Cisco Catalyst 9600 Series

Performance Validation

August 2021

DR210602C

Contents

1.0 Executive Summary

Campus networks connect multiple local area networks (LANs) and require designs that readily accommodate density, scale, redundancy and security for guaranteed, reliable communications. With changing trends and future needs, the network should be intelligent enough to adapt to changing standards and unique activity.

Integral to this architecture are the aggregating and routing technologies – or, high-density switches. These devices ensure intelligent forwarding and port density that can help enterprise campuses achieve realistic deployment with reduced complexity and intent-based performance.

Cisco Systems, Inc. engaged Miercom to validate real-world performance of its Catalyst 9600 Series Switch using the **Supervisor Engine 1, C9600-LC-24C (40/100G) and C9600-LC-48YL (10/25G)** line cards. To validate data sheet specifications in a large-scale environment, Miercom engineers used the Spirent Test Center system to simulate high-density traffic. This test setup helped evaluate the way Cisco Catalyst 9600 switches can simplify, optimize and boost networking performance by leveraging intelligence and automation.

Key Findings for the Cisco Catalyst 9600 Series

- **Supervisor Engine 1 offered up to 9.6 Tbps total switching throughput with bi-directional traffic.**
- **Catalyst 9600 Series Switch delivered full line-rate throughput on every port with zero packet loss, based on high-density RFC2544 unicast and RFC3918 multicast throughput testing.**
- **Latency for unicast throughput testing was as low as 3.38µs and 3.33 µs for both unicast and multicast performance.**
- **Supervisor Engine 1 was scalable for up to 252,000 routes, and up to 131,000 MAC entries with customized SDM template.**
- **Catalyst 9600 series switch provides sub-second failover with NSF/SSO and NSR**.

Miercom has independently observed the performance of the Cisco Catalyst 9600 Series 100/40/25/10G Switches and awards the ***Miercom Performance Verified*** certification in recognition of its proven performance.

Robert Smithers

CEO, Miercom

2.0 Product Tested

Cisco Catalyst 9600 Switch Series

This switch series is designed for large-scale resiliency at a low operational cost point. These switches provide intelligent, automated technology for optimizing intent-based networking. Its security features further protect hardware and software integrity, as well as work with Cisco IOS XE APIs and Unified Access Data Plane (UADP) ASIC programmability for investment protection.

The Catalyst 9600 Series is the industry's first purpose-built 40 and 100 Gigabit Ethernet (GE) line of modular switches for enterprise campuses. The Cisco Catalyst 9606R chassis hardware supports the following:

- Up to 25.6 Tbps wired switching capacity with up to 6.4 Tbps bandwidth per slot
- 100/40 GE nonblocking Quad Small Form-Factor Pluggable (QSFP+, QSFP28)
- 25 GE Small Form-Factor Pluggable Plus (SFP, SFP+, SFP28)
- 10/5/2.5/1 GE and 100/10 (Megabit per second) Mbps RJ45 copper ports
- Redundant platinum rated power supplies
- Reversable fans tray with redundant fans

Cisco Catalyst 9600 Supervisor Engine 1

The UADP 3.0 Application-Specific Integrated Circuit (ASIC) is future-ready for next-generation technologies, with a programmable pipeline, microengine capabilities, and template-based configurable allocation of Layer 2, Layer 3, forwarding, ACL, and Quality-of-Service (QoS) entries.

- 2.0-GHz Intel® x86 CPU with 8 cores
- Console supports mini USB and RJ-45 connectivity
- Supports 2 x USB 3.0 ports
- Management port supports RJ-45 (1 GE) and SFP+ (10 GE)
- Up to 108 MB of buffer (36 MB of unified buffer per ASIC)
- Up to 262,144 IPv4/IPv6 entries with customized template
- Up to 131,072 MAC entries with customized template
- Line-rate, hardware-based Flexible NetFlow (FNF) delivers flow collection for up to 294,000 flows with customized template
- IPv6 support in hardware provides wire-rate forwarding for IPv6 networks
- Dual-stack support for IPv4 and IPv6 and dynamic hardware forwarding table allocations enable IPv4-to-IPv6 migration
- Flexible routing (IPv4, IPv6, and multicast) tables, Layer 2 tables, ACL tables, and QoS tables

3.0 How We Did It

Using hands-on network testing tools, business environments are simulated and challenged with real-world traffic scenarios to provide an accurate assessment of product performance.

Testing of the Cisco Catalyst 9600 switch employed the Spirent Test Center to generate traffic using bidirectional 100/25GE test ports, one for each corresponding port on the Device Under Test (DUT).

The following steps were taken prior to testing of each DUT:

1. Spirent Test Center was connected to the DUT
2. One Spirent test port was connected to each 100/25GE port on the switch, depending on the line cards used (C9600-LC-24C used 100GE; C9600-LC-48YL used 25GE)
3. Connectivity was confirmed on each port to avoid re-cabling for duration of testing

A battery of tests was applied to each switch to examine different aspects of the DUT based on standards (publicly available Internet Requests for Comments, or RFCs). The ones applicable to this assessment include RFCs 2544 for Unicast throughput and latency, and RFC 3918 for Multicast throughput and latency.

Traffic consisted of the following packet sizes:

- 192, 256, 512, 1024, 1280, 1518, 9216 bytes
- IMIX

	Hardware	Software Version
DUT	Catalyst 9600 Series Switches	IOS XE 17.03.03
Test Equipment	Spirent Test Center	5.16

Test Topology

Source: Miercom

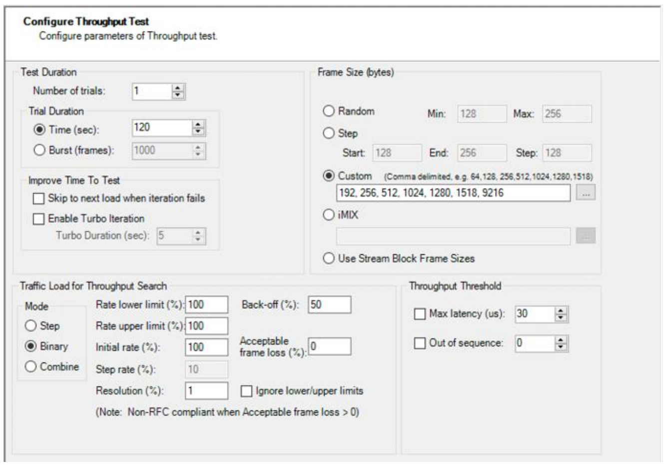
The Cisco Catalyst 9600 appliance is a chasis-based modular platform with a centralized Supervisor Engine.

4.0 Performance

Performance was tested using the RFC 2544 standard for conducting basic throughput and latency benchmark tests measurements and RFC 3918 for Mulicast testing with 100 Groups, 1 source and 47 receivers . This test analyzes full load capacity (throughput and latency) using 4 x C9600-LC-24C as well as line card performance (throughput and latency) using 1x C9600-LC-48YL. All ports are open and using Layer 2 and Layer 3 traffic.

4.1 Full Chassis Capacity Test

Using fully loaded chassis with two supervisors and 4x C9600-LC-24C line cards, the Catalyst 9600 switch was tested for full load capacity using 48 x 100 GE ports and generated Layer 2 and Layer 3 traffic. The following frame sizes (in bytes) were generated: 192, 256, 512, 1024, 1280, 1518, 9216.



The test duration was set to 120 seconds per frame size. Test options included Enable Learning, a mode that places a two second delay on traffic at a rate of 1000 frames per second, repeated five times.

This test determined the maximum rate at which the DUT received and forwarded traffic across all ports without any frame loss. Frames were generated at increasing rates through the DUT. Latency was recorded in microseconds (μs) as the difference in timestamps between packets sent and received by the Spirent Test Center system.

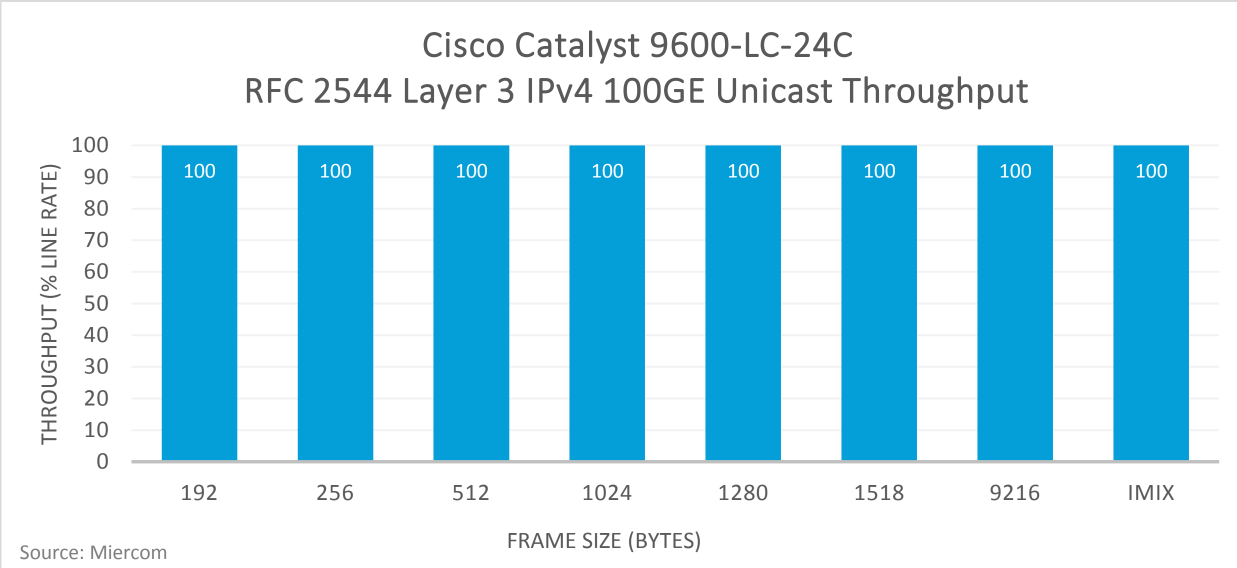
The DUT was configured, in accordance with RFC 2544 and RFC 3918 , to endure a stress test of the following load distributions traversing the local and other line cards to force traffic across all the fabric modules:

