



Data Center & Cloud Computing



S5800-8TF12S Switch 1/10GE Ethernet Performance Validation

White Paper
October, 2014

Overview

The FS S5800-8TF12S Switch is a high-performance, high-density, low-latency 1 and 10 Gigabit Ethernet switch facing next generation Metro, Data Center and Enterprise Ethernet network. This compact 1RU 1- and 10-Gbps switch provides line-rate Layer 2 and 3 switching. It runs the FSOS Software operating system, providing customers with features and capabilities that are widely deployed worldwide.

To fully validate the FS S5800-8TF12S performance, rigorous testing was performed. IETF RFC 2544 is widely accepted in the industry as standard benchmarking methodologies to evaluate switch performance by measuring throughput, back to back, forwarding latency and frame loss at various conditions. Spirent TestCenter RFC 2544 was used in the tests.

The IETF RFC 2544 Benchmarking Methodology

The RFC 2544 standard, established by the Internet Engineering Task Force (IETF) standards body, is the de facto methodology that outlines the tests required to measure and prove performance criteria for carrier Ethernet networks.

The standard provides an out-of-service benchmarking methodology to evaluate the performance of network devices using throughput, back-to-back, frame loss and latency tests, with each test validating a specific part of an SLA. The methodology defines the frame size, test duration and number of test iterations. Once completed, these tests will provide performance metrics of the Ethernet network under test. Specific tests are:

- Back to Back
- Frame Loss
- Throughput
- Latency

Back to Back Test

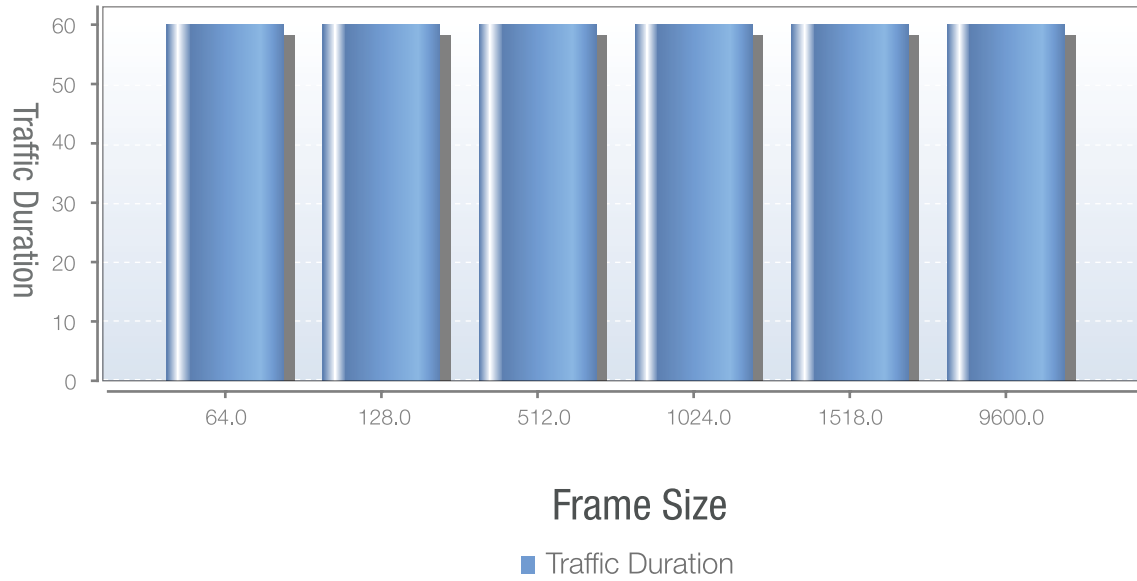
Overview

The back-to-back test (also known as burstability or burst test) assesses the buffering capability of a switch. It measures the maximum number of frames received at full line rate before a frame is lost. In carrier Ethernet networks, this measurement is quite useful as it validates the excess information rate (EIR).

Test Objective

The objective of the Back to Back test is to determine the node buffer capacity by sending bursts of traffic at the highest theoretical rate, and then measuring the longest burst where no packets are dropped.

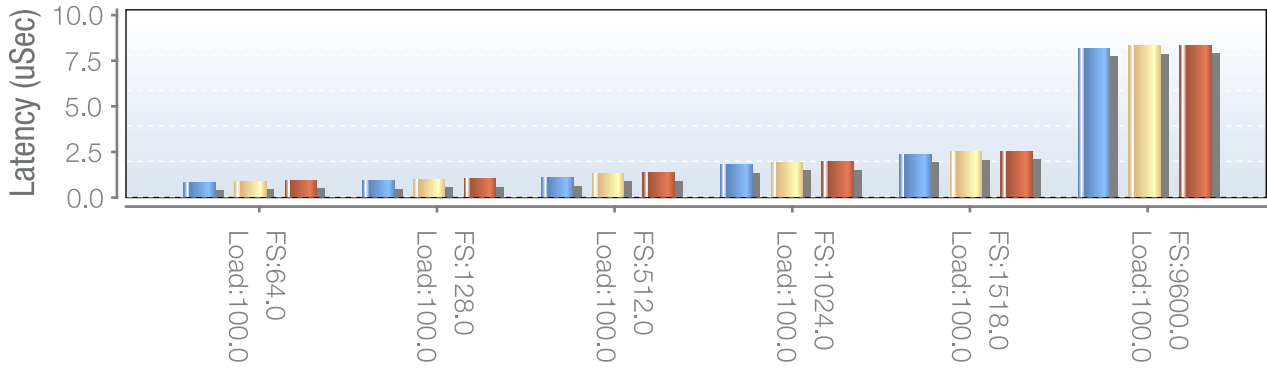
Back-to-Back Burst Duration per Frame Size



