameters

The primary input parameters for this test include:

- IPv6 addresses configured on the test ports running the Performance Endpoints. In this case, the twelve pairs are set up to use the same IPv6 addresses for E1 and E2 respectively.
- IxChariot scripts utilizing pairs to reflect a combination of common Internet application scripts, using TCP-IPv6 as the underlying protocol. Scripts used in this test case include:

- o HTTP Transaction Scripts
  - HTTPtext,
  - HTTPgif
- o FTP Transaction Scripts
  - FTPget
  - FTPput
- o Instant Messaging Scripts
  - MSN Messenger Text Chat,
- o Email Download Script
  - POP3,
- o Peer-To-Peer Script
  - BitTorrent_Contact_Tracker
  - BitTorrent_Download.
- o Streaming scripts
  - Realmed
  - NetMtgv

- Network protocol – TCP and UDP for IPv6 respectively, depending on the script type. This means that streaming media scripts will use UDP-IPv6.
- IPv6 Hardware Performance Pair (HPP) – Set up an HPP using the same IP addresses as the standard IxChariot pairs. Select an IPv6 stream type to generate stateless traffic. for this test, IPv6 Ping Of Death was selected as the stream type. E1 for this pair may or may not be the same as the other pairs. In this test, E1 is different for different pairs to demonstrate the impact of a host from outside the network attacking the router under test.

Note: Traffic is sent against the DUT, so E2 for this pair should be set with the IPv6 address of the DUT. Set the stream rate to a percentage of the line rate of the Ixia port (e.g., 1%).

- E1 Setup addresses (i.e., management port IPv4 addresses of Ixia port)
- Set Run Option to a fixed duration of five minutes and review the test results. Increasing the test duration for tests that stress the DUT with Hardware Performance Pairs will help to ensure good Relative Precision values (i.e., 10 or less) in the IxChariot results.

5.3 Test Methodology

For a single ingress/egress port pair, two pairs are defined (one for each IP version) and then executed with run options set to a fixed time. Gradually, the stream rate percentage is raised to increase the load of the Ping of Death attack.

IxChariot Test - C:\DOCUME~1\cbuerger\LOCALS~1\TEMPOR~1\OLKD5\IPC18A-1.TST

File Edit View Run Window Help

Test Setup | Throughput | Transaction Rate | Response Time | One-Way Delay | Lost Data | Raw Data Totals | Endpoint Configuration | Datagram

Group		Run Status	Timing Records Completed	95% Confidence Interval	Average (Mbps)	Minimum (Mbps)	Maximum (Mbps)	Measured Time (sec)	Relative Precision
All Pairs			6,001		10.565	0.030	6.410		
	Pair 1	Finished	16	0.001	0.048	0.042	0.049	291.960	2.859
	Pair 2	Finished	826	0.004	0.287	0.092	0.375	299.834	1.461
	Pair 3	Finished	521	0.001	0.077	0.031	0.099	299.491	1.375
	Pair 4	Finished	1,648	0.050	4.425	1.338	6.410	298.372	1.140
	Pair 5	Finished	1,447	0.044	3.884	1.329	6.410	298.526	1.134
	Pair 6	Finished	225	0.001	0.060	0.030	0.067	299.968	1.456
	Pair 7	Finished	653	0.001	0.300	0.224	0.458	300.340	0.227
	Pair 8	Finished	115	0.000	0.064	0.063	0.065	301.293	0.103
	Pair 9	Finished	550	0.025	1.513	0.495	1.827	299.589	1.633
	Pair 10	Finished	0	n/a	n/a	n/a	n/a	n/a	n/a

Throughput

Legend
— Pair 1 -- IPv6 MSN Messenger Login test
— Pair 2 -- IPv6 HTTPtext test
— Pair 3 -- IPv6 POP3 test
— Pair 4 -- IPv6 FTPGet test
— Pair 5 -- IPv6 FTPput test
— Pair 6 -- IPv6 MSN Messenger Text Chat test
— Pair 7 -- IPv6 RealMedia test
— Pair 8 -- IPv6 NetMeeting test
— Pair 9 -- IPv6 HTTPgif test
— Pair 10 -- IPv6 PingOfDeath 1% line rate