- Layer 3 (L3) - IPv4, IPv6
- Multicast – IPv4, IPv6
- Layer 2 (L2)

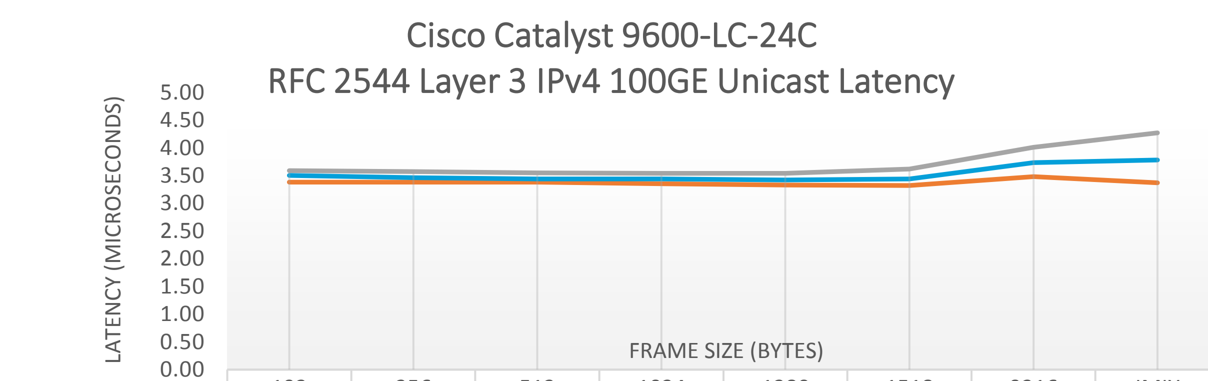
Spirent Test Center was configured to forward and receive traffic to and from each directly connected port on the switch. Frames were initially sent at the theoretically rated throughput of the port, and if successfully processed by the DUT, the switch was said to have achieved “wire speed” or “full line rate”. For example, the 100 GE port is sent 100 percent of its 100 Gbps load, and if successful, was observed as performing at full line rate.

The throughput was recorded as the most successful percentage of theoretical line rate. We expected 100 percent line rate across all ports.

4.1.1 Layer 3 IPv4 100GE Unicast Throughput and Latency



The Cisco Catalyst 9600-LC-24C exhibited full line-rate forwarding performance for all frame sizes with all 100GE ports loaded. Test results shown are for the 100GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv4 unicast traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Testing was conducted in accordance with RFC 2544.

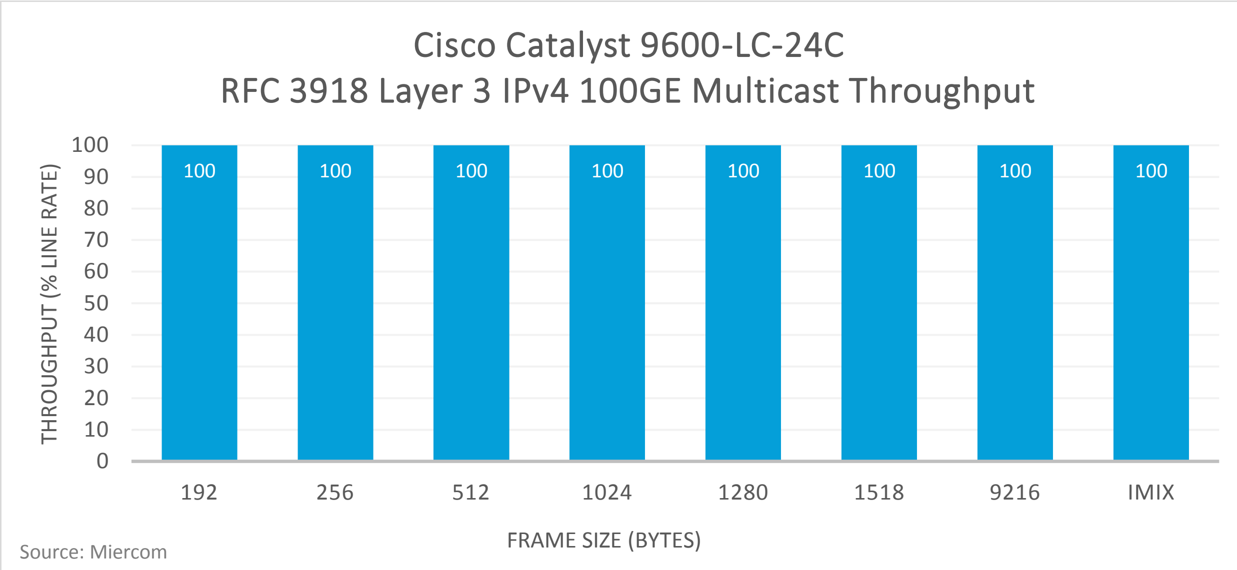


	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.38	3.38	3.38	3.35	3.33	3.32	3.48	3.37
Avg Latency	3.50	3.46	3.44	3.44	3.42	3.44	3.73	3.78
Max Latency	3.59	3.57	3.55	3.54	3.54	3.62	4.01	4.27

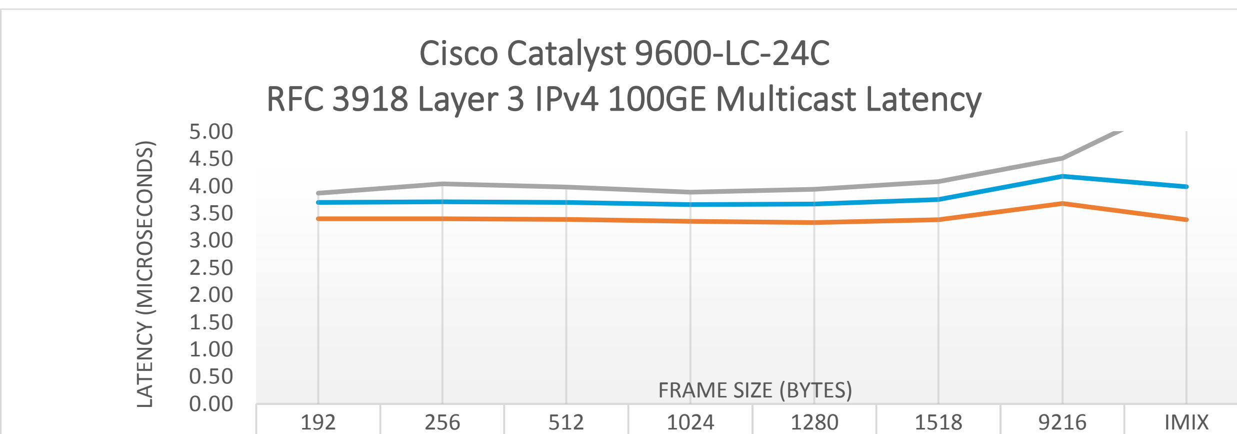
Source: Miercom

The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 100GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv4 unicast traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.42 to 3.78 microseconds. Tests were conducted in accordance with RFC 2544.

