



Enabling a Converged World™

Introduction to Ixia

2012

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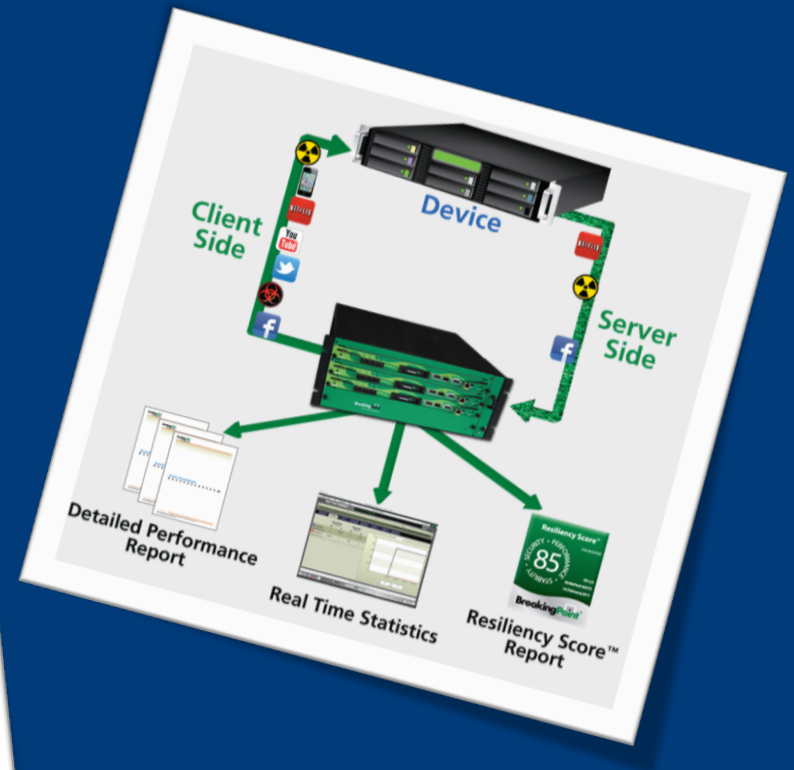
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datacom

Lösungen zum

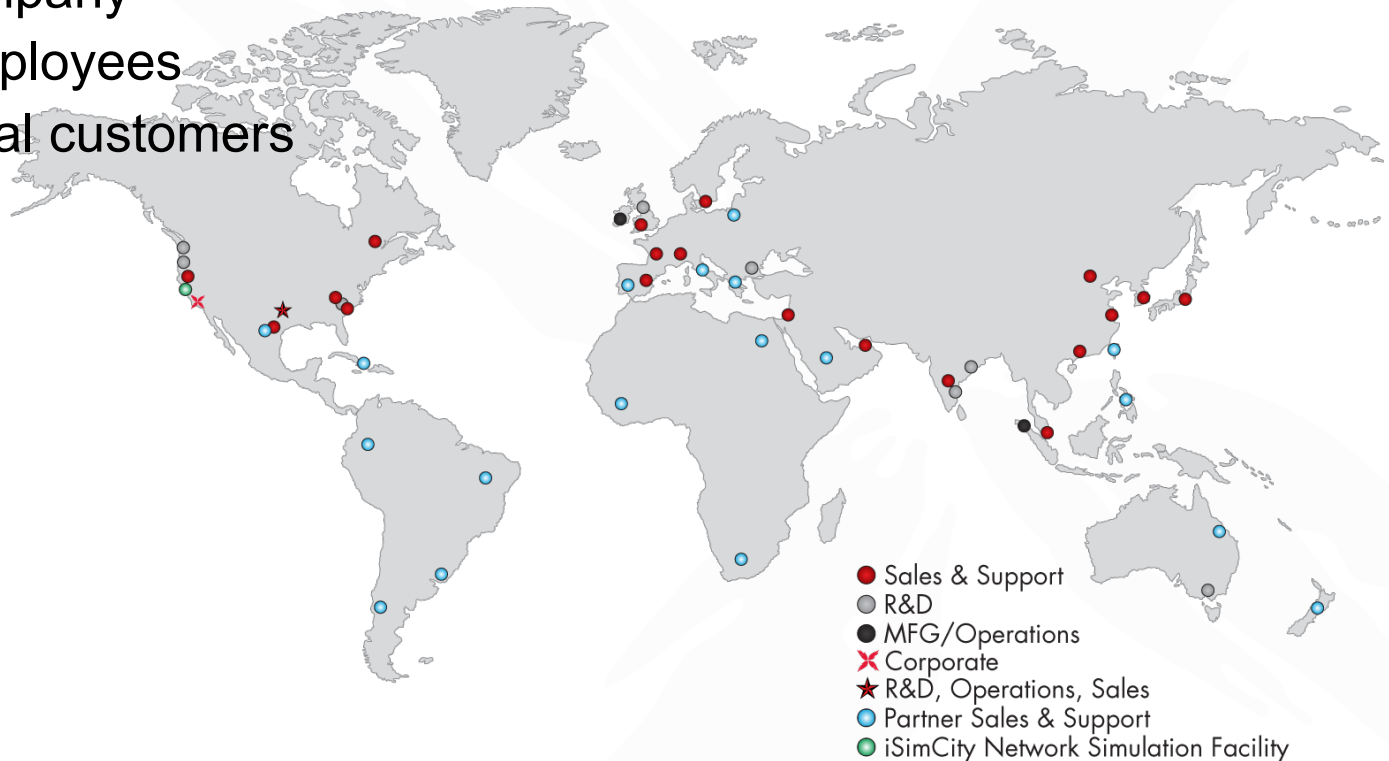
- Testen
- Optimieren
- Managen

von

- Netzwerken
- Services



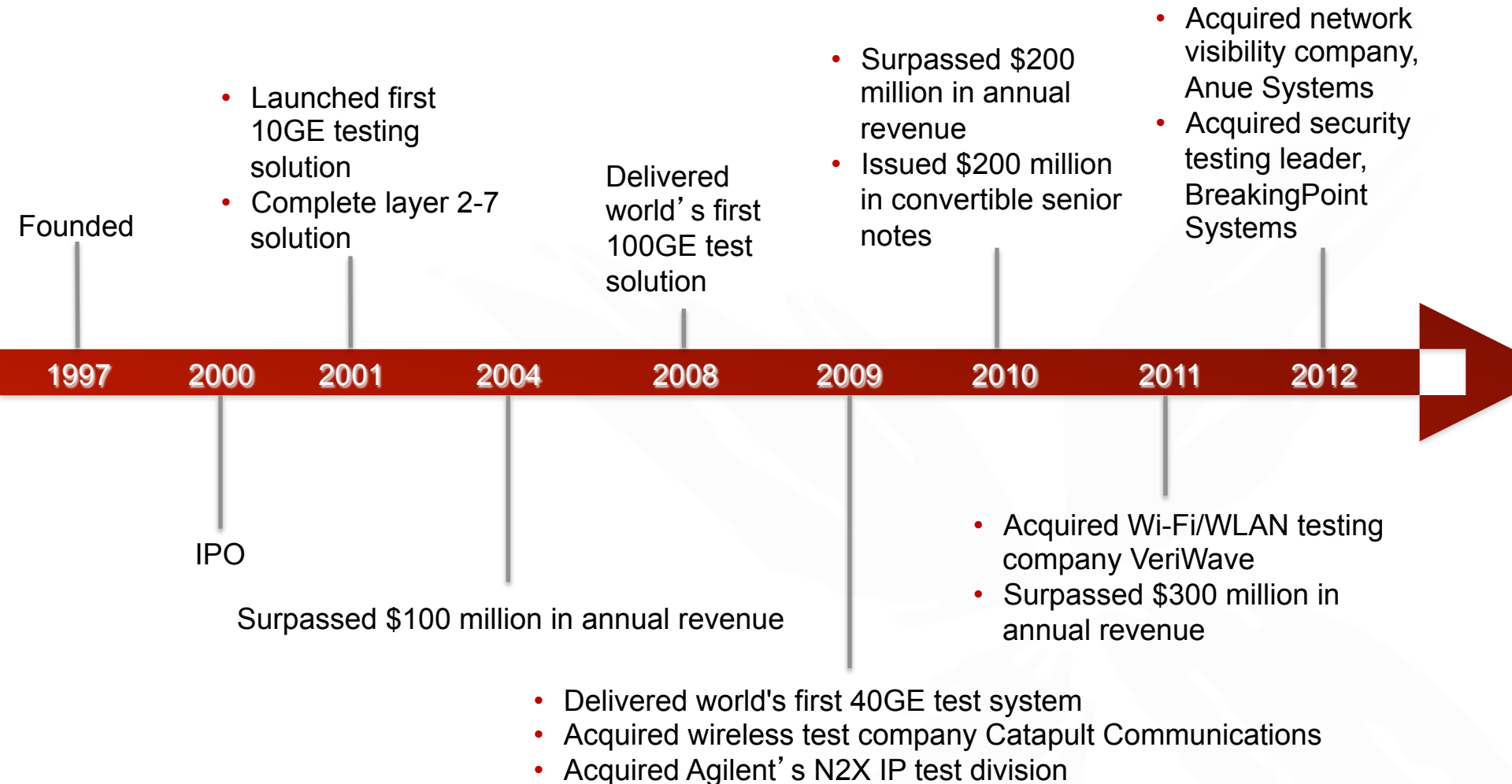
- Ixia solutions and services ensure business continuity by establishing end-to-end visibility into the performance and security of pre-deployment and production networks
- Publicly traded: XXIA (NASDAQ)
- Global company
- 1,450+ employees
- 2,500+ loyal customers



