

Dell Networking Data Center Switches

Dell PowerSwitch S5448F-ON 100/400GbE Aggregation Switch Performance Evaluation

EXECUTIVE SUMMARY

Next-generation open networking is a key element of enterprise data centers. High-performance and high-density are mandatory characteristics for aggregation switches. Dell Technologies offers a complete set of data center purpose built Layer 2 and Layer 3 switches that not only provide 100GbE and 400GbE ports but are also part of the open networking innovation supporting multiple Network Operating Systems (NOS) options.

Dell Technologies commissioned Tolly to benchmark the overall performance, latency and power consumption of its Dell PowerSwitch S5448F-ON, an aggregation switch offering up to 48x 100GbE ports and 8x 400GbE ports.

The PowerSwitch S5448F-ON delivered 100% line-rate RFC2544 Layer 2 and Layer 3 throughput with all 48x 100GbE ports and 8x 400GbE ports in a dual-snake topology at frame sizes of 512-bytes and greater. Tolly engineers also benchmarked Layer 2/Layer 3 latency, power consumption as well as MAC/FIB table capacities.

THE BOTTOM LINE

The Dell S5448F-ON PowerSwitch demonstrated:

- 1 100% line-rate L2/L3 throughput at 512-byte and higher frame sizes with 48x 100GbE + 8x 400GbE ports
- 2 8Tbps of aggregate throughput at 100% line rate
- 3 FIBv4 and IPv4 routing table capacity of 340,000 BGP routes without loss

Dell PowerSwitch S5448F-ON 100/400GbE Aggregation Switch



Source: Dell Technologies

Figure 1




Test Results

Layer 2/3 RFC2544 Throughput

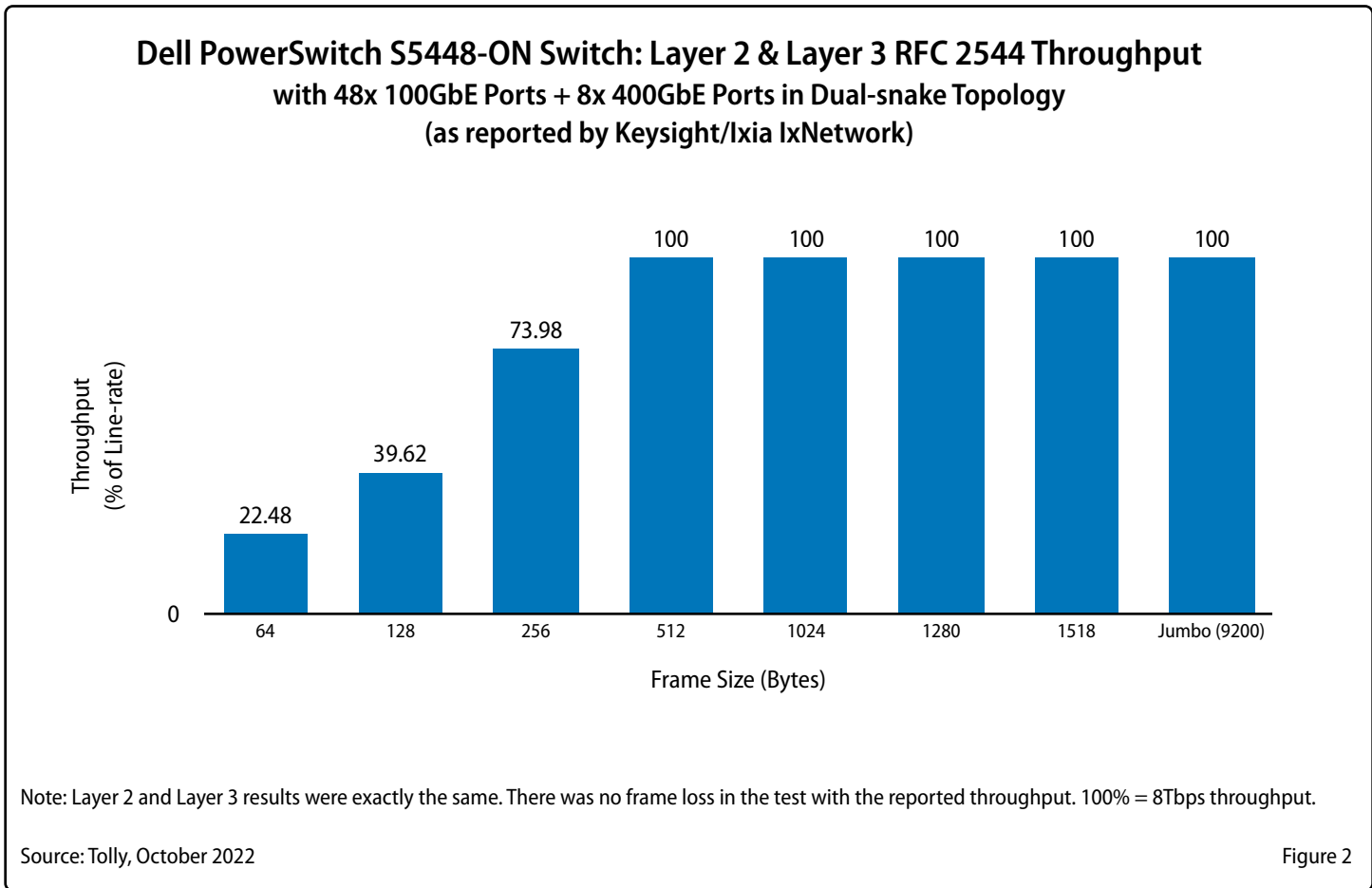
Tolly engineers benchmarked the throughput and latency using IETF RFC2544. The throughput tests used all 48x 100GbE ports and 8x 400GbE ports on the switch simultaneously handling bi-directional traffic in a dual-snake topology¹. The maximum throughput with zero frame loss is reported for each test.