4.1.2 Layer 3 IPv4 100GE Multicast Throughput and Latency



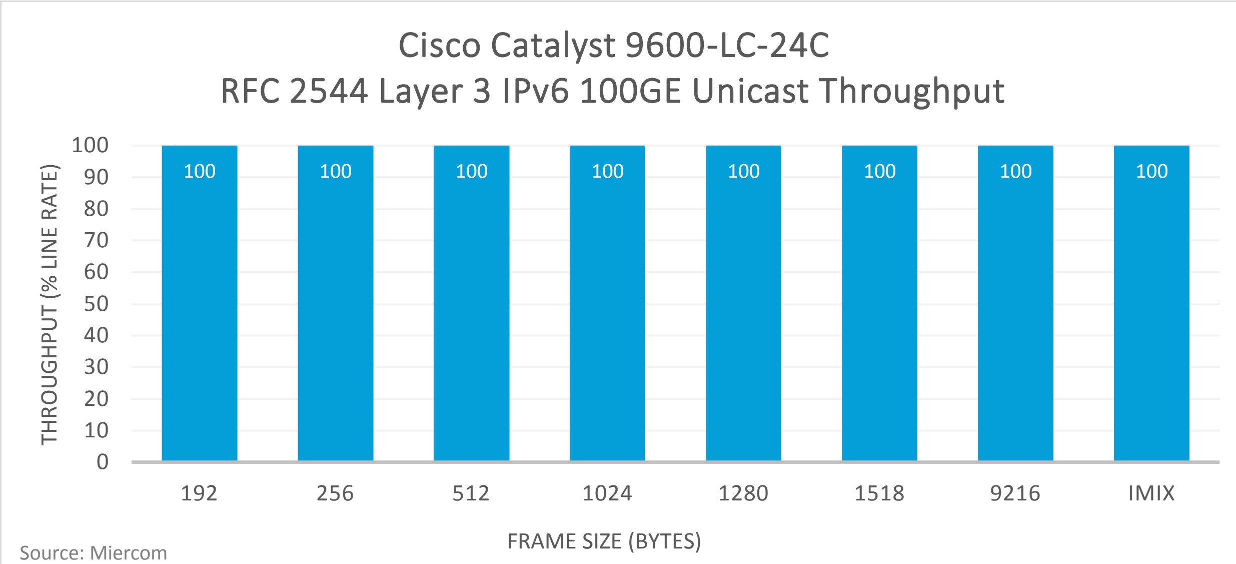
The Cisco Catalyst 9600-LC-24C exhibited full line-rate forwarding performance for all frame sizes with all 100GE ports loaded. Test results shown are for the 100GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv4 multicast traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Testing was conducted in accordance with RFC 3918.



	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.40	3.40	3.39	3.35	3.33	3.38	3.68	3.38
Avg Latency	3.70	3.71	3.70	3.66	3.67	3.75	4.18	3.99
Max Latency	3.87	4.04	3.98	3.89	3.94	4.08	4.51	5.61

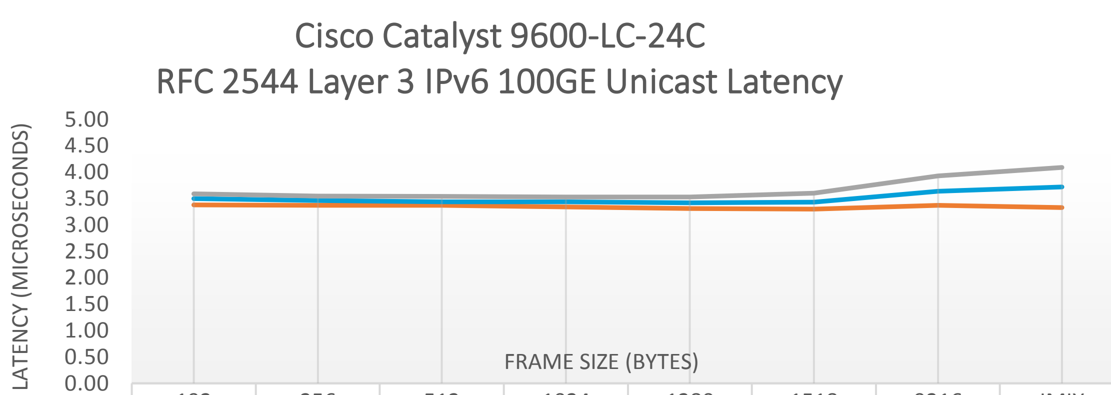
The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 100GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv4 multicast traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.67 to 4.18 microseconds. Tests were conducted in accordance with RFC 3918.

4.1.3 Layer 3 IPv6 100GE Unicast Throughput and Latency



Source: Miercom

The Cisco Catalyst 9600-LC-24C exhibited full line-rate forwarding performance for all frame sizes with all 100GE ports loaded. Test results shown are for the 100GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Testing was conducted in accordance with RFC 2544.

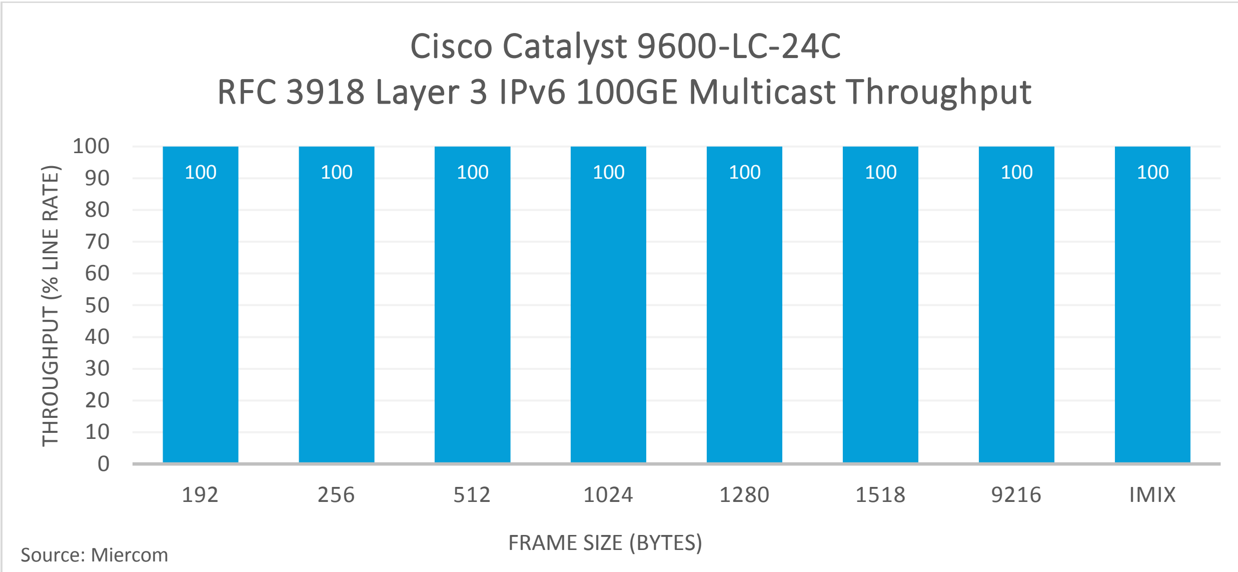


	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.38	3.37	3.37	3.34	3.31	3.30	3.37	3.33
Avg Latency	3.50	3.46	3.44	3.44	3.42	3.43	3.64	3.72
Max Latency	3.59	3.55	3.54	3.53	3.53	3.60	3.93	4.09

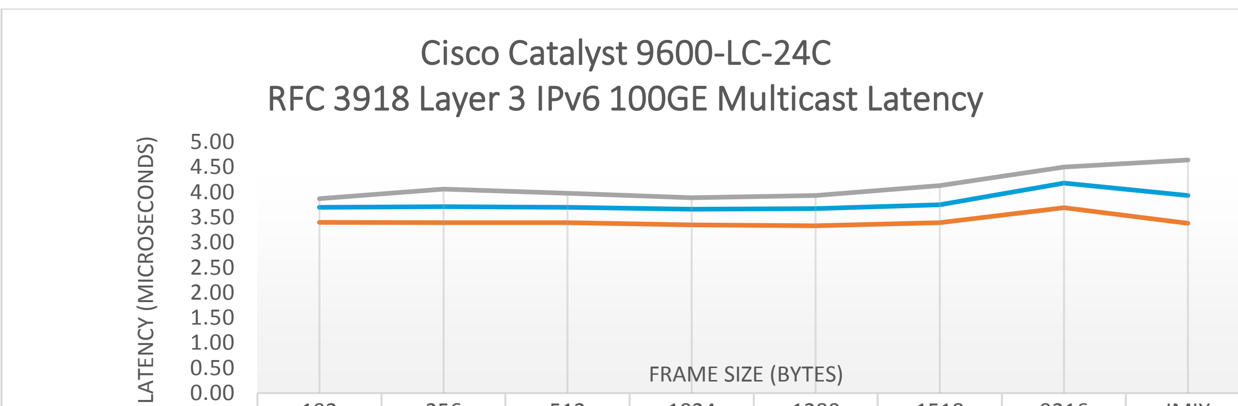
Source: Miercom

The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 100GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.42 to 3.72 microseconds. Tests were conducted in accordance with RFC 2544.

4.1.4 Layer 3 IPv6 100GE Multicast Throughput and Latency



The Cisco Catalyst 9600-LC-24C exhibited full line-rate forwarding performance for all frame sizes with all 100GE ports loaded. Test results shown are for the 100GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Testing was conducted in accordance with RFC 3918.