- Ixia provides the industry's most comprehensive converged IP network validation and network visibility solutions. Equipment manufacturers, service providers, enterprises, and government agencies use Ixia's solutions to design, verify, and monitor a broad range of wired, Wi-Fi, and 3G/LTE equipment and networks.
- Ixia's test solutions emulate realistic media-rich traffic and network conditions so that customers can optimize and validate the design, performance, and security of their pre-deployment networks.
- Ixia's intelligent network visibility platforms provide clarity into physical and virtual production networks for improved performance, security, resiliency, and application delivery of cloud, data center, and service provider networks.



Ixia Milestones



NEMs



Service Providers



Enterprise



Government





Industry Leadership



Wireless Backhaul
Test Equipment Market
Leader, 2011,
Frost & Sullivan



5273 Net Tool Optimizer
Best IT Product for
Telecommunications
Network Products Guide
2012



IxLoad-Attack
Best in Test
Test & Measurement World



Ixia Anue 3500
NGN Leadership Award
2012



IxLoad-Attack
Global Excellence
Info Security Products Guide



Customer Experience
GTB Innovation Award
2012



2011 Wireless
Backhaul Distribution



特別賞
Xcellon-Flex
Best of Show,
Interop Tokyo, 2011



LTE Visionary Award,
2010, TMC



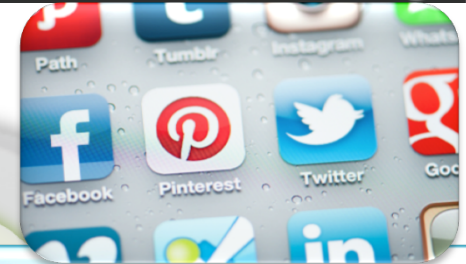
End-to-End Solution for IT Resiliency



Develop



Deploy



Deliver

Devices

Network

Data Center

Application
Services

Wi-Fi Backhaul

MPLS

Storage

Video

Broadband

Contact Center

Unified Communications

LTE

40/100G

Virtualization

3G/4G

Availability

Security

Performance



Only BreakingPoint Creates Stateful Traffic

Comprehensive Applications

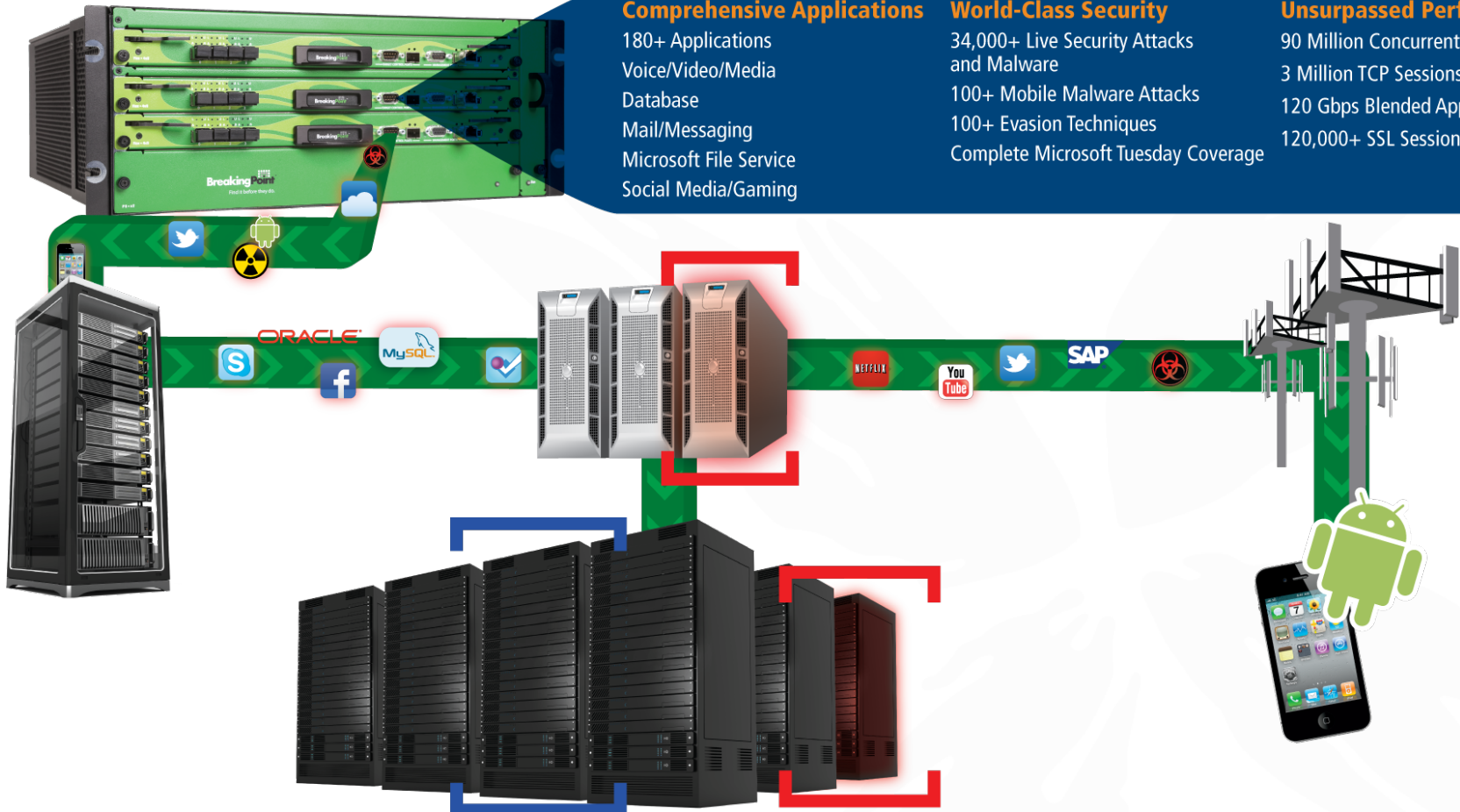
180+ Applications
Voice/Video/Media
Database
Mail/Messaging
Microsoft File Service
Social Media/Gaming

World-Class Security

34,000+ Live Security Attacks and Malware
100+ Mobile Malware Attacks
100+ Evasion Techniques
Complete Microsoft Tuesday Coverage

Unsurpassed Performance

90 Million Concurrent TCP Sessions
3 Million TCP Sessions per Second
120 Gbps Blended Application Traffic
120,000+ SSL Sessions per Second





Case Study – Bank – 20 Gbps Firewall Test Report 2011

Professional Service Delivery

- The goal of this professional service was to validate the performance and stability of six firewalls to reach 20 Gbps of application traffic.
- We have been using a BreakingPoint Storm CTM with 2x blade 4x Ports 10 Gigabit.