At all frame sizes of 512-byte and above, including "jumbo" frames, the Dell PowerSwitch S5448-ON switch demonstrated line-rate 8Tbps L2 or L3 throughput. With 64-byte frames, the switch delivered 1.80Tbps which is 22.48% of line-rate L2 or L3 throughput. With 128-byte frames, the switch delivered 3.17Tbps which is 39.62% of line-rate L2 or L3 throughput. With 256-byte frames, the switch delivered 5.92Tbps which is 73.98% of line-rate L2 or L3 throughput. See Figure 2.

Dell Technologies
Dell PowerSwitch S5448F-ON
100/400GbE Aggregation Switch
Performance Evaluation



Tested October 2022



¹ All 100GbE ports were tested in a snake topology while all 400GbE ports were tested in another snake topology simultaneously.



Layer 2/3 RFC2544 Latency

Last-in, first out (LIFO) latency was benchmarked in a port-to-port topology with two 100GbE ports on the switch and two 400GbE ports on the switch. Tests used 100% line-rate throughput for each frame size.

microseconds (μs) to 1.18 μs was reported for different frame sizes on the 100GbE ports and results averaging from between 1.07 μs and 1.14 μs on the 400GbE ports. See Figure 3.

Tests measured latency on the ports of the switch in store-and-forward mode. The results at Layer 2 and Layer 3 were almost identical. Latency averaging from 0.93