Duration is measured in SECONDS

Frame Size (bytes)	Back-to-Back Burst(frames)	Back-to-Back Time(sec)	Intended Load(%)	Average Frame Rate (fps)	Average Tx Frames	Average Rx Frames	Average Lost Frames
64	10714285716	60	100	178571428.6	10714285716	10714285716	0
128	6081081084	60	100	101351351.4	6081081084	6081081084	0
512	1691729328	60	100	28195488.8	1691729328	1691729328	0
1024	862068972	60	100	14367816.2	862068972	862068972	0
1518	585175560	60	100	9752926	585175560	585175560	0
9600	93555096	60	100	1559251.6	93555096	93555096	0

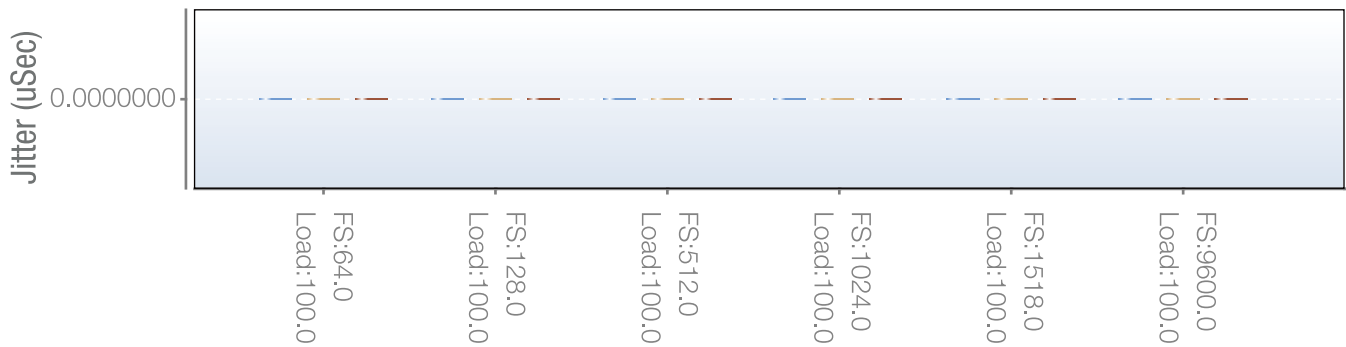
Latency by Frame Size and Load



Frame Size and Load (%)

■ Min Latency ■ Avg Latency ■ Max Latency

Jitter by Frame Size and Load



Frame Size and Load (%)

■ Min Jitter ■ Avg Jitter ■ Max Jitter

Summary Statistics by Trial

Trial	Frame Size (bytes)	Intended Load (%)	Offered Load (%)	Offered Load (fps)	Tx Frames	Rx Frames	Frame Lost	Burst Siset	Duration (Sec)	Min Latency (uSec)	Avg Latency (uSec)	Max Latency (uSec)
1	64	100	100	178571428.6	10714285716	10714285716	0	10714285716	60	0.98	1.06	1.12
1	128	100	100	101351351.4	6081081084	6081081084	0	6081081084	60	1.07	1.182	1.22
1	512	100	100	28195488.8	1691729328	1691729328	0	1691729328	60	1.28	1.62	1.65
1	1024	100	100	14367816.2	862068972	862068972	0	862068972	60	2.2	2.379	2.41
1	1518	100	100	9752926	585175560	585175560	0	585175560	60	2.96	3.124	3.16
1	9600	100	100	1559251.6	93555096	93555096	0	93555096	60	10.44	10.609	10.65

Theoretical Maximum Frame Rates

Media Type	Line Speed (Mbps)	64 Byte	128 Byte	256 Byte	512 Byte	1024 Byte	1280 Byte	1518 Byte
Ethernet	10	14,880	8,445	4,528	2,349	1,197	961	812
Ethernet	100	148,809	84,459	45,289	23,496	11,973	9,615	8,127
Gigabit Ethernet	1,000	1,488,095	844,594	452,898	234,962	119,731	96,153	81,274
10 Gigabit Ethernet	10,000	14,880,952	8,445,945	4,528,985	2,349,624	1,197,318	961,538	812,743
40 Gigabit Ethernet	40,000	59,523,809	33,783,783	18,115,942	9,398,496	4,789,272	3,846,153	3,250,975
100 Gigabit Ethernet	100,000	148,809,523	84,459,459	45,289,855	23,496,240	11,973,180	9,615,384	8,127,438
POS (OC-3)	155	288,000	145,116	72,840	36,491	18,263	14,613	12,323
POS (OC-12)	622	1,152,000	580,465	291,361	145,964	73,053	58,622	49,413
POS (OC-48)	2,448	4,608,000	2,321,860	1,165,447	583,859	292,214	233,817	197,182
POS (OC-192)	9,953	18,432,000	9,287,441	4,661,789	2,335,438	1,168,858	935,269	788,729
ATM (OC-3)	155	176,603	117,735	58,867	32,109	16,054	13,082	11,037
ATM (OC-12)	622	706,412	470,940	235,468	122,810	64,216	52,578	44,148