Pairs: 10 | Start: 12/2/2004, 3:42:44 PM | End: 12/2/2004, 3:47:46 PM | Run time: 00:05:02 | Ran to completion
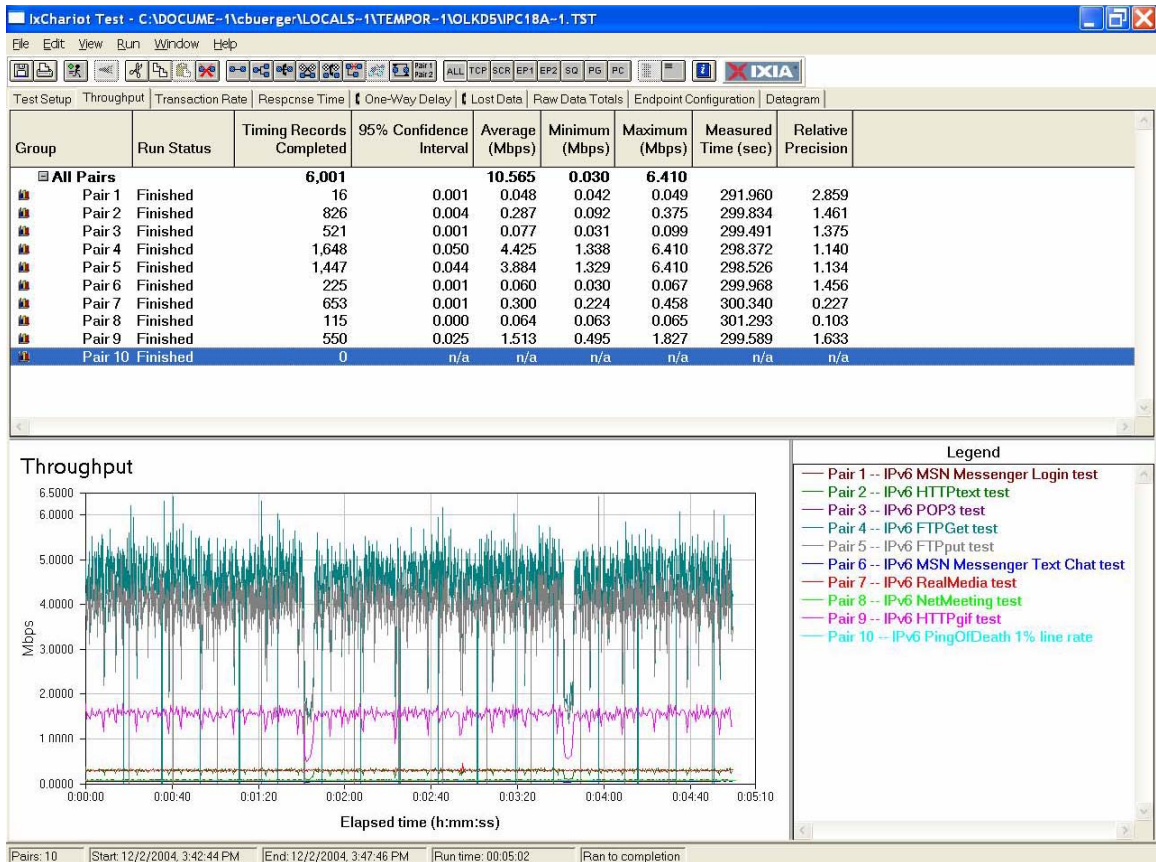
Figure 12. IPv6 Internet performance test results with 1% IPv6 Ping Of Death traffic targeted against the Layer 3 switch

As illustrated in Figure 12, the DUT is handling the attack traffic very well with only a minor decrease in overall throughput when compared to Figure 8.

Note: The IPv6 Ping of Death stream traffic was targeted against the IPv6 address of the DUT. Therefore, IxChariot will not report any results. It is recommended that you verify the correct operation of this stream with a protocol analyzer.

Increasing the line rate percentage to 5% resulted in a substantial drop in overall throughput; however, in general, the DUT handled IPv6 Ping Of Death traffic targeted against device better than IMIX traffic traversing the device.