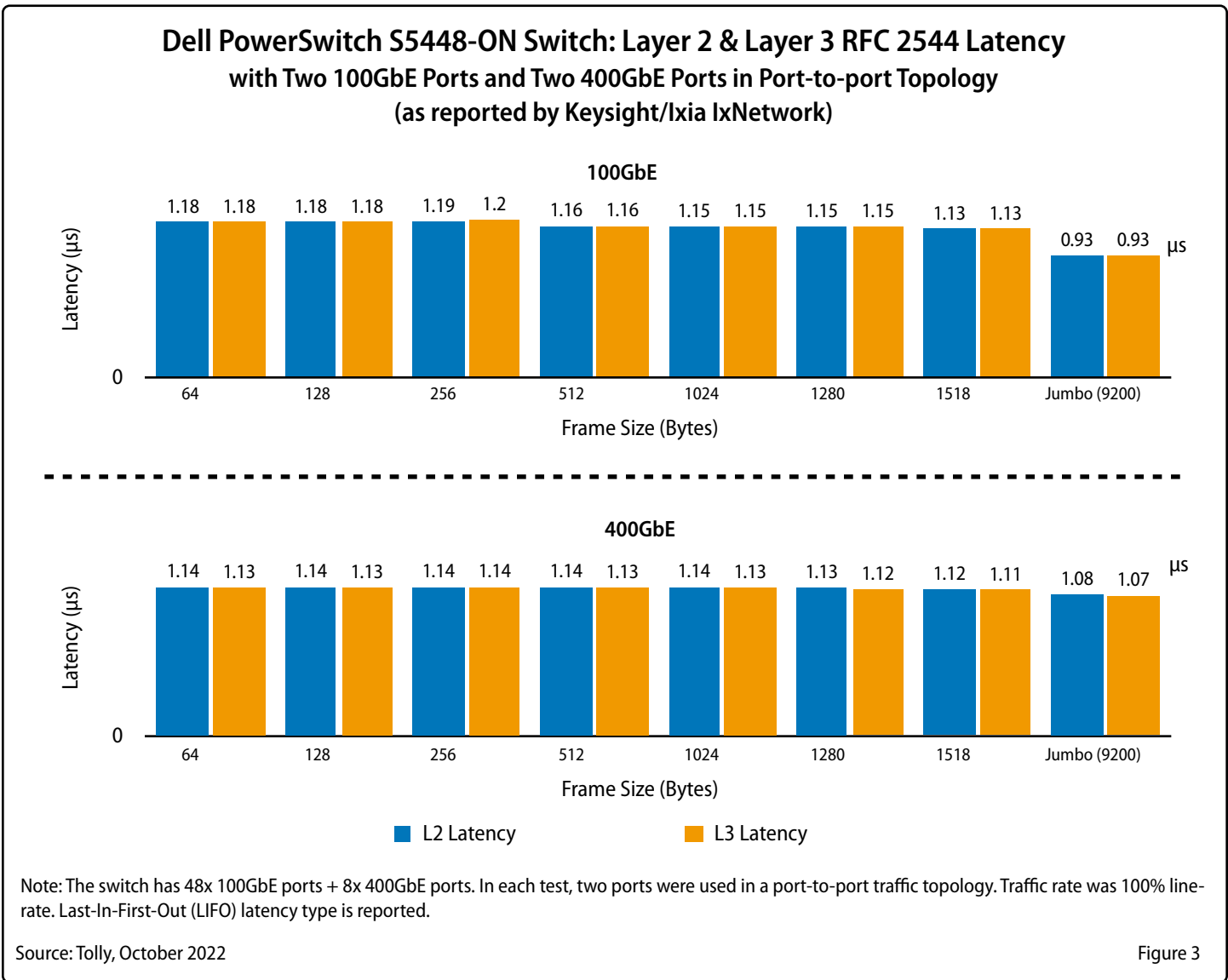


Figure 3



Power Consumption

Tolly engineers benchmarked the power consumption and calculated the ATIS weighted power of each switch according to the ATIS-0600015.03.2016 "Energy Efficiency for Telecommunication Equipment: Methodology for Measurement and Reporting for Router and Ethernet Switch Products" document. See Table 1.

The PowerSwitch S5448F-ON has ATIS weighted power of 274.9 Watts and ATIS TEER (Telecommunication Energy Efficiency Ratio) of 29.1Gbps/Watt.

Dell PowerSwitch S5448F-ON Power Consumption

ATIS Weighted Power (lower is better)	Idle Power (all ports connected and up)	30% Traffic	100% Traffic	ATIS TEER (Gbps/Watt)
274.9W	250W	272W	323W	29.1

Notes: 1. 48x 100GbE + 8x 400GbE ports. Maximum throughput of 8Tbps tested.

2. ATIS weighted power = 0.1 * (idle power) + 0.8 * (power with 30% traffic) + 0.1 * (power with 100% traffic). The default iMIX profile in Ixia IxNetwork was used in the test with all ports in a dual-snake topology

Source: Tolly, October 2022

Table 1

Table Capacity

Tolly engineers also benchmarked the maximum capacity of several key tables on the switch. Please see Table 2 for verified capacity of each table. The MAC table capacity was tested in Scaled-L2 mode of the switch. The FIB capacity was tested in Scaled-L3-Routes mode of the switch.

Dell PowerSwitch S5448F-ON Table Capacity

MAC Table	222,000 MAC addresses
FIBv4 / IPv4 Routing Table - BGP	340,000 routes

Source: Tolly, October 2022

Table 2

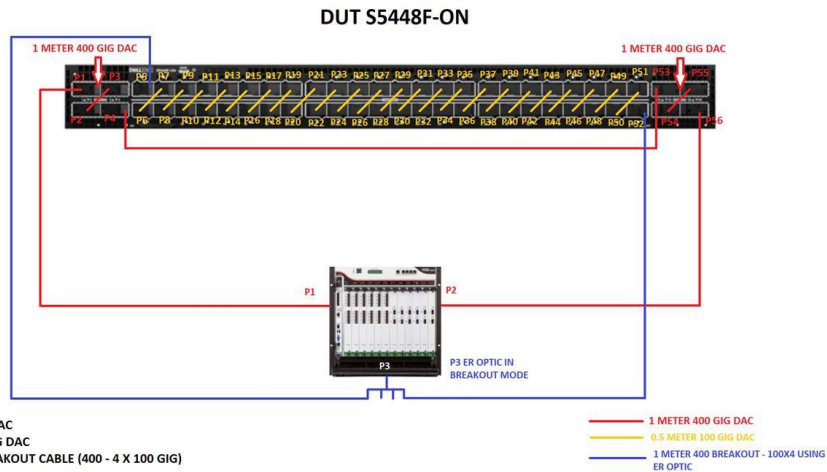
Dell PowerSwitch S5448-ON Switch Test Bed