Frame Loss Test

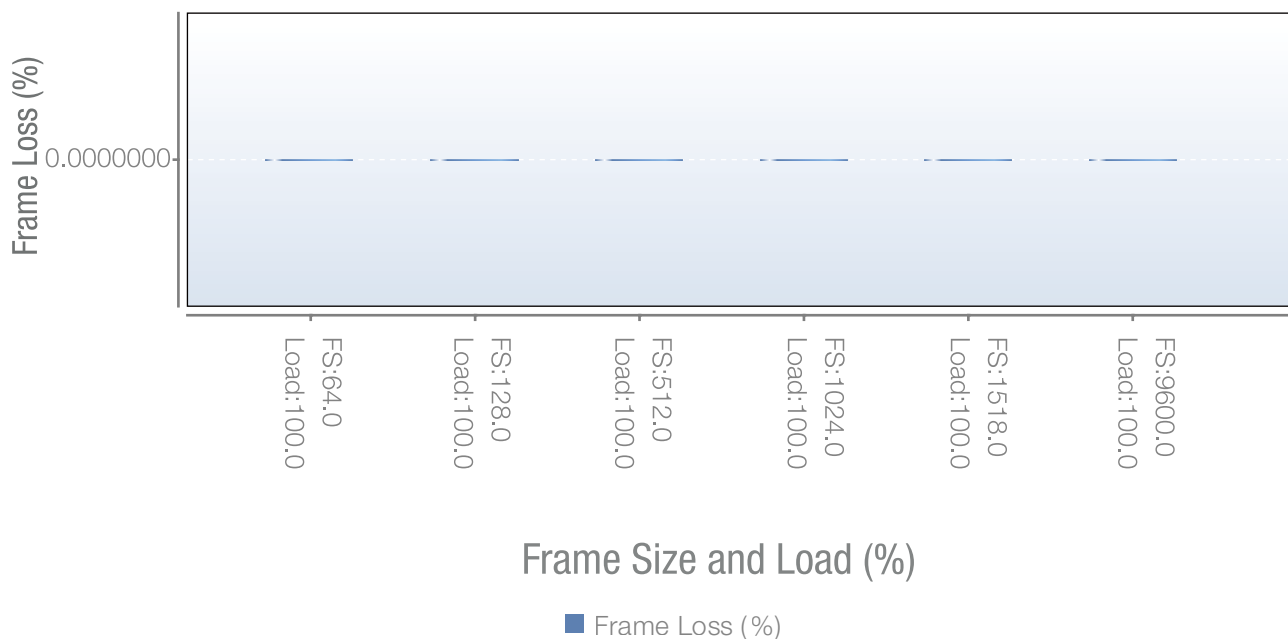
Overview

The Frame Loss test determines how many frames the DUT loses at various frame size. The number of frames to transmit is specified along with the initial transmit rate, and the percentage decrease in the frame rate (the Granularity parameter) for each iteration.

Test Objective

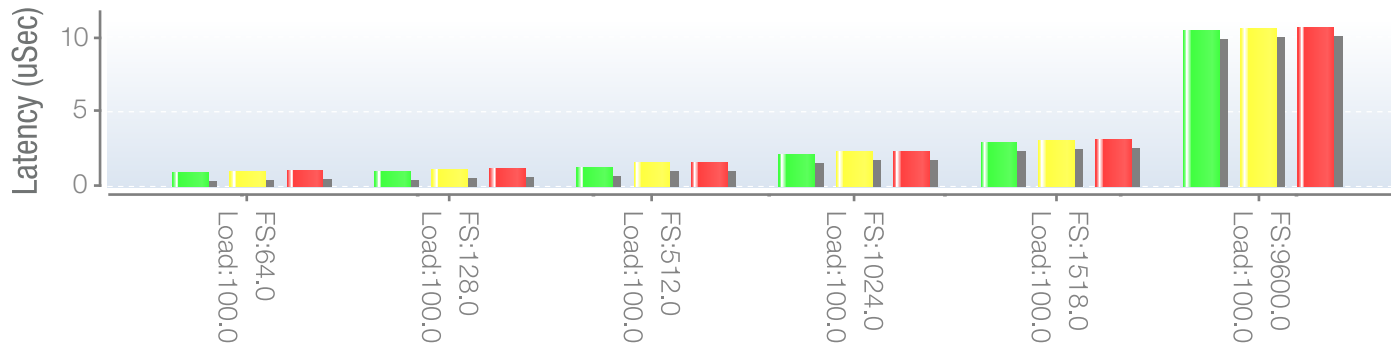
The objective of the frame loss test is to determine the frame loss ratio throughout the entire range of input data rates and frame sizes.