Test Session 1

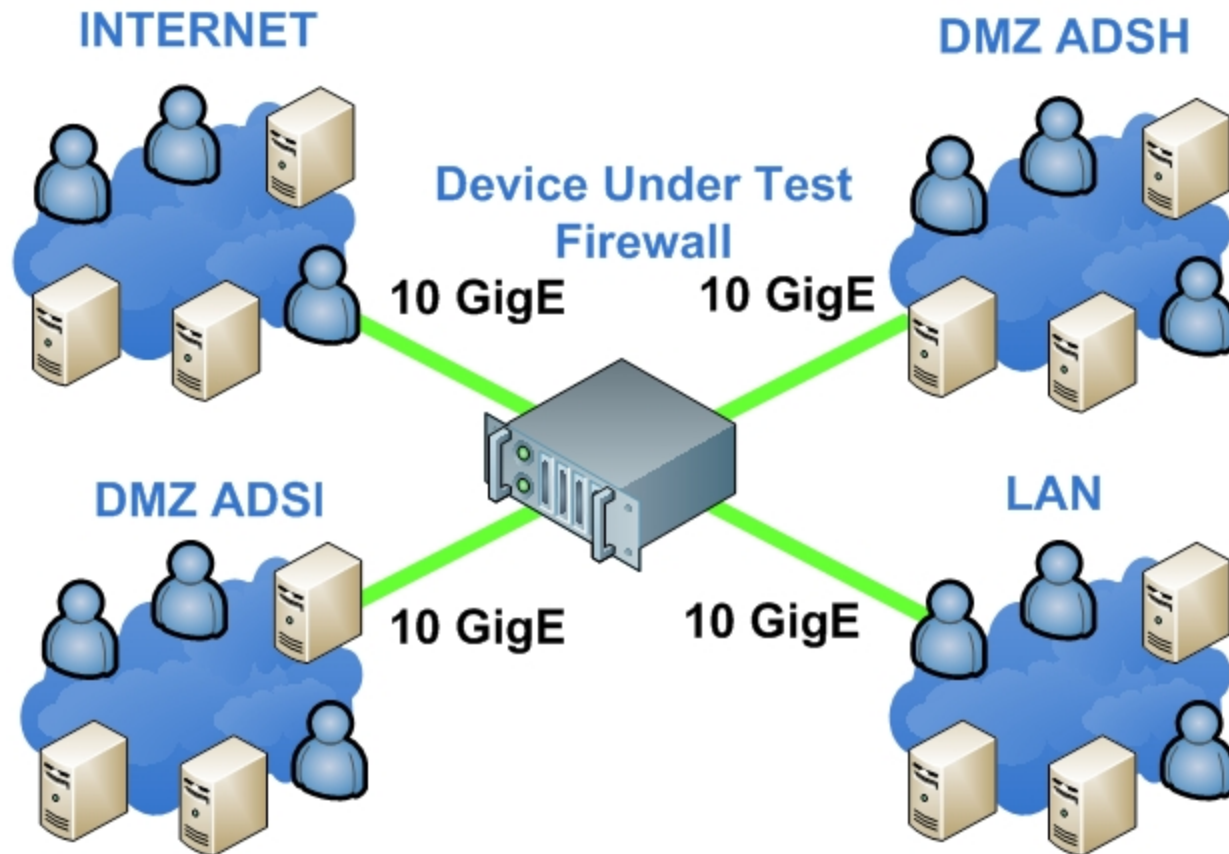
December 2010

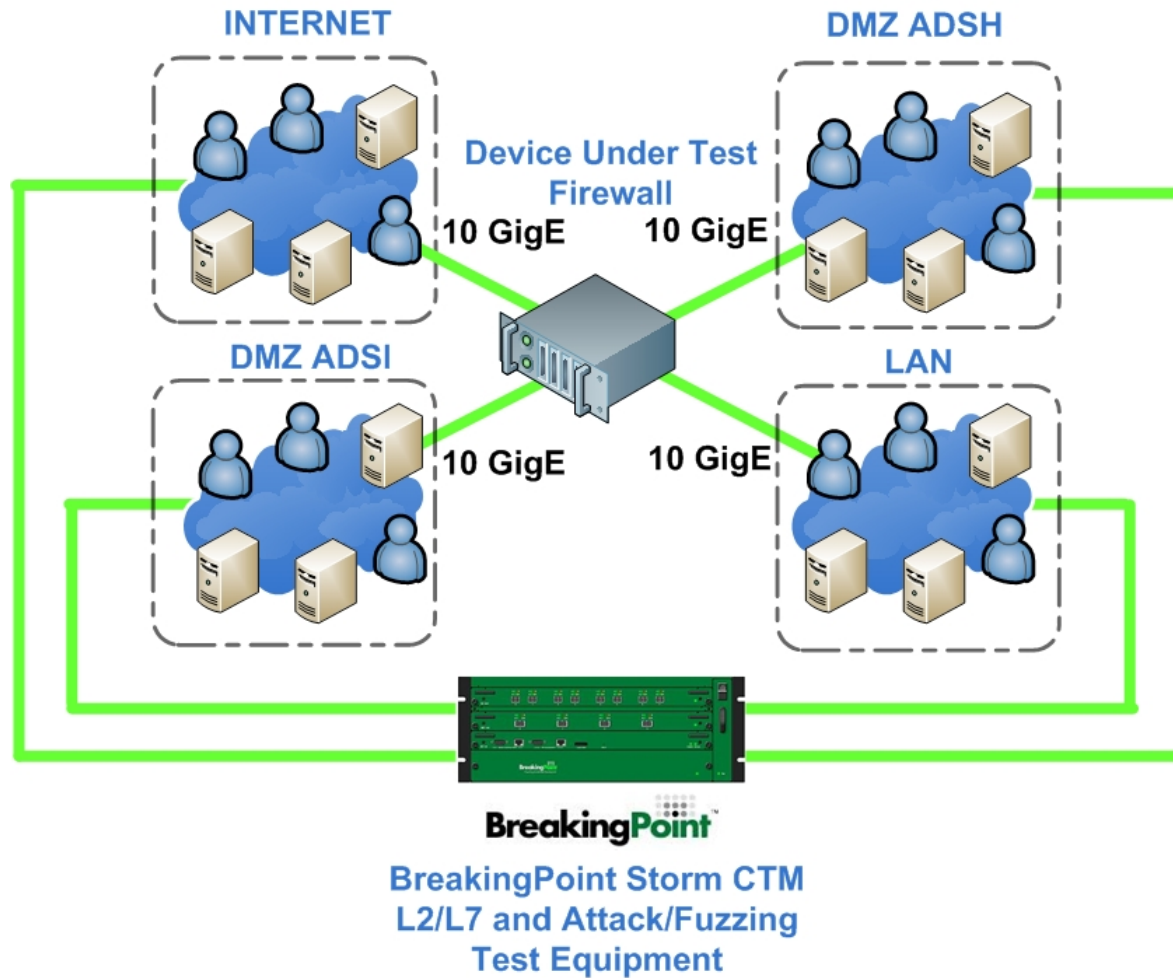


Test Session 1 - Network Equipment Information

NETWORK EQUIPMENT	HARDWARE	VERSION
BreakingPoint Storm CTM	2x Blades Storm 4x 10 Gigabit	OS 2.1 Strike Pack 72219
Juniper NS5400	2x SPM XGE-G4 4x Ports 10 Gigabit	ScreenOS 6.2 R7
Juniper SRX3400	2x NPC 2x SPC 4x Ports 10 Gigabit	JuneOS 10.2.R3.10
Palo Alto Networks PAN-5060	4x Ports 10 Gigabit	PAN-OS 4.0.0.B24
Stonesoft 3205	4x Ports 10 Gigabit	5.2.2
Fortinet 3950B	1x Blade FMCXD2 4x Ports 10 Gigabit	FortiOS 4.2.2 Build 8514
Crossbeam X80	4x NPM 8650 8x APM 8650 4x Ports 10 Gigabit	XOS 9.0.1 CheckPoint R71.10

Network Test Infrastructure





- For the test each firewall was loaded with 640 rules with logging enabled. The last rule matching the application traffic and network zones defined.

L3 – RFC 2544

- The goal of this suite of tests was to find the maximum L3 performance of the device under test.
- The following frame sizes were used: 64 / 512 / 1024 / 1518 / 4096 Bytes.



L3 Performance Test – RFC2544

Test Type L3 64 Bytes	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	5 Gbps	800 Mbps	6 Gbps	4.8 Gbps	2.6 Gbps	20 Gbps
Packet/Second	7.1M	1.1M	8.5M	6.8M	3.7M	28.4M
Latency	13.092 μ s	52.976 μ s	10.440 μ s	66.738 μ s	85.770 μ s	4.741 μ s