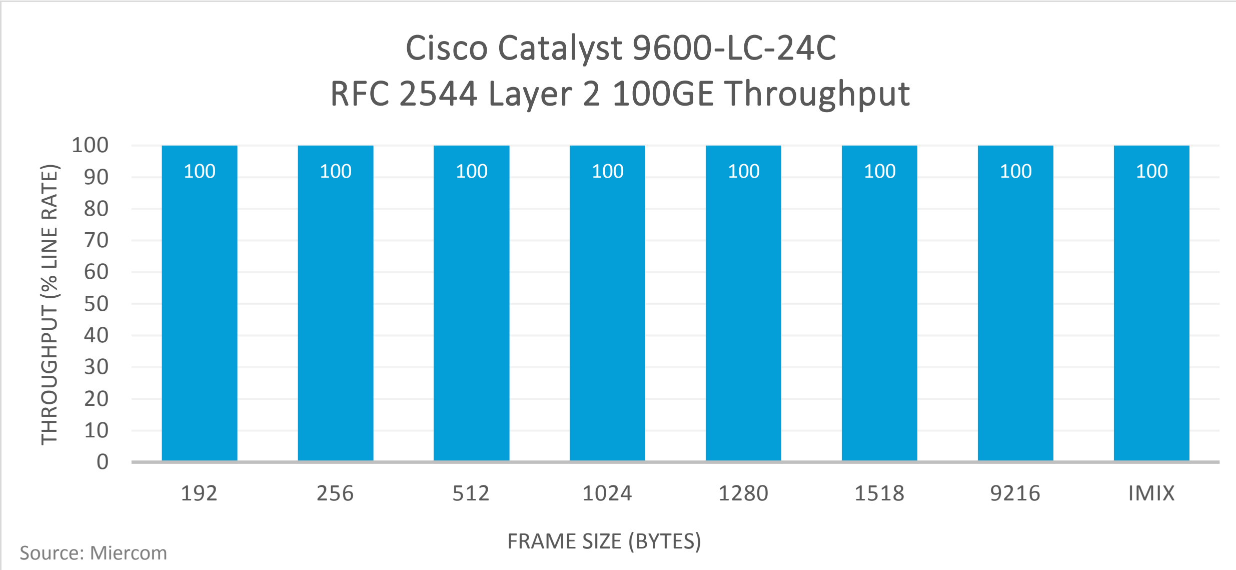


	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.40	3.39	3.39	3.35	3.33	3.39	3.69	3.38
Avg Latency	3.70	3.71	3.70	3.66	3.67	3.75	4.18	3.93
Max Latency	3.87	4.06	3.98	3.89	3.93	4.13	4.50	4.64

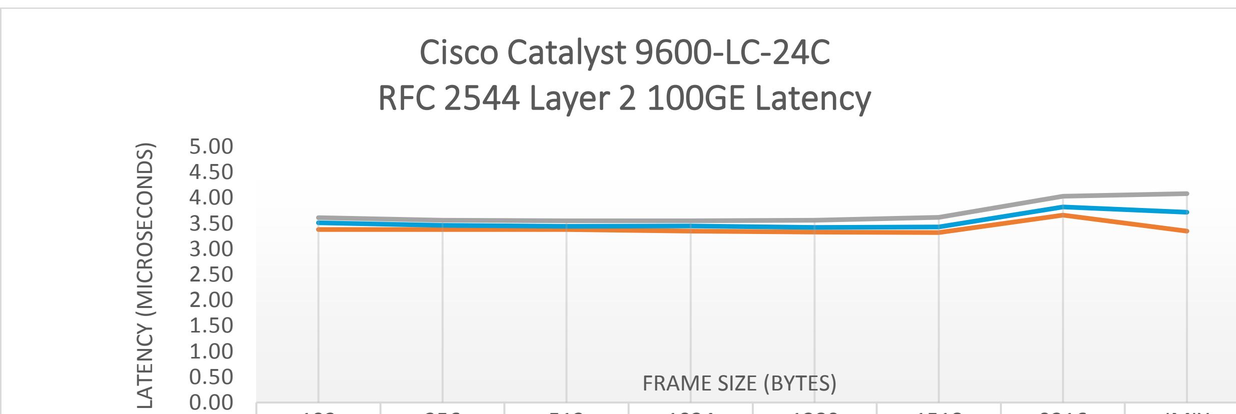
Source: Miercom

The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 100GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.33 to 4.64 microseconds. Tests were conducted in accordance with RFC 3918.

4.1.5 Layer 2 100GE Throughput and Latency



The Cisco Catalyst 9600-LC-24C exhibited full line-rate forwarding performance for all frame sizes with all 100GE ports loaded. Test results shown are for the 100GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Testing was conducted in accordance with RFC 2544.



	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.38	3.38	3.38	3.35	3.33	3.32	3.66	3.35
Avg Latency	3.51	3.46	3.44	3.45	3.42	3.43	3.82	3.72
Max Latency	3.61	3.56	3.55	3.55	3.56	3.62	4.03	4.08

Source: Miercom

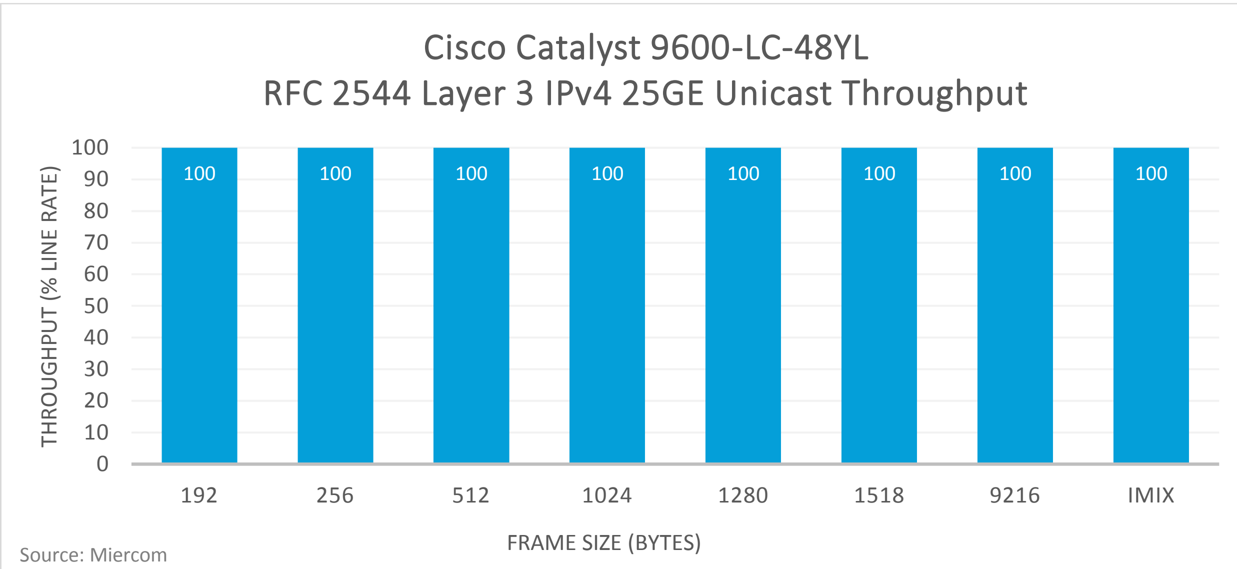
The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 100GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.42 to 3.82 microseconds. Tests were conducted in accordance with RFC 2544.

4.2 Line Card Performance Test

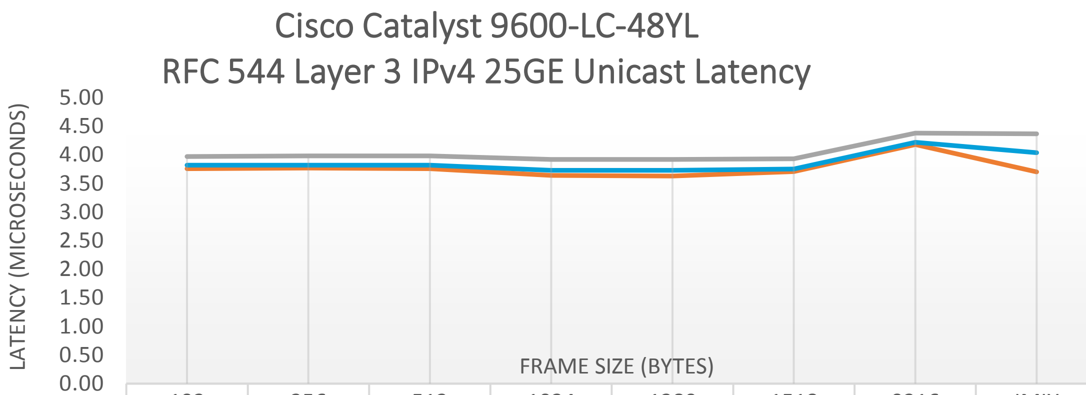
This test determined the maximum bandwidth of the line card using 1x C9600-LC-48 YL line card (48 x 25 GE ports) and for the following:

- Layer 3 (L3) - IPv4, IPv6
- Multicast – IPv4, IPv6
- Layer 2 (L2)

4.2.1 Layer 3 IPv4 25GE Unicast Line Rate Performance



The Cisco Catalyst 9600-LC-48YL exhibited full line-rate forwarding performance for all frame sizes with all 25GE ports loaded. Test results shown are for the 25GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes.