Frame Loss Rate



Frame Size (bytes)	Load(%)	Total Tx Frames	Total Rx Frames	Total Frames Lost	Frame Loss(%)
64	100	10714285716	10714285716	0	0
128	100	6081081084	6081081084	0	0
512	100	1691729328	1691729328	0	0
1024	100	862068972	862068972	0	0
1518	100	585175560	585175560	0	0
9600	100	93555096	93555096	0	0

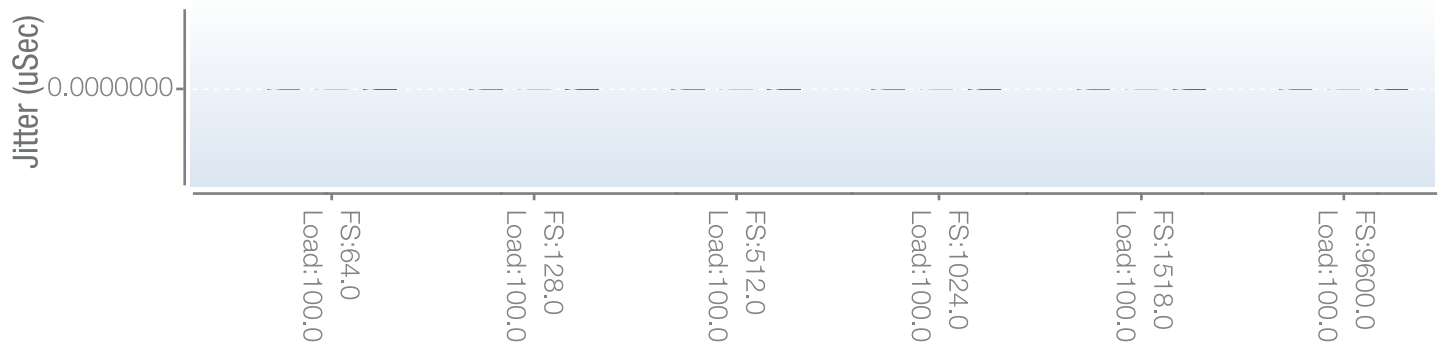
Latency by Frame Size and Load



Frame Size and Load (%)

■ Min Latency ■ Avg Latency ■ Max Latency

Jitter by Frame Size and Load



Frame Size and Load (%)

■ Min Jitter ■ Avg Jitter ■ Max Jitter

Frame Size (bytes)	Load (%)	Frame Loss(%)	Min Latency (uSec)	Avg Latency (uSec)	Max Latency (uSec)	Min Jitter (uSec)	Avg Jitter (uSec)	Max Jitter (uSec)
64	100	0	0.97	1.054	1.12	0	0	0
128	100	0	1.06	1.181	1.22	0	0	0
512	100	0	1.31	1.618	1.65	0	0	0
1024	100	0	2.2	2.379	2.41	0	0	0
1518	100	0	2.96	3.124	3.16	0	0	0
9600	100	0	10.46	10.609	10.65	0	0	0

Frame Loss by Trial

Trial	Frame Size (bytes)	Load (%)	Tx Frames	Rx Frames	Frames Lost	Frame Loss (%)
1	64	100	10714285716	10714285716	0	0
1	128	100	6081081084	6081081084	0	0
1	512	100	1691729328	1691729328	0	0
1	1024	100	862068972	862068972	0	0
1	1518	100	585175560	585175560	0	0
1	9600	100	93555096	93555096	0	0

Theoretical Maximum Frame Rates

Media Type	Line Speed (Mbps)	64 Byte	128 Byte	256 Byte	512 Byte	1024 Byte	1280 Byte	1518 Byte
Ethernet	10	14,880	8,445	4,528	2,349	1,197	961	812
Ethernet	100	148,809	84,459	45,289	23,496	11,973	9,615	8,127
Gigabit Ethernet	1,000	1,488,095	844,594	452,898	234,962	119,731	96,153	81,274
10 Gigabit Ethernet	10,000	14,880,952	8,445,945	4,528,985	2,349,624	1,197,318	961,538	812,743
40 Gigabit Ethernet	40,000	59,523,809	33,783,783	18,115,942	9,398,496	4,789,272	3,846,153	3,250,975
100 Gigabit Ethernet	100,000	148,809,523	84,459,459	45,289,855	23,496,240	11,973,180	9,615,384	8,127,438
POS (OC-3)	155	288,000	145,116	72,840	36,491	18,263	14,613	12,323
POS (OC-12)	622	1,152,000	580,465	291,361	145,964	73,053	58,622	49,413
POS (OC-48)	2,448	4,608,000	2,321,860	1,165,447	583,859	292,214	233,817	197,182
POS (OC-192)	9,953	18,432,000	9,287,441	4,661,789	2,335,438	1,168,858	935,269	788,729
ATM (OC-3)	155	176,603	117,735	58,867	32,109	16,054	13,082	11,037
ATM (OC-12)	622	706,412	470,940	235,468	122,810	64,216	52,578	44,148