Test Type L3 512 Bytes	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	4.6 Gbps	5.2 Gbps	19.8 Gbps	19.2 Gbps	17.6 Gbps	39.2 Gbps
Packet/Second	1.1M	1.2 Gbps	4.6M	3.2M	4.1M	9.2M
Latency	25.551 μ s	149.558 μ s	13.647 μ s	85.085 μ s	72.175 μ s	5.955 μ s
Test Type L3 1024 Bytes	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	4.6 Gbps	8 Gbps	FAIL	27.2 Gbps	34.4 Gbps	39.6 Gbps
Packet/Second	0.550 M	1M	FAIL	3.2M	4.1M	4.7M
Latency	39.124 μ s	63.384 μ s	FAIL	112.728 μ s	180.322 μ s	7.281 μ s



L3 Performance Test – RFC2544

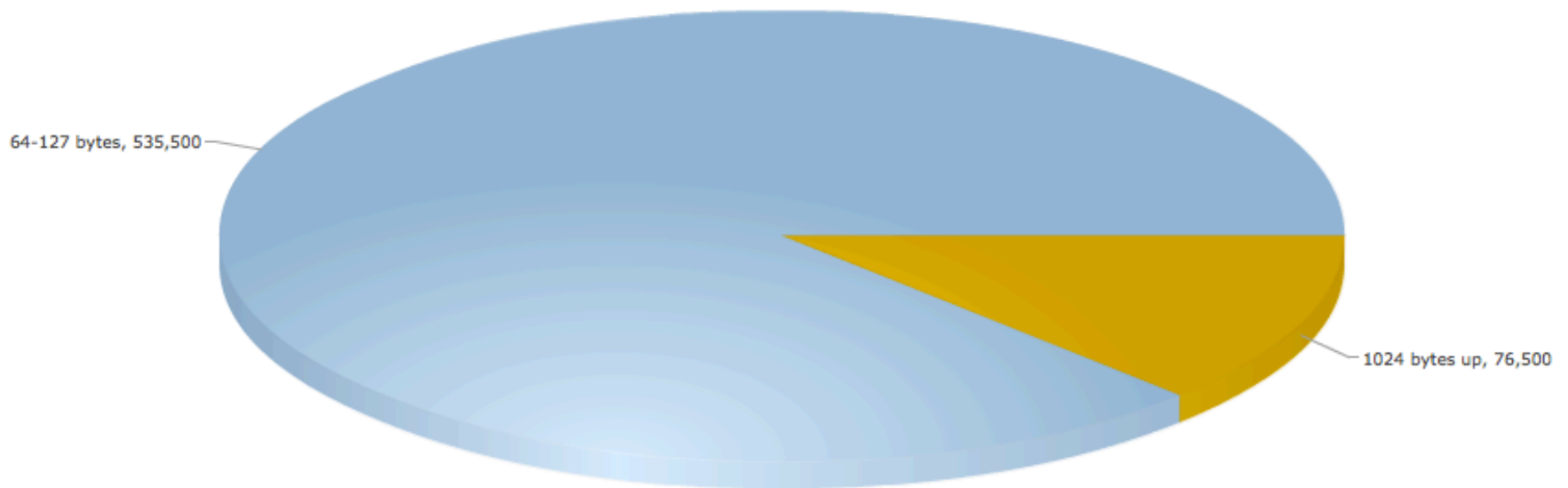
Test Type L3 1518 Bytes	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	4.6 Gbps	12.8 Gbps	19.8 Gbps	33 Gbps	39.8 Gbps	39.6 Gbps
Packet/Second	0.373M	1M	1.6M	2.6M	3.2M	3.2M
Latency	47.307 µs	72.444 µs	18.525 µs	136.776 µs	87.334 µs	8.393 µs
Test Type L3 4096 Bytes	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	4.6 Gbps	CRASH	CRASH	36 Gbps	CRASH	39.6 Gbps
Packet/Second	0.139M	CRASH	CRASH	1.1M	CRASH	1.2M
Latency	91.601 µs	CRASH	CRASH	269.988 µs	CRASH	14.626 µs

L4 – TCP Traffic

- The goal of this suite of tests was to find the maximum L4 performance of the device under test.
- We were checking the maximum new TCP connection per second, the maximum concurrent TCP connections and the maximum TCP bandwidth.