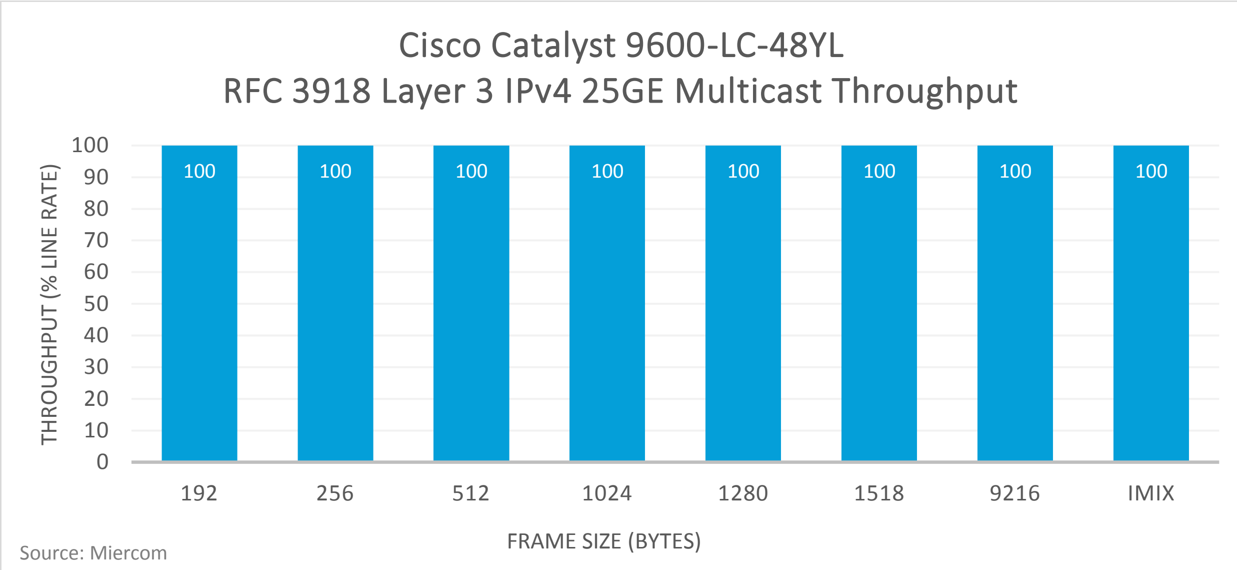


	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.76	3.77	3.76	3.64	3.63	3.71	4.18	3.70
Avg Latency	3.82	3.82	3.82	3.73	3.73	3.75	4.22	4.04
Max Latency	3.97	3.98	3.98	3.92	3.92	3.93	4.38	4.37

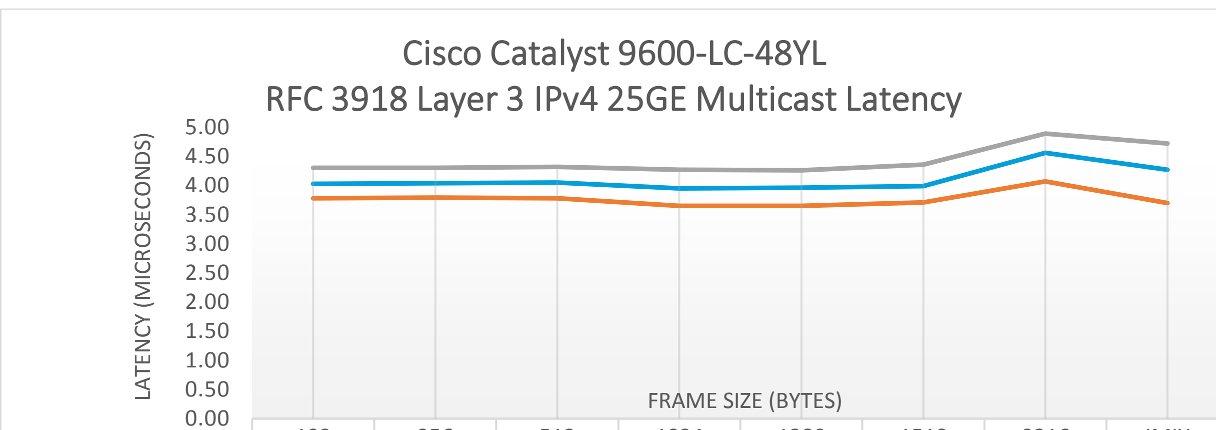
Source: Miercom

The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 25GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.73 to 4.22 microseconds. Tests were conducted in accordance with RFC 2544.

4.2.2 Layer 3 IPv4 25GE Multicast Line Rate Performance



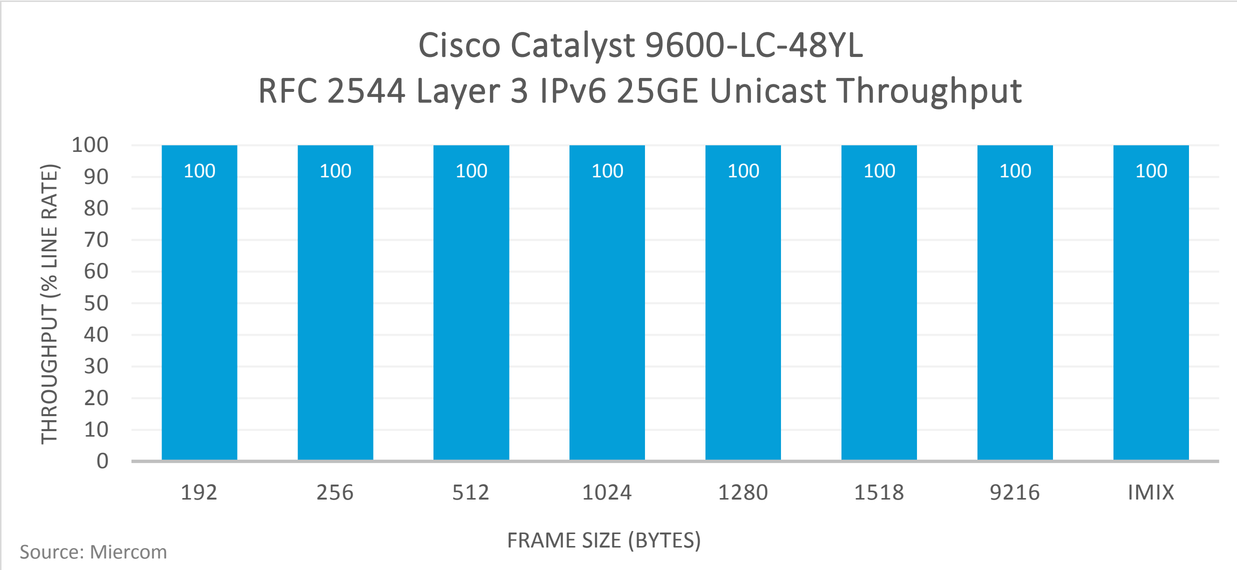
The Cisco Catalyst 9600-LC-48YL exhibited full line-rate forwarding performance for all frame sizes with all 25GE ports loaded. Test results shown are for the 25GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes.



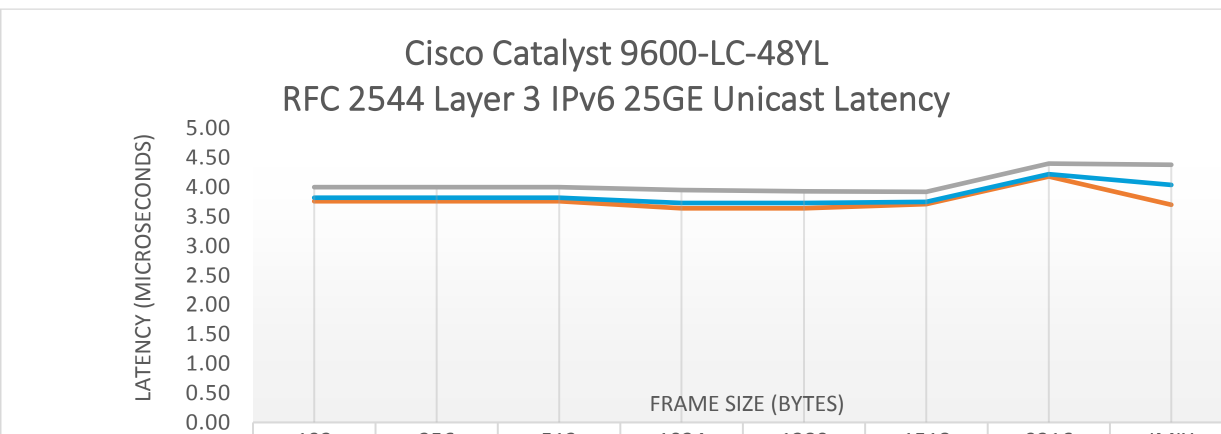
	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.78	3.79	3.78	3.65	3.65	3.71	4.07	3.70
Avg Latency	4.03	4.04	4.05	3.95	3.96	3.99	4.56	4.27
Max Latency	4.30	4.30	4.32	4.27	4.26	4.36	4.89	4.72

The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 25GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.95 to 4.56 microseconds. Tests were conducted in accordance with RFC 3918.

4.2.3 Layer 3 IPv6 25GE Unicast Line Rate Performance



The Cisco Catalyst 9600-LC-48YL exhibited full line-rate forwarding performance for all frame sizes with all 25GE ports loaded. Test results shown are for the 25GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes.