Throughput Test

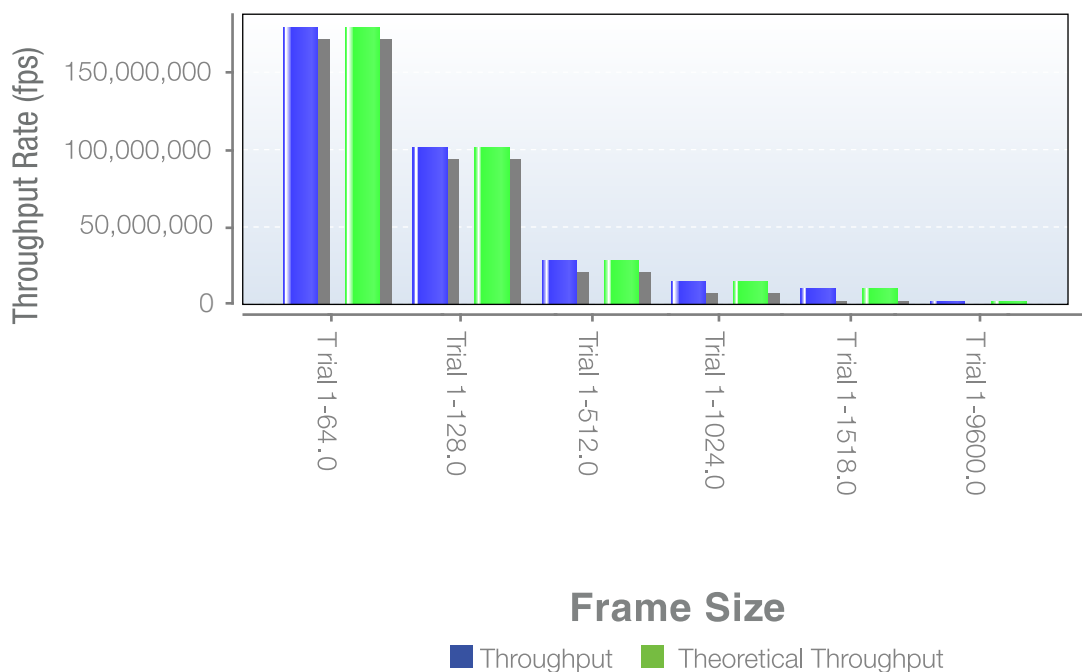
Overview

The throughput test determines how well suited a device is to applications in which minimal frame loss is critical. With each trial of the throughput test, test frames are sent at a specific frame rate and the number of frames forwarded by the DUT is counted. If there is any frame loss, the rate is decreased; otherwise, the rate is increased. The trials are repeated until the maximum rate is found at which there is no frame loss.

Test Objective

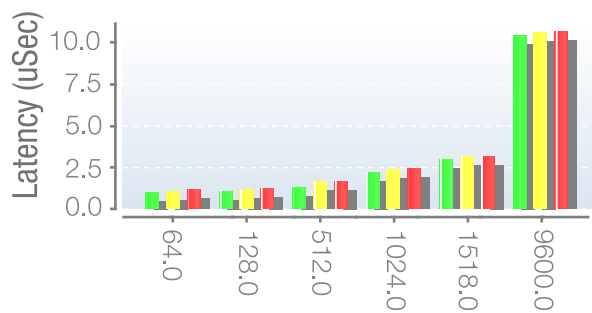
The objective of the throughput test is to determine the throughput of the DUT. Throughput is defined as the maximum rate at which none of the offered frames are dropped by the device.

Throughput by Frame Size VS Theoretical Max



Total Trials	Number of Passed Trials	Frame Size (bytes)	Intended Load (%)	Offered Load (%)	Throughput (%)	Aggregated Throughput (fps)	Aggregated Theoretical Max (fps)	Aggregated Throughput (Mbps)	Aggregated Theoretical Max (Mbps)
1	1	64	100	100	100	178571428.6	178571428.571	120000	120000
1	1	128	100	100	100	101351351.4	101351351.351	120000	120000
1	1	512	100	100	100	28195488.8	28195488.722	120000	120000
1	1	1024	100	100	100	14367816.2	14267816.092	120000	120000
1	1	1518	100	100	100	9752926	9752925.878	120000	120000
1	1	9600	100	100	100	1559251.6	1559251.559	120000	120000

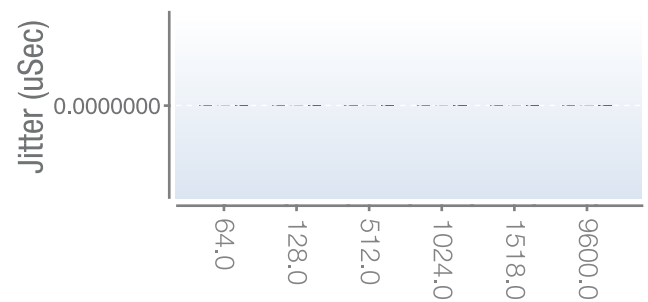
Latency by Frame Size at Throughput



Frame Size

■ Min Latency ■ Avg Latency ■ Max Latency

Jitter by Frame Size at Throughput



Frame Size

■ Min Jitter ■ Avg Jitter ■ Max Jitter

Frame Size (bytes)	Intended Load (%)	Offered Load (%)	Min Frame Loss (%)	Min Latency (uSec)	Avg Latency (uSec)	Max Latency (uSec)	Min Jitter (uSec)	Avg Jitter (uSec)	Max Jitter (uSec)
64	100	100	0	0.99	1.057	1.13	0	0	0
128	100	100	0	1.06	1.183	1.22	0	0	0
512	100	100	0	1.29	1.617	1.66	0	0	0
1024	100	100	0	2.2	2.378	2.41	0	0	0
1518	100	100	0	2.95	3.124	3.16	0	0	0
9600	100	100	0	10.44	10.609	10.65	0	0	0