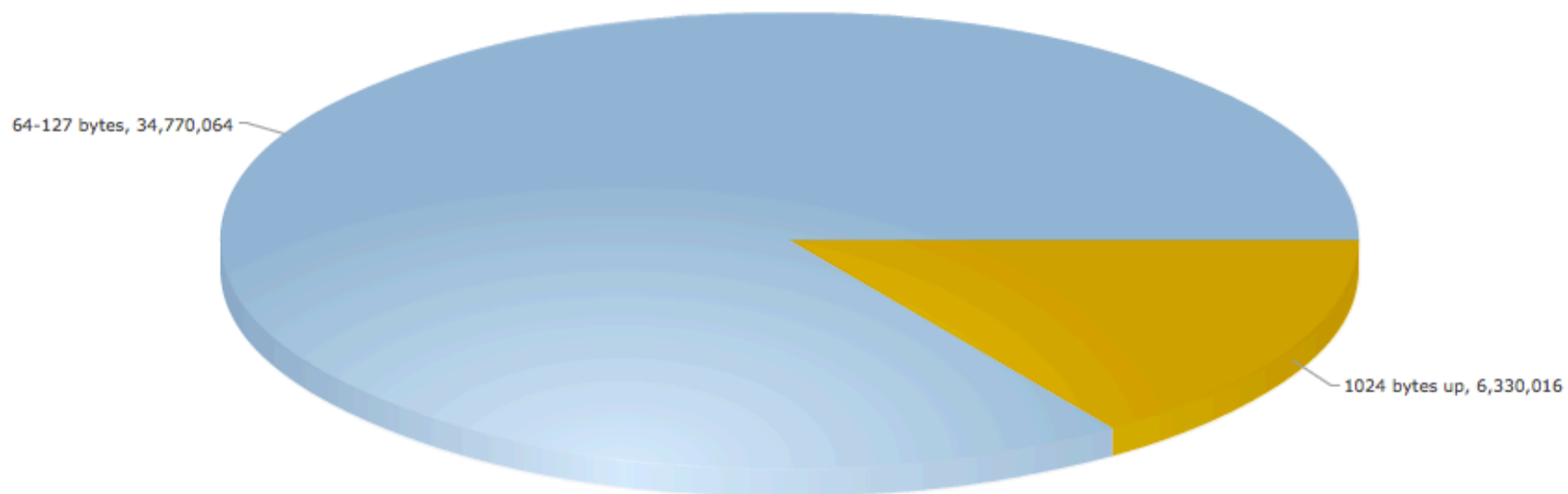


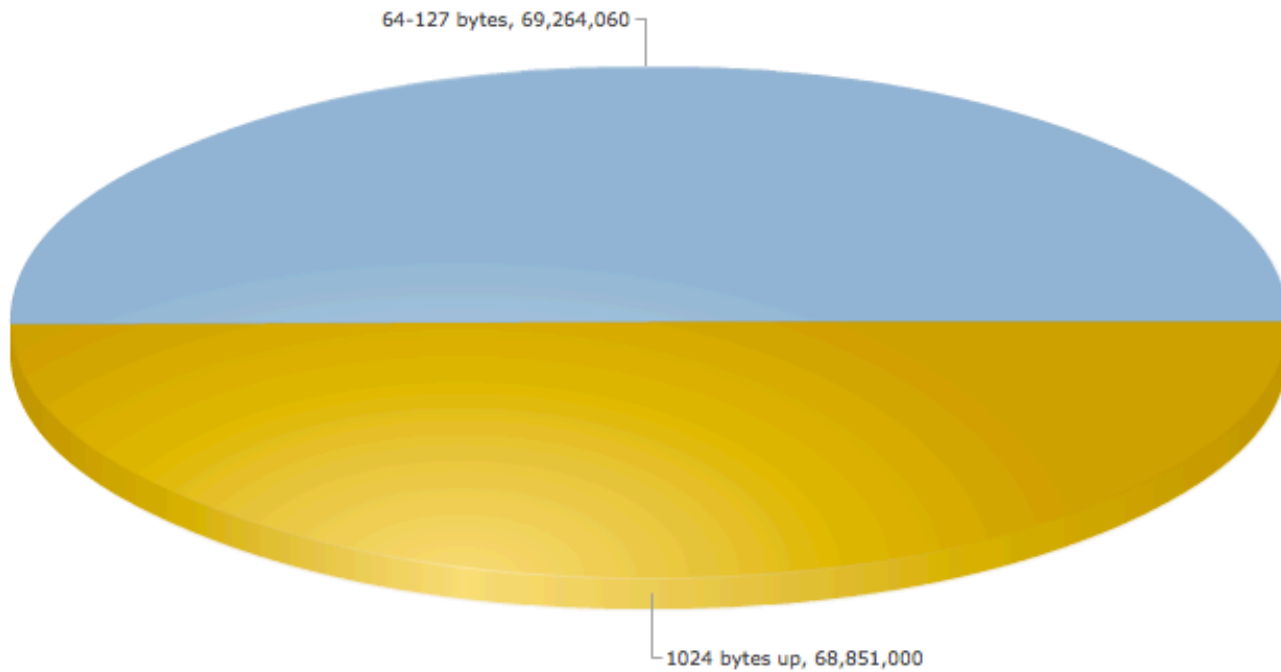
L4 New TCP Connections per second packet distribution





L4 Concurrent TCP connection packet distribution







L4 Performance test – TCP traffic

Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
NEW TCP/SEC	13,000	50,000	70,000	60,000	CRASH	62,500

Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
TCP OPEN	1M	1.5M	4.3M	CRASH	CRASH	6.5M

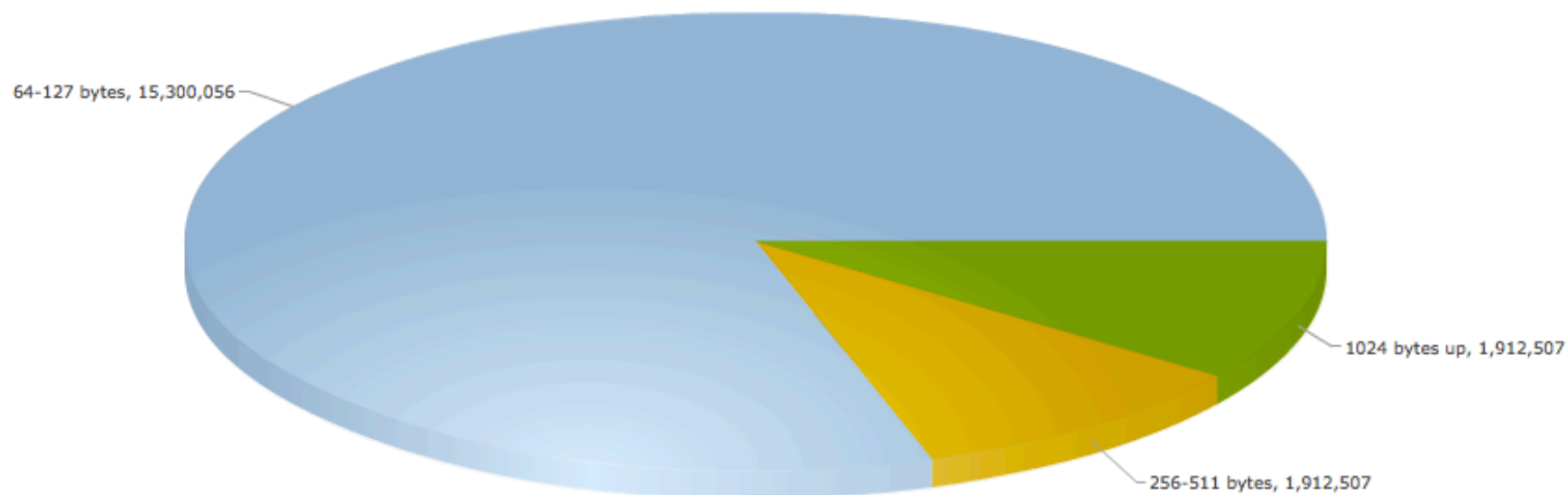
Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
TCP BANDWIDTH	4.6 Gbps	9.2 Gbps	19.5 Gbps	CRASH	CRASH	35.9 Gbps

L7 – HTTP Traffic

- The goal of this test was to find the maximum L7 performance of the device under test.
- We were checking the maximum HTTP transactions per second, the maximum concurrent HTTP transactions and maximum HTTP Bandwidth.