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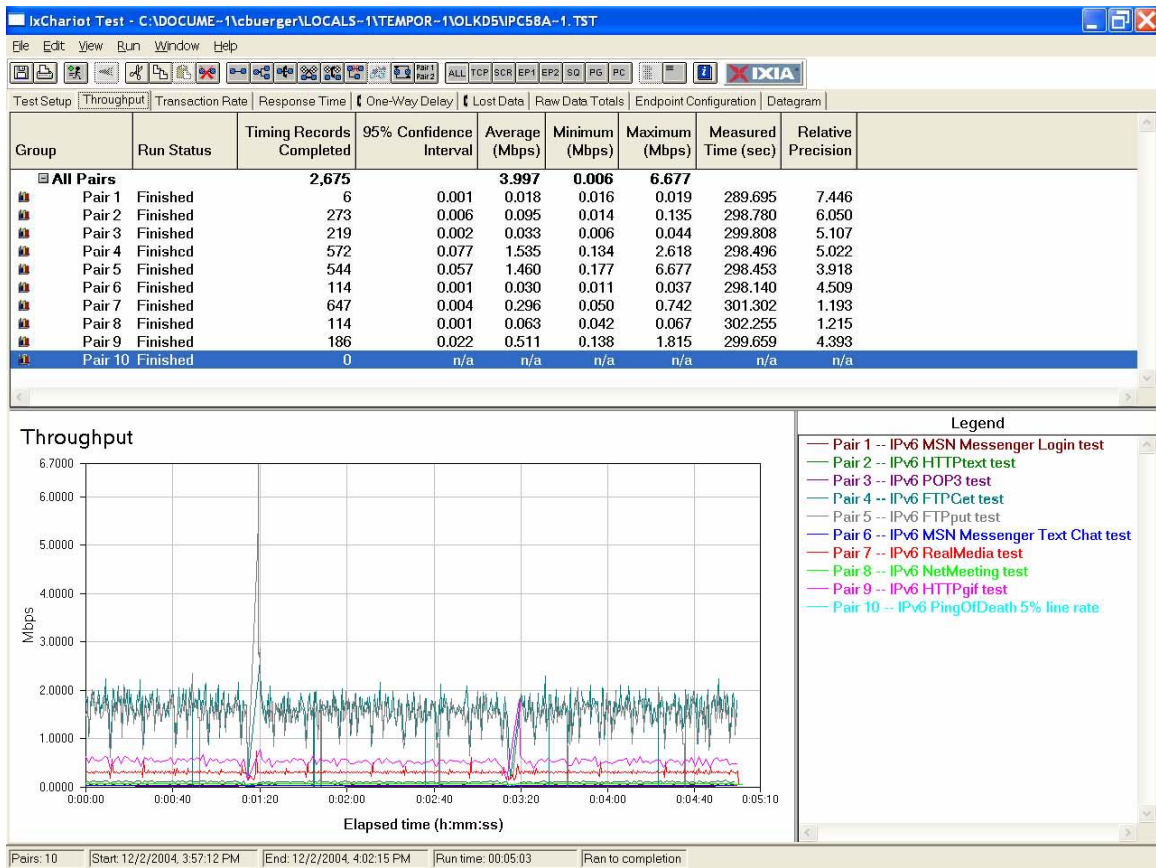| Group	Run Status	Timing Records Completed	95% Confidence Interval	Average (Mbps)	Minimum (Mbps)	Maximum (Mbps)	Measured Time (sec)	Relative Precision
All Pairs		2,675		3.997	0.006	6.677		
Pair 1	Finished	6	0.001	0.018	0.016	0.019	289.695	7.446
Pair 2	Finished	273	0.006	0.095	0.014	0.135	298.780	6.050
Pair 3	Finished	219	0.002	0.033	0.006	0.044	299.808	5.107
Pair 4	Finished	572	0.077	1.535	0.134	2.618	298.496	5.022
Pair 5	Finished	544	0.057	1.460	0.177	6.677	298.453	3.918
Pair 6	Finished	114	0.001	0.030	0.011	0.037	298.140	4.509
Pair 7	Finished	647	0.004	0.296	0.050	0.742	301.302	1.193
Pair 8	Finished	114	0.001	0.063	0.042	0.067	302.255	1.215
Pair 9	Finished	186	0.022	0.511	0.138	1.815	299.659	4.393
Pair 10	Finished	0	n/a	n/a	n/a	n/a	n/a	n/a

Figure 13. IPv6 Internet performance test results with 5% IPv6 Ping Of Death traffic targeted against the Layer 3 switch