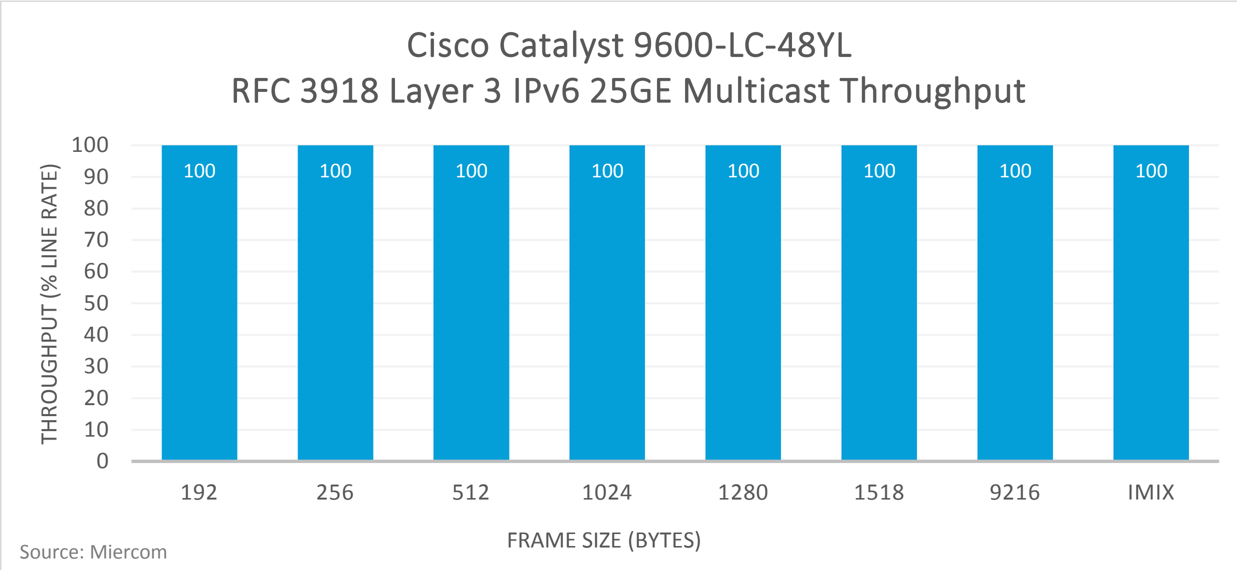


	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.76	3.76	3.76	3.64	3.64	3.71	4.18	3.70
Avg Latency	3.82	3.82	3.82	3.73	3.73	3.75	4.22	4.04
Max Latency	4.00	4.00	4.00	3.95	3.93	3.92	4.40	4.38

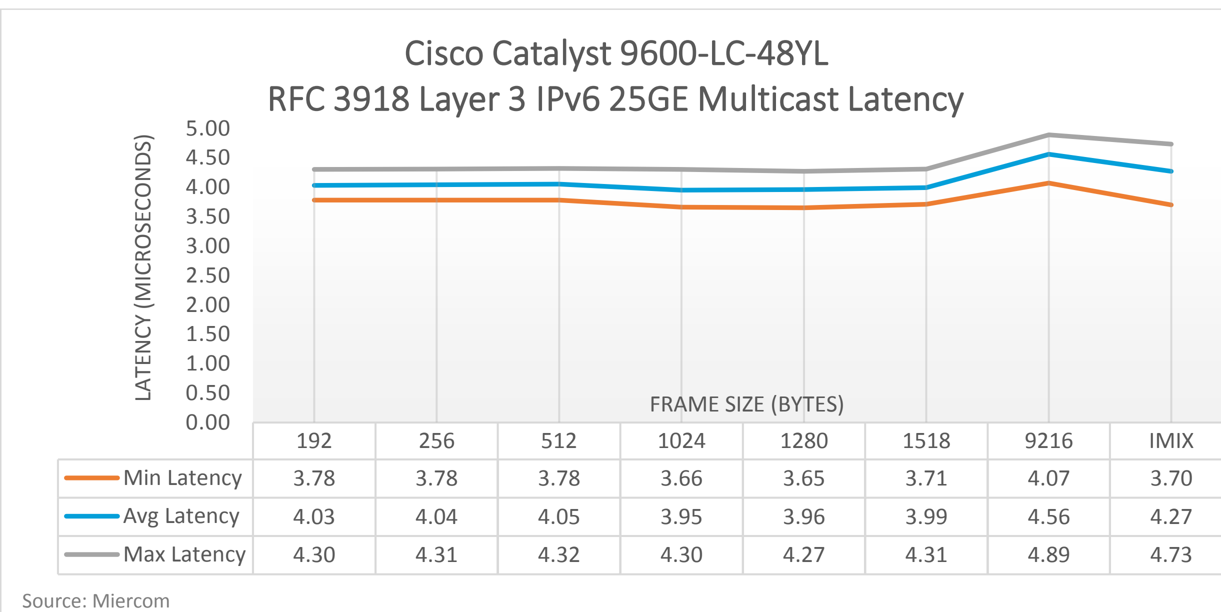
Source: Miercom

The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 25GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.73 to 4.22 microseconds. Tests were conducted in accordance with RFC 2544.

4.2.4 Layer 3 IPv6 25GE Multicast Line Rate Performance



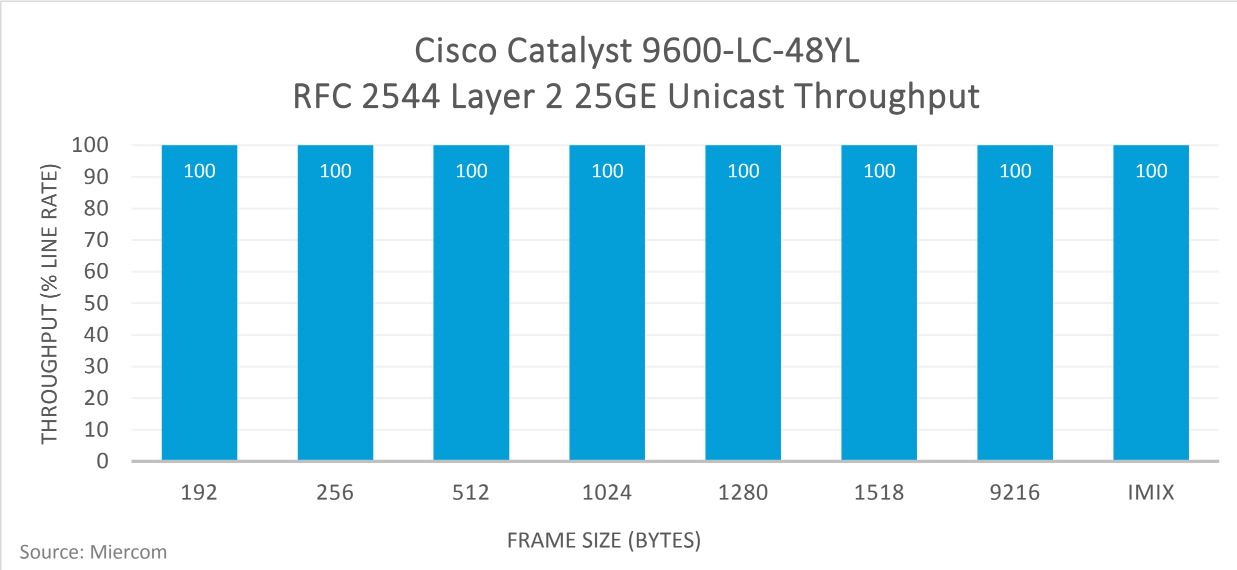
The Cisco Catalyst 9600-LC-48YL exhibited full line-rate forwarding performance for all frame sizes with all 25GE ports loaded. Test results shown are for the 25GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes.



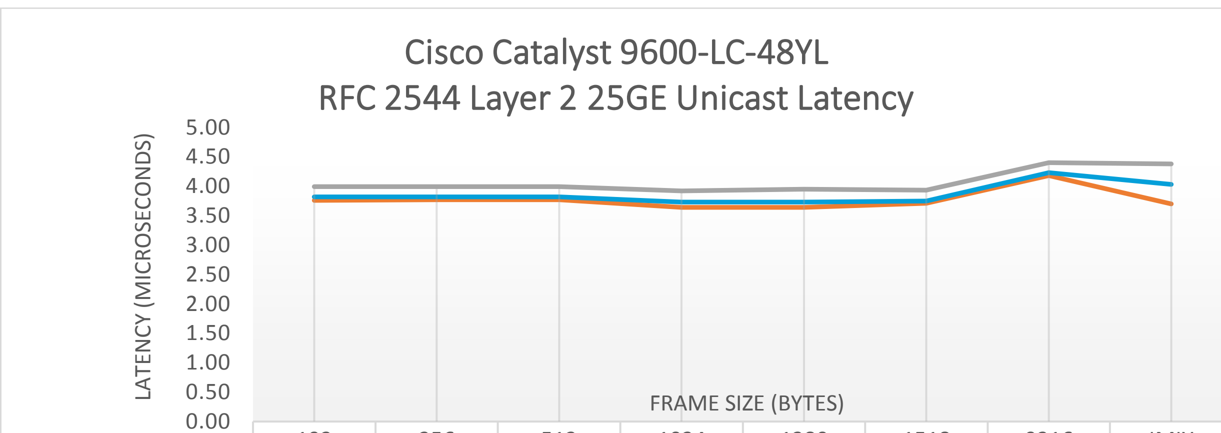
	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.78	3.78	3.78	3.66	3.65	3.71	4.07	3.70
Avg Latency	4.03	4.04	4.05	3.95	3.96	3.99	4.56	4.27
Max Latency	4.30	4.31	4.32	4.30	4.27	4.31	4.89	4.73

The Cisco Catalyst 9600-LC-24C exhibited the latency results shown above during 25GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.95 to 4.56 microseconds. Tests were conducted in accordance with RFC 3918.