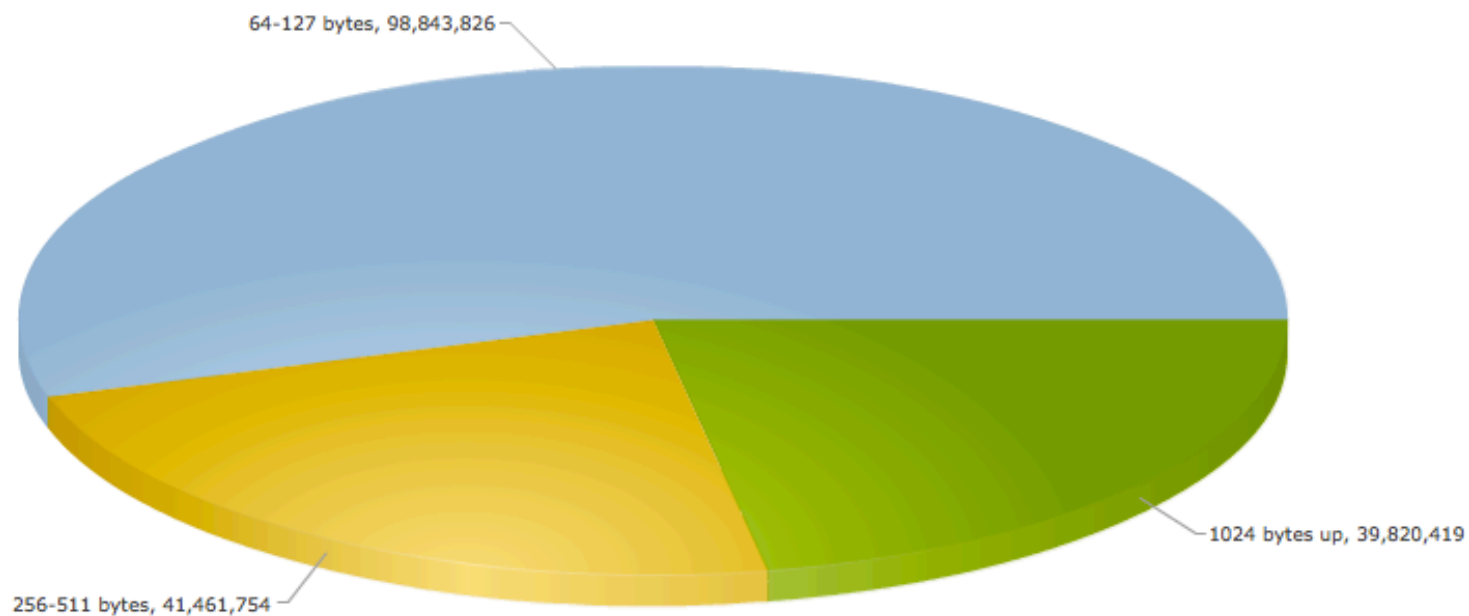


L7 New HTTP packets per second packet distribution



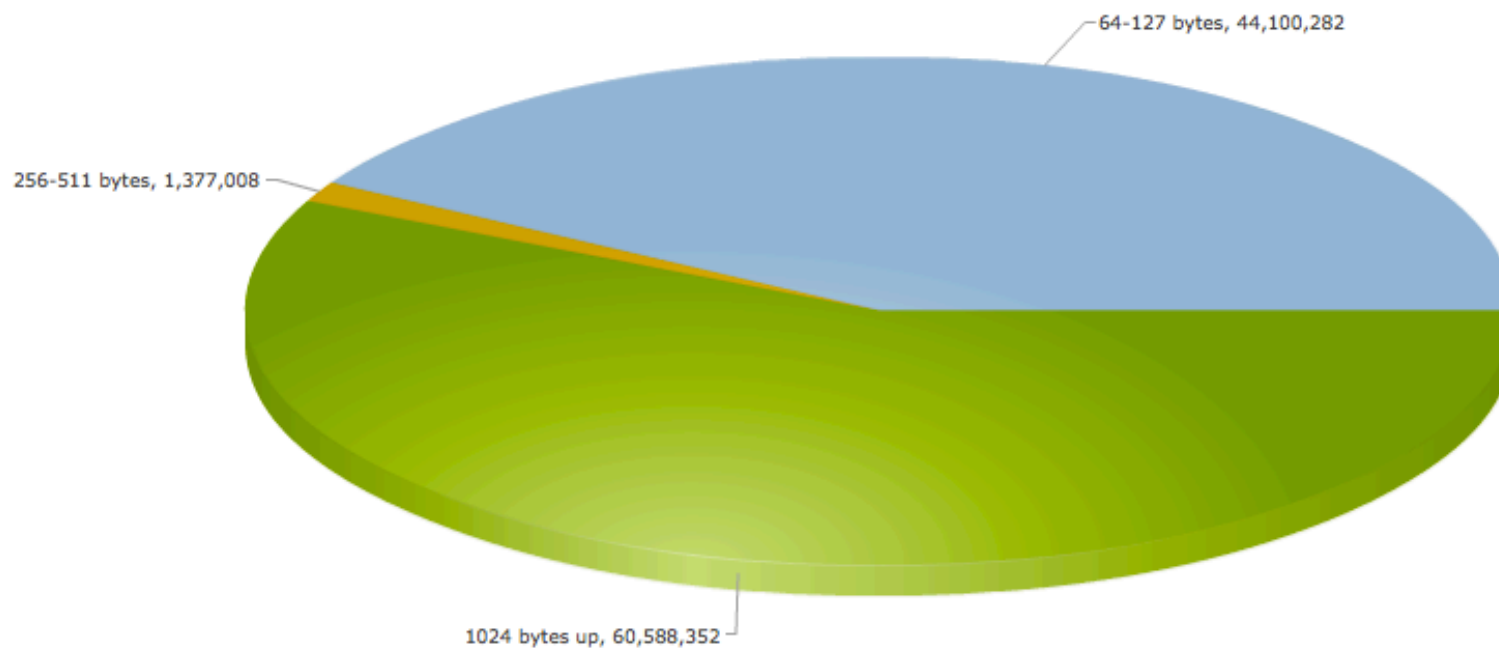


L7 Concurrent HTTP transactions packet distribution





L7 HTTP Bandwidth packet distribution





L7 HTTP Performance test

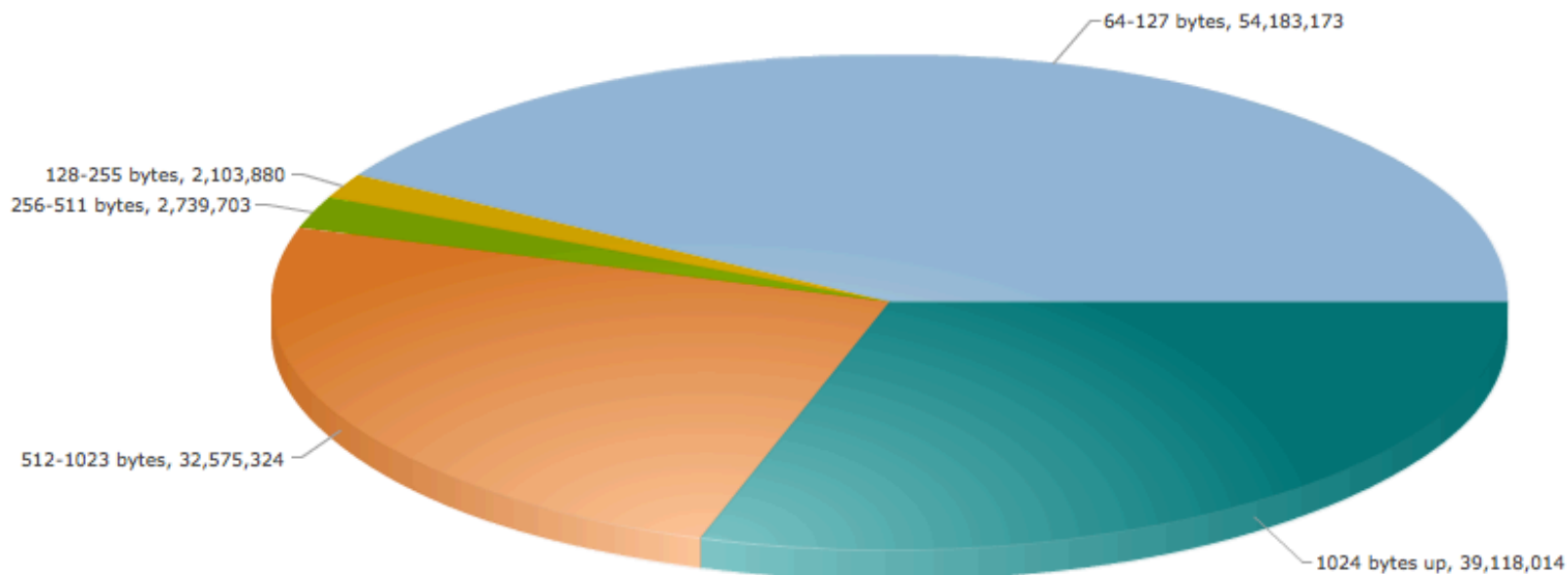
Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
NEW HTTP/SEC	13,000	45,000	18,000	CRASH	CRASH	50,000

Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
HTTP OPEN	1M	0.690M	4.3M	CRASH	CRASH	6.5M

Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
HTTP BANDWIDTH	4.6 Gbps	9.1 Gbps	19 Gbps	CRASH	CRASH	35.9 Gbps

L7 – Real World Application Mix 1

- The goal of this test was to find the maximum L7 application performance of the device under test based on the end customer's specific application mix. Simulating exactly the production environment network traffic to validate accurately the performance of the device under test under production conditions.
- We were checking the maximum application bandwidth, maximum packet per second and maximum new application session per second.





L7 Application Mix 1 performance test

Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	2.6 Gbps	3.4 Gbps	12.6 Gbps	CRASH	CRASH	16.3 Gbps
Packet/Second	0.693M	0.935M	2.6M	CRASH	CRASH	3.2M
Session/Sec	12,000	16,000	60,000	CRASH	CRASH	75,000

Summary of test results



Summary of all test results - test session 1

Test Type	Vendor 1	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
L3-64 Bytes Packet/Sec	7.1M	1.1M	8.5M	6.8M	3.7M	28.4M
L3-1518 Bytes BWD	4.6 Gbps	12.8 Gbps	19.9 Gbps	33 Gbps	39.8 Gbps	39.6 Gbps
L3-4096 Bytes BWD	4.6 Gbps	CRASH	CRASH	36 Gbps	CRASH	39.6 Gbps
TCP/SEC	13,000	50,000	70,000	60,000	CRASH	62,500
TCP OPEN	1M	1.5M	4.3M	CRASH	CRASH	6.5M
TCP BWD	4.6 Gbps	9.2 Gbps	19.5 Gbps	CRASH	CRASH	35.9 Gbps
HTTP/SEC	13,000	45,000	18,000	CRASH	CRASH	50,000
HTTP OPEN	1M	0.690M	4.3M	CRASH	CRASH	6.5M
HTTP BWD	4.6 Gbps	9.1 Gbps	19 Gbps	CRASH	CRASH	35.9 Gbps
APP MIX 1 BWD	2.6 Gbps	3.4 Gbps	12.6 Gbps	CRASH	CRASH	16.3 Gbps

- Vendor 3, Vendor 4, Vendor 5 and Vendor 6 firewalls crashed when pushed them to their maximum performance. We suggested the end customer asked the firewall vendors to fix their bugs or recommend the right hardware to reach 20 Gbps of end customer application mix.
- Vendor 1 and Vendor 2 were the only firewalls who had been able to complete the test plan without crashing. But their performance was low in comparison of end customer's goal of reaching 20 Gbps of their application mix.
- At this stage none of the firewalls evaluated could be deployed in production under the requirements of end customer.
- We suggested a second test session.

Test Session 2

February 2011

- The goal of this professional service was to validate the performance and stability of five firewalls to reach 20 Gbps of application traffic with high availability enabled.
- We have been using a BreakingPoint Storm CTM with 2x blade 4x ports 10 Gigabit.