Throughput by Trial

Traffic Duration : 60 Seconds

Custom Frame Size(bytes) : {64 128 512 1024 1518 9600}

Trial	Frame Size (bytes)	Result	Intended Load (%)	Offered Load (%)	Throughput (%)	Port Name	Throughput (fps)	Theoretical Max Throughput (fps)	Throughput (Mbps)	Theoretical Max Throughput (Mbps)	Frame Loss (%)	Max Latency Threshold Exceeded	Out of Sequence Threshold Exceeded
1	64	Passed	100	100	100		178571428.6	178571428.571	120000	120000	0	False	False
						Port //1/21	14880952.383	14880952.381	10000	10000			
						Port //1/22	14880952.383	14880952.381	10000	10000			
						Port //1/23	14880952.383	14880952.381	10000	10000			
						Port //1/24	14880952.383	14880952.381	10000	10000			
						Port //1/25	14880952.383	14880952.381	10000	10000			
						Port //1/26	14880952.383	14880952.381	10000	10000			
						Port //1/27	14880952.383	14880952.381	10000	10000			
						Port //1/28	14880952.383	14880952.381	10000	10000			
						Port //1/29	14880952.383	14880952.381	10000	10000			
						Port //1/30	14880952.383	14880952.381	10000	10000			
						Port //1/31	14880952.383	14880952.381	10000	10000			
						Port //1/32	14880952.383	14880952.381	10000	10000			
1	128	Passed	100	100	100		101351351.4	101351351.351	120000	120000	0	False	False
						Port //1/21	8445945.95	8445945.946	10000	10000			
						Port //1/22	8445945.95	8445945.946	10000	10000			
						Port //1/23	8445945.95	8445945.946	10000	10000			
						Port //1/24	8445945.95	8445945.946	10000	10000			
						Port //1/25	8445945.95	8445945.946	10000	10000			
						Port //1/26	8445945.95	8445945.946	10000	10000			
						Port //1/27	8445945.95	8445945.946	10000	10000			
						Port //1/28	8445945.95	8445945.946	10000	10000			
						Port //1/29	8445945.95	8445945.946	10000	10000			
						Port //1/30	8445945.95	8445945.946	10000	10000			
						Port //1/31	8445945.95	8445945.946	10000	10000			
						Port //1/32	8445945.95	8445945.946	10000	10000			
1	512	Passed	100	100	100		28195488.8	28195488.722	120000	120000	0	False	False
						Port //1/21	2349624.067	2349624.06	10000	10000			
						Port //1/22	2349624.067	2349624.06	10000	10000			
						Port //1/23	2349624.067	2349624.06	10000	10000			
						Port //1/24	2349624.067	2349624.06	10000	10000			
						Port //1/25	2349624.067	2349624.06	10000	10000			
						Port //1/26	2349624.067	2349624.06	10000	10000			
						Port //1/27	2349624.067	2349624.06	10000	10000			
						Port //1/28	2349624.067	2349624.06	10000	10000			

						Port //1/29	2349624.067	2349624.06	10000	10000			
						Port //1/30	2349624.067	2349624.06	10000	10000			
						Port //1/31	2349624.067	2349624.06	10000	10000			
						Port //1/32	2349624.067	2349624.06	10000	10000			
1	1024	Passed	100	100	100		14367816.2	14367816.092	120000	120000	0	False	False
						Port //1/21	1197318.017	1197318.008	10000	10000			
						Port //1/22	1197318.017	1197318.008	10000	10000			
						Port //1/23	1197318.017	1197318.008	10000	10000			
						Port //1/24	1197318.017	1197318.008	10000	10000			
						Port //1/25	1197318.017	1197318.008	10000	10000			
						Port //1/26	1197318.017	1197318.008	10000	10000			
						Port //1/27	1197318.017	1197318.008	10000	10000			
						Port //1/28	1197318.017	1197318.008	10000	10000			
						Port //1/29	1197318.017	1197318.008	10000	10000			
						Port //1/30	1197318.017	1197318.008	10000	10000			
						Port //1/31	1197318.017	1197318.008	10000	10000			
						Port //1/32	1197318.017	1197318.008	10000	10000			
1	1518	Passed	100	100	100		9752926	9752925.878	120000	120000	0	False	False
						Port //1/21	812743.833	812743.823	10000	10000			
						Port //1/22	812743.833	812743.823	10000	10000			
						Port //1/23	812743.833	812743.823	10000	10000			
						Port //1/24	812743.833	812743.823	10000	10000			
						Port //1/25	812743.833	812743.823	10000	10000			
						Port //1/26	812743.833	812743.823	10000	10000			
						Port //1/27	812743.833	812743.823	10000	10000			
						Port //1/28	812743.833	812743.823	10000	10000			
						Port //1/29	812743.833	812743.823	10000	10000			
						Port //1/30	812743.833	812743.823	10000	10000			
						Port //1/31	812743.833	812743.823	10000	10000			
						Port //1/32	812743.833	812743.823	10000	10000			
1	9600	Passed	100	100	100		1559251.6	1559251.559	120000	120000	0	False	False
						Port //1/21	129937.633	129937.63	10000	10000			
						Port //1/22	129937.633	129937.63	10000	10000			
						Port //1/23	129937.633	129937.63	10000	10000			
						Port //1/24	129937.633	129937.63	10000	10000			
						Port //1/25	129937.633	129937.63	10000	10000			
						Port //1/26	129937.633	129937.63	10000	10000			
						Port //1/27	129937.633	129937.63	10000	10000			
						Port //1/28	129937.633	129937.63	10000	10000			
						Port //1/29	129937.633	129937.63	10000	10000			