4.2.5 Layer 2 25GE Line Rate Performance



The Cisco Catalyst 9600-LC-48YL exhibited full line-rate forwarding performance for all frame sizes with all 25GE ports loaded. Test results shown are for the 25GE port-pair testing configuration. The switch endured a maximum sustainable load without loss for Layer 3 IPv6 traffic for frames sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes.



	192	256	512	1024	1280	1518	9216	IMIX
Min Latency	3.76	3.77	3.77	3.64	3.64	3.71	4.18	3.70
Avg Latency	3.82	3.82	3.82	3.73	3.73	3.75	4.23	4.03
Max Latency	3.99	3.99	3.99	3.92	3.95	3.93	4.40	4.38

The Cisco Catalyst 9600-LC-48YL exhibited the latency results shown above during 100GE switch testing. The switch was subjected to maximum sustainable load without loss for Layer 3 IPv6 traffic for frame sizes ranging from 192 to 9216 bytes and an IMIX weighted mixture of frame sizes. Average latency ranges from 3.73 to 4.23 microseconds. Tests were conducted in accordance with RFC 2544.

5.0 FIB Scale with Custom SDM Template

This standard validates the Forwarding Information Base (FIB) convergence performance. Routing entries change frequently in a dynamic network. In a high-capacity network, these changes may cause delays or packet loss. Despite these changes, a Core switch is expected to handle thousands of routes while providing high performance and scalability.

The Cisco Catalyst 9600 series uses flexible Switch Database Management (SDM) ASIC templates to optimize table sizes throughout the network. Depending on the deployment, the SDM template can configure the switch for specific features. For example, the Distribution Template balances system resources between Layer 3 routes and Layer 2 MAC and Netflow. By default, the Catalyst 9600 uses the Core template which favors Layer 3 routes and balances Layer 2 MAC and Netflow.

The Cisco Catalyst 9600 Supervisor 1 engine also supports a Custom SDM template, which allows users to configure the system resources. This divides FIB and TCAM resources to fit deployment models.

IOSXE 17.3.1

FIB Scale Customization

* Total Multicast (L2+L3) =/< 48K

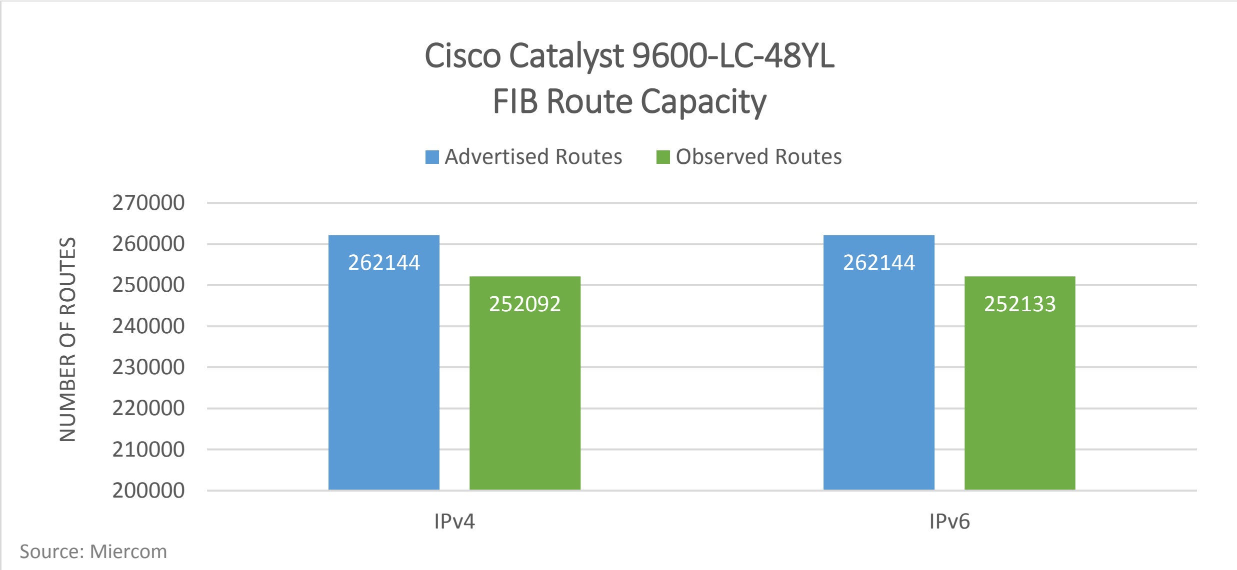
Feature	Scale Values (Min – Max)	Default Value	Step Units
L2 MAC	32K - **128K**	32K	16K
L3 Unicast	64K - **256K**	64K	16K
L3 Multicast *	0 - **32K**	16K	16k
L2 Multicast *	0 - **32K**	16K	16K
SGT & MPLS IP-to-Tag labels	0 - **64K**	32K	32K
Netflow - Input	0 - **64K**	32K	32K
Netflow - Output	0 - **64K**	0	32K
Total Resources	**416K**		

Scale Values: minimum and maximum possible values
Step Units: granularity (block size) of scale per type
Default Value: default value, if it's not specified by CLI

16K – 16384
32K – 32768

Using the Spirent test tool, we determined the deep routing capacity the DUT could sustain at a single time – a scalability test revealing capacity and network limitations. Route capacity was calculated while 100 percent of ingress traffic was sent by the DUT to every route advertised.

The DUT was set to reach a maximum scale of 256K (262,144) IPv4/IPv6 routes.

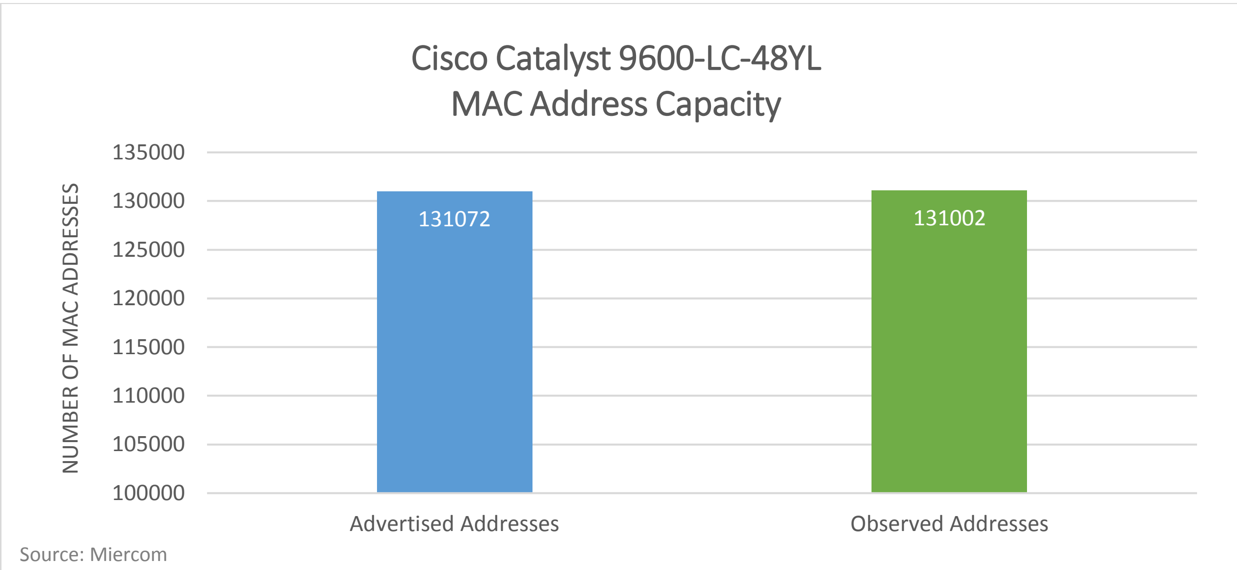


The Cisco Catalyst 9600-LC-48YL switch eBGP route scalability over IPv4 and IPv6 were observed to be 96.2 percent of advertised route capacity.

6.0 MAC Scale with Custom SDM Template

C9600 Sup1 is set to Core SDM template by default with MAC scale (32K). We sent 32,000 unicast MAC addresses to confirm the configuration; efficiency was expected to be 99 percent.

To test the maximum MAC scale, we then injected maximum MAC addresses of 128K (131,072) using custom SDM template , throttling to reach 131,002 MAC addresses.