Ports were connected in a dual-snake traffic topology

Physical Connections

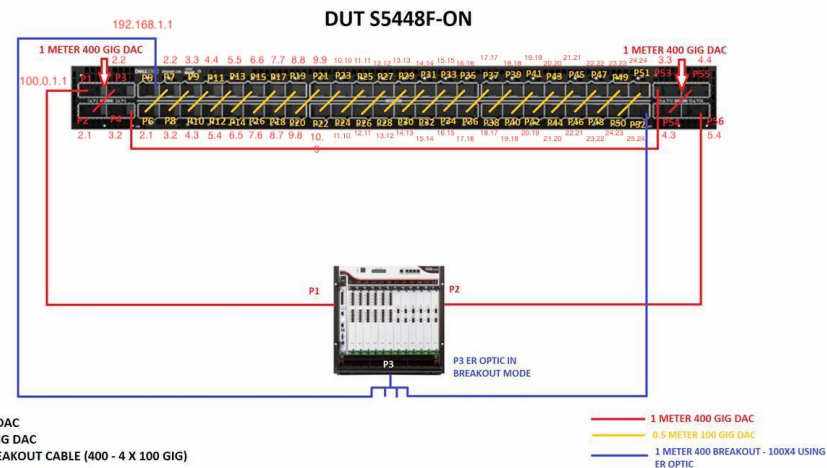


Layer 2 Configuration



48x 100GbE Ports + 8x 400GbE Ports.

Layer 3 Configuration



Source: Tolly, October 2022

Figure 4



Test Methodology

Test Bed

The test bed includes one Dell PowerSwitch S5448F-ON aggregation switch (hardware revision X02, software version 10.5.3.4), and a Keysight AresONE-400GE QSFP-DD High Density 8-Port Test System appliance. On the Keysight appliance, two ports were configured in 100GbE mode and two ports were configured in 400GbE mode. The four ports were directly connected to the Dell switch under test. See Figure 4 on previous page.

RFC2544 Throughput and Latency

All L2/L3 performance benchmarks were completed using the RFC2544 wizard in Keysight IxNetwork for throughput and latency. A “jumbo” frame size of 9200-byte was tested that is beyond the RFC specification but commonly tested in any case. Each frame size was tested for three iterations with one minute per iteration. In all test runs, all three iterations had the same result.

The throughput tests used all 48x 100GbE ports and 8x 400GbE ports on the switch simultaneously handling bi-directional traffic in a dual-snake topology with all 100GbE ports in a snake topology and all 400GbE ports in another. Maximum throughput with zero frame loss was reported for each frame size.

In L2 tests, the switch ports worked in L2 (switch port) mode. In L3 tests, the switch ports worked in L3 (no switch port) mode.

Power Consumption

Power consumption data was recorded by a WattsUp power meter. The circuit for each switch was independent from any other operating equipment. The same test setup was used as for the RFC2544 performance tests with iMIX packets. When all ports were connected and up but without traffic, the power consumption was recorded.

Then Tolly measured the power consumption with 30% line-rate traffic and 100% line-rate traffic. Data was recorded after 1 minute of steady state operation for each the ‘loaded’ test cases. The ATIS weighted power consumption was calculated as ATIS weighted power (Watts) = $0.1 * (\text{idle power}) + 0.8 * (\text{power with 30\% traffic}) + 0.1 * (\text{power with 100\% traffic})$ as a data center switch.

Table Capacity

Capacity of each table was evaluated individually.

In the MAC table test, engineers created devices on one Keysight port with different MAC addresses and sent traffic to the Dell switch to let it learn the MAC addresses. Then engineers sent traffic from the other Keysight port to the devices through the Dell switch. All traffic was forwarded by the MAC table without broadcasting. A third Keysight port was connected to the Dell switch to verify that there was no broadcast test frames. The switch was in Scaled-L2 mode in the MAC table capacity test.

In the FIBv4 test, engineers sent in BGP routes from one Keysight port to the Dell switch and verified that all routes worked properly on the switch to forward traffic with traffic from the other Keysight port. The switch was in Scaled-L3-Routes mode in the FIBv4 capacity test.




About Tolly

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You can reach the company by E-mail at sales@tolly.com, or by telephone at +1 561.391.5610.

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Test Equipment Summary

Vendor	Product	Web
Keysight	Keysight AresONE-400GE QSFP-DD High Density 8-Port Test System (T400GD-8P-QDD) Keysight IxNetwork version 9.20	 https://www.keysight.com

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