Port //1/30	129937.633	129937.63	10000	10000
Port //1/31	129937.633	129937.63	10000	10000
Port //1/32	129937.633	129937.63	10000	10000

Theoretical Maximum Frame Rates

Media Type	Line Speed (Mbps)	64 Byte	128 Byte	256 Byte	512 Byte	1024 Byte	1280 Byte	1518 Byte
Ethernet	10	14,880	8,445	4,528	2,349	1,197	961	812
Ethernet	100	148,809	84,459	45,289	23,496	11,973	9,615	8,127
Gigabit Ethernet	1,000	1,488,095	844,594	452,898	234,962	119,731	96,153	81,274
10 Gigabit Ethernet	10,000	14,880,952	8,445,945	4,528,985	2,349,624	1,197,318	961,538	812,743
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POS (OC-3)	155	288,000	145,116	72,840	36,491	18,263	14,613	12,323
POS (OC-12)	622	1,152,000	580,465	291,361	145,964	73,053	58,622	49,413
POS (OC-48)	2,448	4,608,000	2,321,860	1,165,447	583,859	292,214	233,817	197,182
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ATM (OC-3)	155	176,603	117,735	58,867	32,109	16,054	13,082	11,037
ATM (OC-12)	622	706,412	470,940	235,468	122,810	64,216	52,578	44,148

Latency Test

Overview

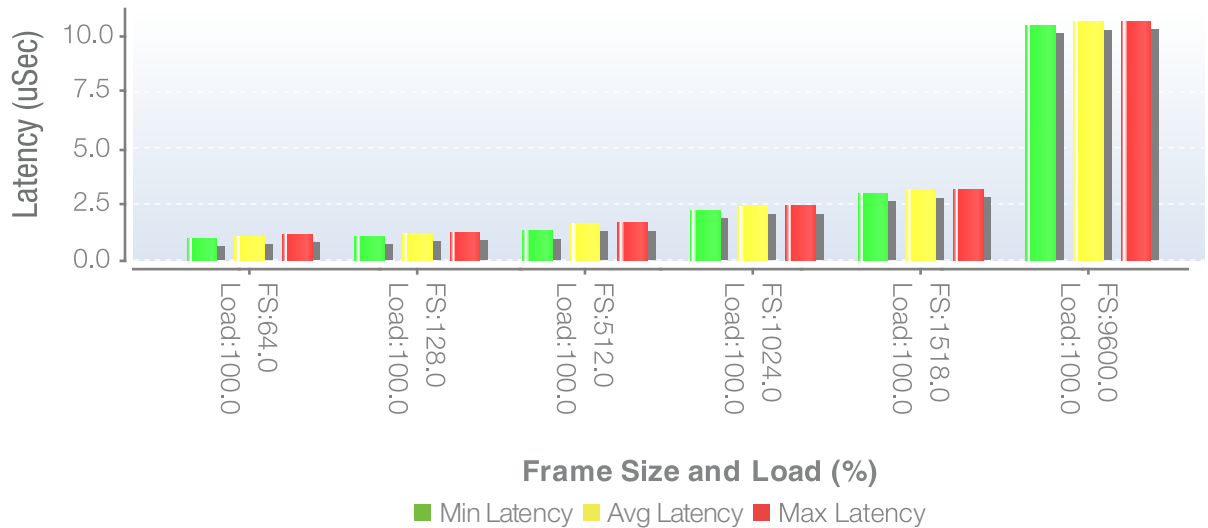
Latency is the amount of time it takes for the switch to move a packet from its incoming port to its outgoing port.

Essentially, the latency test measures how quickly a switch can forward a packet. The test uses the First In, First Out (FIFO) method, subtracting the time that the first bit exits the switch from the time that the first bit entered the switch.