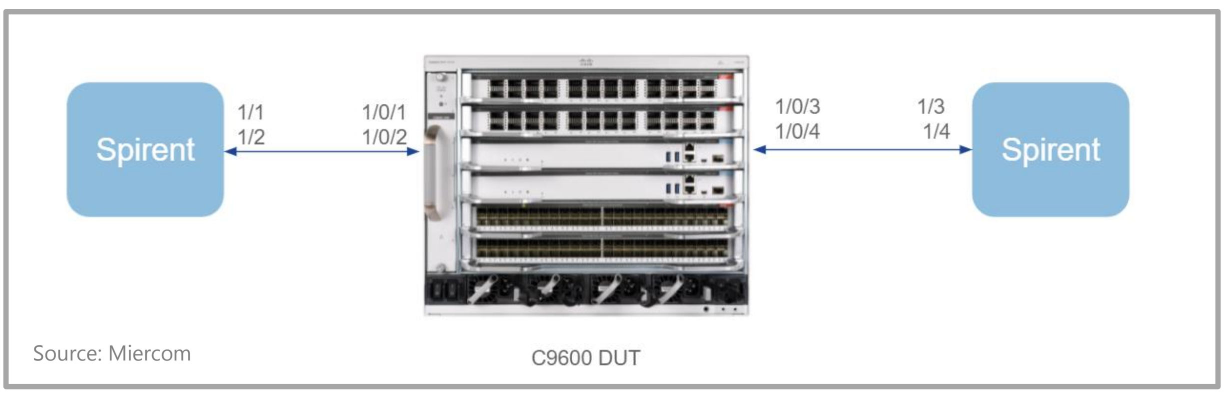


The Cisco Catalyst 9600-LC-48YL switch proved 1 percent more MAC address capacity than advertised.

7.0 High Availability

The Cisco Catalyst 9600 Series switches support high-availability (HA) features, including the following:

- Cisco Stateful Switch-Over (SSO) is a well-established HA technology that supports fault resistance by allowing a redundant supervisor engine to take over if the primary supervisor engine fails. Cisco SSO (frequently used with NSF) minimizes the time a network is unavailable to its users following a switchover while continuing to forward IP packets.
- Cisco Non-Stop Forwarding (NSF) NSF works with SSO to minimize the amount of time a network is unavailable to its users following a switchover. The main objective of Cisco NSF is to continue forwarding IP packets following a route processor (RP) switchover.
- Cisco Catalyst® 9600 platform StackWise® Virtual technology allows the clustering of two physical switches together into a single logical entity. The two switches operate as one; they share the same configuration and forwarding state.
- Multichassis EtherChannel configurable across StackWise-Virtual members for high resiliency.
- IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) provides rapid spanning tree convergence independent of spanning tree timers and also offers the benefit of Layer 2 load balancing and distributed processing.
- Per-VLAN Rapid Spanning Tree (PVRST+) allows rapid spanning tree (IEEE 802.1w) reconvergence on a per-VLAN spanning tree basis, providing simpler configuration than MSTP. In both MSTP and PVRST+ modes, stacked units behave as a single spanning tree node.
- Switch-port auto-recovery ("err-disable" recovery) automatically attempts to reactivate a link that is disabled because of a network error.



The topology above was used for NSF and NSR high availability testing.

Non-Stop Forwarding (NSF)

NSF requires a neighboring device to work in tandem in the event of a failure on either active or standby side, traffic will not be deeply impacted. If the "Hello" packets that are normally sent by the active device are no longer seen, the entire neighborhood goes down. NSF relies on the support of neighboring devices. NSF is not a needed feature but is recommended.

SSO NSF Testing

Two consoles were involved in SSO NSF testing; one was active and the other on standby. The active was rebooted and the standby was expected to take over.

```
Mod Ports Card Type                                        Model          Serial No.
---+-----+-------------------------------------------+--------------+--------------
1   48    48-Port 10GE / 25GE                          C9600-LC-48YL   CAT2310L58G
2   24    24-Port 40GE/12-Port 100GE                   C9600-LC-24C    CAT2310L4DT
3   0     Supervisor 1 Module                          C9600-SUP-1     CAT2325L740
4   0     Supervisor 1 Module                          C9600-SUP-1     CAT2325L028
5   24    24-Port 40GE/12-Port 100GE                   C9600-LC-24C    CAT2328L3KU
6   24    24-Port 40GE/12-Port 100GE                   C9600-LC-24C    CAT2331L65H

Mod MAC addresses                   Hw    Fw            Sw                 Status
---+--------------------------------+----+------------+------------------+--------
1   DC8C.3772.D700 to DC8C.3772.D77F 1.0  17.3.1r[FC2]  17.03.03            ok
2   DC8C.3772.E880 to DC8C.3772.E8FF 1.0  17.3.1r[FC2]  17.03.03            ok
3   683B.78E4.6880 to 683B.78E4.68FF 1.0  17.3.1r[FC2]  17.03.03            ok
4   5C5A.C748.C380 to 5C5A.C748.C3FF 1.0  17.3.1r[FC2]  17.03.03            ok
5   084F.A901.FD00 to 084F.A901.FD7F 1.0  17.3.1r[FC2]  17.03.03            ok
6   084F.A9A2.4300 to 084F.A9A2.437F 1.0  17.3.1r[FC2]  17.03.03            ok

Mod Redundancy Role     Operating Redundancy Mode Configured Redundancy Mode
---+-------------------+-------------------------+---------------------------
3   Active              sso                       sso
4   Standby             sso                       sso
```

Modules 3 and 4 contained the Supervisor 1 Module. For this testing Module 3 was active and Module 4 was on Standby as shown in the screenshot. SSO is by default. Slot 1 was being used for this HA testing.

Additionally BGP protocol was being used. Traffic generator will be sent from Port 1 to 4 and after running BGP, we are able to see 200 routes in Routing Summary.

```
C9600#redundancy force-switchover
Proceed with switchover to standby RP? [confirm]
    Manual Swact = enabled

*May  7 16:20:53.802: %RF-5-RF_RELOAD: Self reload. Reason: redundancy force-switchover
*May  7 16:20:54.052: %SYS-5-SWITCHOVER: Switchover requested by red_switchover_process. Reason: redundancy force-switchover.May  7 16:21:0
0.471: %PMAN-3-RELOAD_RP: R0/0: pvp: Reloading: RP switchover initiated. This RP will be reloaded
```

Using the command #redundancy force-switchover, we forced the active switch to reboot and the standby immediately took over.

Streams > Dropped Stream Results | Change Result View | Result Count: 4/4

Count es)	Tx Rate (fps)	Rx Sig Rate (fps)	Duplicate Count (Frames)	Dropped Count (Frames)	Dropped Frame Duration (us)	Min Latency (us)	Max Latency (us)	Avg Latency (us)
391,126	11,322,463	11,322,456	0	42	3.71	3.86	96.95	47.8233
414,825	11,322,464	11,322,456	0	42	3.71	3.86	97.1	47.7901
881,472	11,322,464	11,322,457	0	41	3.62	3.86	96.97	47.7706
187,743	11,322,463	11,322,459	0	41	3.62	3.86	97.06	47.8034

Redundancy command was executed and approximately 3ms of traffic loss was observed after completed switchover.

Non-Stop Routing (NSR)

NSR is a new feature that no longer leverages neighboring devices. Internally between the active and standby processors, a special communication checkpoint framework is enabled to sync routing protocol information.

Previously, only hardware routing information was synced, and the FIB information contained only the best route. For NSR, everything (RIB and FIB) is synced from active to standby. Standby then has an exact replica of everything the active has. Now if the active device fails, the standby has the same information and can immediately take over and continue forwarding the "Hello" to neighboring devices.

NSR is a unique competitive differentiator that is supported on Catalyst 9400, 9500H, and 9600 on both standalone, dual supervisor, mode and stackwise virtual mode.

NSR testing is not supported with BGP at the time of testing, therefore OSPF is being used. Port 5 and 6 on slot 1 are being used with IPv4 addresses.

```
C9600#sh run | sec ospf
router ospf 1
 nsr
 network 192.168.1.16 0.0.0.7 area 0
```

OSPF configuration, note that NSR is necessary to be configured in order to enable.

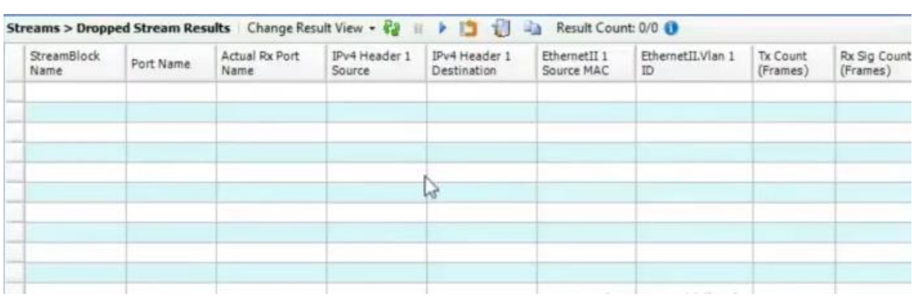
```
C9600#sh ip route summary
IP routing table name is default (0x0)
IP routing table maximum-paths is 32
Route Source    Networks    Subnets     Replicates  Overhead    Memory (bytes)
connected       0           96          0           9984        29952
static          0           0           0           0           0
ospf 1          0           100         0           10400       31600
```

OSPF routing was used and 100 were found. 50 routes are on each port.

Using the command #redundancy force-switchover, we forced the active switch to reboot, and the standby immediately took over. We don't observe any traffic drop as shown on "Dropped Stream Results" in Spirent Test Center.

```
C9600#redundancy force-switchover
Proceed with switchover to standby RP? [confirm]
    Manual Swact = enabled

*May  7 16:40:54.927: %RF-5-RF_RELOAD: Self reload. Reason: redundancy force-switchover
*May  7 16:40:55.179: %SYS-5-SWITCHOVER: Switchover requested by red_switchover_process. Reason: redundancy force-switchover.
```



Redundancy command was launched and no traffic drops were observed.

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