Test Objective

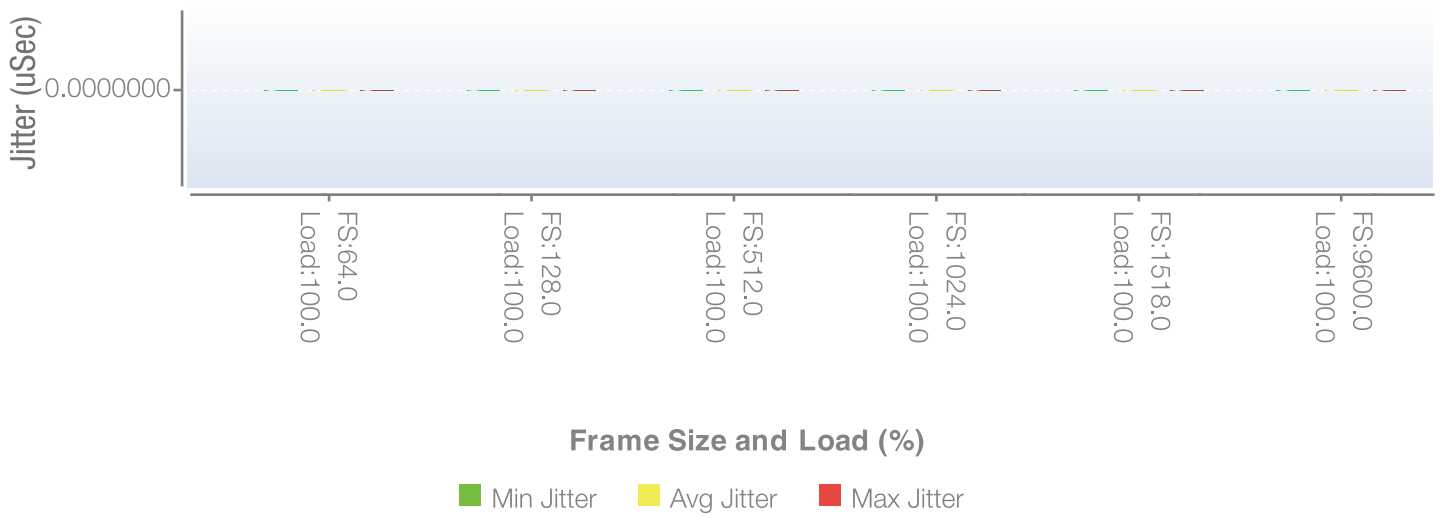
The objective of the latency test is to get the latency of the Frame in DUT when running at its maximum throughput.

Latency by Frame Size and Load



Frame Size (bytes)	Load (%)	Min Latency (uSec)	Avg Latency (uSec)	Max Latency (uSec)	Latency Type
64	100	0.97	1.058	1.15	FIFO
128	100	1.06	1.182	1.22	FIFO
512	100	1.3	1.62	1.65	FIFO
1024	100	2.21	2.379	2.41	FIFO
1518	100	2.96	3.124	3.16	FIFO
9600	100	10.44	10.609	10.65	FIFO

Jitter by Frame Size and Load



Frame Size (bytes)	Load (%)	Frame Loss (%)	Min Jitter (uSec)	Avg Jitter (uSec)	Max Jitter (uSec)
64	100	0	0	0	0
128	100	0	0	0	0
512	100	0	0	0	0
1024	100	0	0	0	0
1518	100	0	0	0	0
9600	100	0	0	0	0

Latency by Load

Trial	Frame Size (bytes)	Load (%)	Min Latency (uSec)	Avg Latency (uSec)	Max Latency (uSec)	Min Jitter (uSec)	Avg Jitter (uSec)	Max Jitter (uSec)	TX Frames	Rx Frames
1	64	100	0.97	1.058	1.15	0	0	0	10714285716	10714285716
1	128	100	1.06	1.182	1.22	0	0	0	6081081084	6081081084
1	512	100	1.3	1.62	1.65	0	0	0	1691729328	1691729328
1	1024	100	2.21	2.379	2.41	0	0	0	862068972	862068972
1	1518	100	2.96	3.124	3.16	0	0	0	585175560	585175560
1	9600	100	10.44	10.609	10.65	0	0	0	93555096	93555096

Theoretical Maximum Frame Rates

Media Type	Line Speed (Mbps)	64 Byte	128 Byte	256 Byte	512 Byte	1024 Byte	1280 Byte	1518 Byte
Ethernet	10	14,880	8,445	4,528	2,349	1,197	961	812
Ethernet	100	148,809	84,459	45,289	23,496	11,973	9,615	8,127
Gigabit Ethernet	1,000	1,488,095	844,594	452,898	234,962	119,731	96,153	81,274
10 Gigabit Ethernet	10,000	14,880,952	8,445,945	4,528,985	2,349,624	1,197,318	961,538	812,743
40 Gigabit Ethernet	40,000	59,523,809	33,783,783	18,115,942	9,398,496	4,789,272	3,846,153	3,250,975
100 Gigabit Ethernet	100,000	148,809,523	84,459,459	45,289,855	23,496,240	11,973,180	9,615,384	8,127,438
POS (OC-3)	155	288,000	145,116	72,840	36,491	18,263	14,613	12,323
POS (OC-12)	622	1,152,000	580,465	291,361	145,964	73,053	58,622	49,413
POS (OC-48)	2,448	4,608,000	2,321,860	1,165,447	583,859	292,214	233,817	197,182
POS (OC-192)	9,953	18,432,000	9,287,441	4,661,789	2,335,438	1,168,858	935,269	788,729
ATM (OC-3)	155	176,603	117,735	58,867	32,109	16,054	13,082	11,037
ATM (OC-12)	622	706,412	470,940	235,468	122,810	64,216	52,578	44,148

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