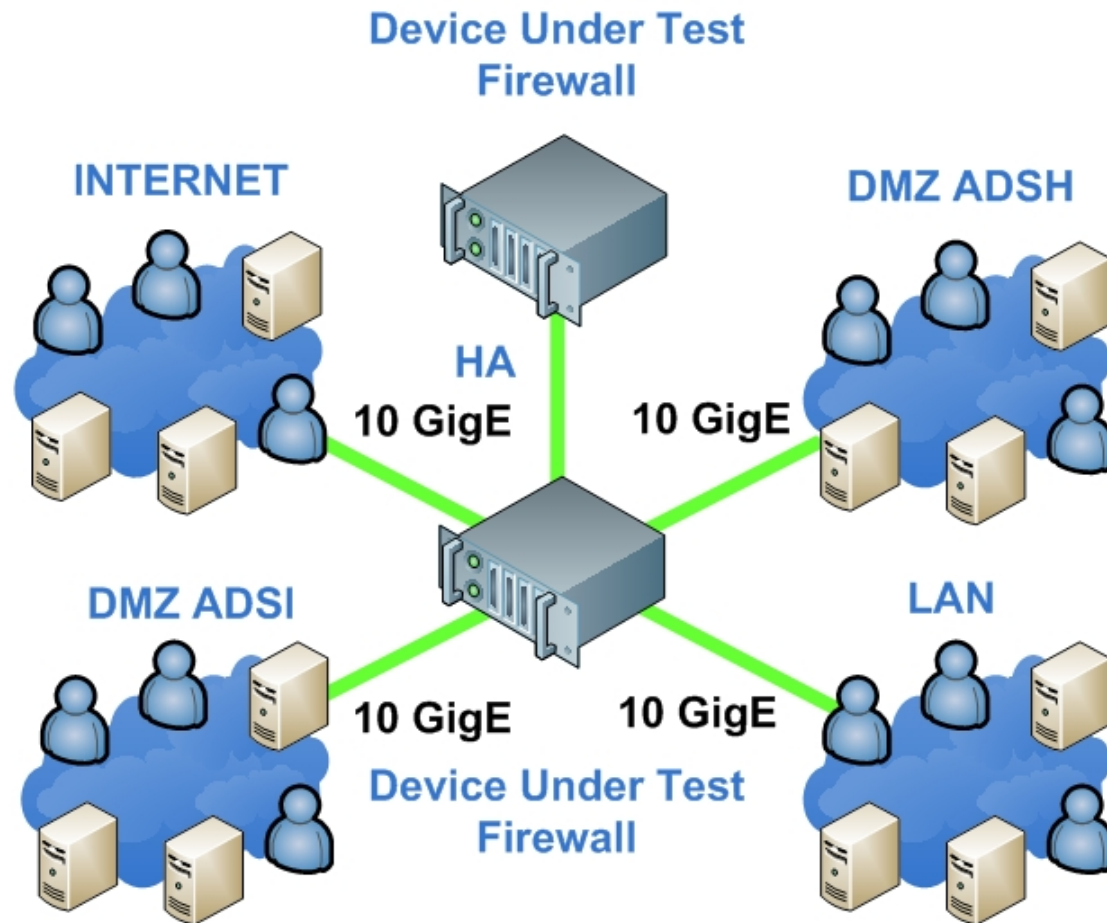


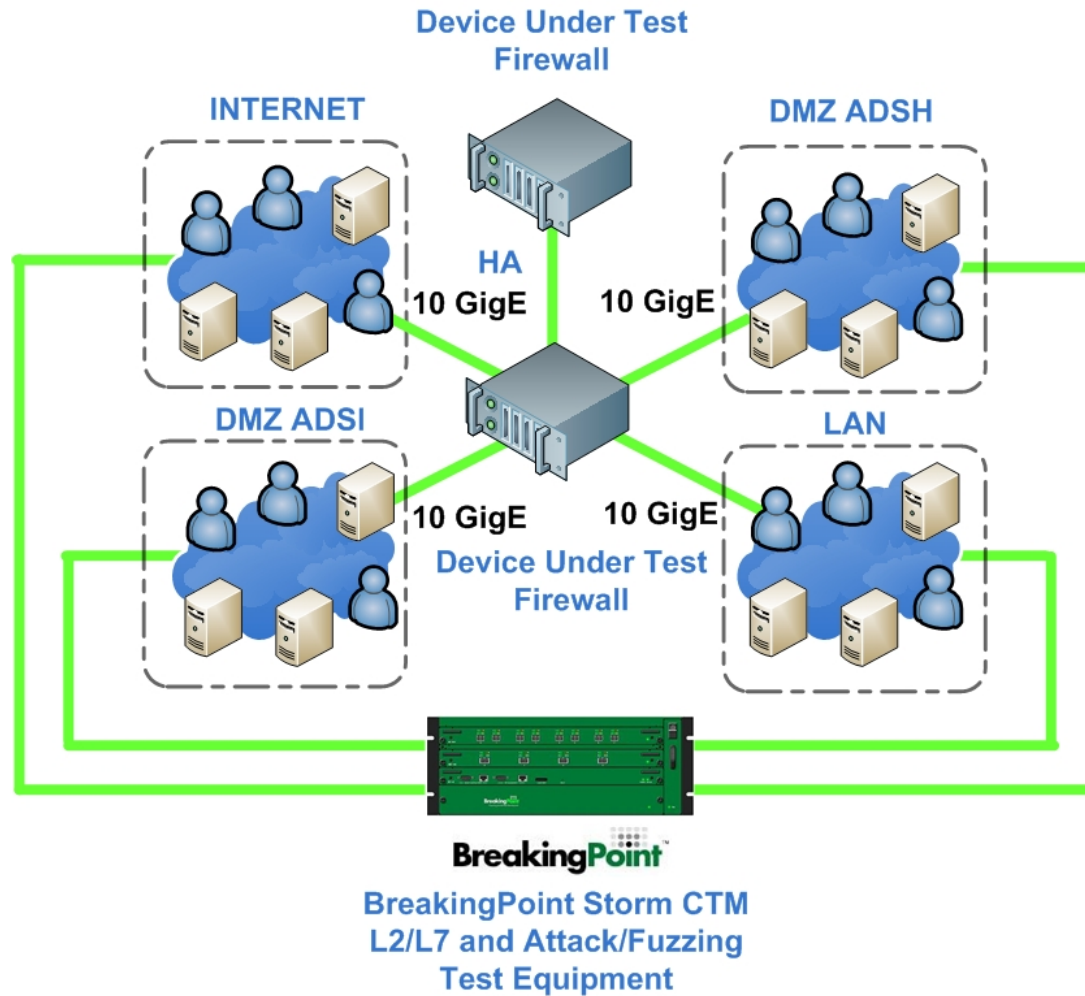
Test Session 2 - Network Equipment Information

NETWORK EQUIPMENT	HARDWARE	VERSION
BreakingPoint Storm CTM	2x Blades Storm 4x 10 Gigabit	OS 2.1 Strike Pack 72219
Juniper SRX5600	2x IOC/NPC 4x SPC 4x Ports 10 Gigabit	JuneOS 10.3.R2.11
Palo Alto Networks PAN-5060	4x Ports 10 Gigabit	PAN-OS 4.0.0-C240
Stonesoft 3205	4x Ports 10 Gigabit	5.2.3 Build 8065
Fortinet 3950B	1x Blade FMCXD2 4x Ports 10 Gigabit	FortiOS 4.2.2 Build 8604
Crossbeam X80	1x NPM 8620 2x NPM 8650 4x APM 9600 4x Ports 10 Gigabit	XOS 9.5.1 CheckPoint R70 Patch HCC 64B

Hardware and software modification from test session 1 in red.

Network Test Infrastructure





- For the test each firewall was loaded with 640 rules with logging enabled. The last rule matching the application traffic and network zones defined.

L3 – RFC 2544

- The goal of this suite of tests was to find the maximum L3 performance of the device under test.
- We are checking the following frame sizes 64 / 512 / 1024 / 1518 / 9000 bytes.



L3 Performance Test – RFC2544

Test Type L3 64 Bytes	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	Drop Packet	7.6 Gbps	10 Gbps	3.2 Gbps	19.9 Gbps
Packet/Second	Drop Packet	10.7M	14M	4.5M	28.4M
Latency	Drop Packet	11.485 µs	70 µs	82.6 µs	4.79 µs
Test Type L3 512 Bytes	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	Drop Packet	19.8 Gbps	19 Gbps	18.4 Gbps	39.2 Gbps
Packet/Second	Drop Packet	4.6M	4.4M	4.3M	9.2M
Latency	Drop Packet	14.024 µs	67 µs	71.645 µs	5.974 µs
Test Type L3 1024 Bytes	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	Drop Packet	19.9 Gbps	19.9 Gbps	36.2 Gbps	39.2 Gbps
Packet/Second	Drop Packet	2.4M	2.3M	4.3M	3.1M
Latency	Drop Packet	18.540 µs	204 µs	86,817 µs	8.388 µs



L3 Performance Test – RFC2544

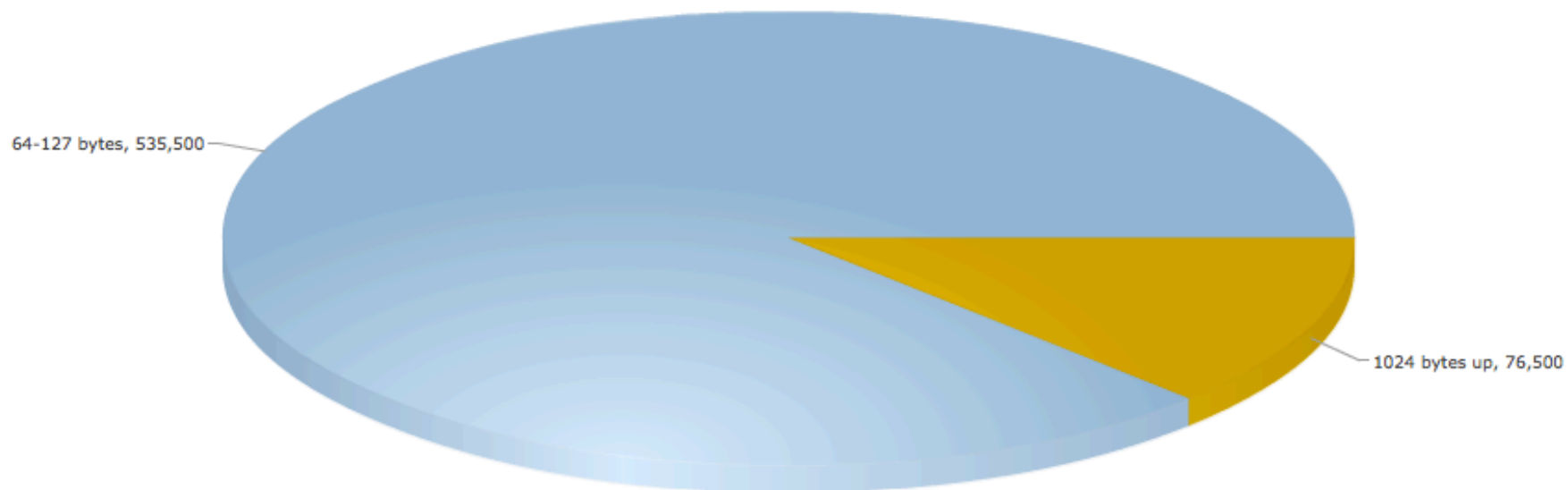
Test Type L3 1518 Bytes	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	Drop Packet	19.9 Gbps	19.9 Gbps	39.2 Gbps	39.2 Gbps
Packet/Second	Drop Packet	1.6M	1.6M	3.2M	3.2M
Latency	Drop Packet	18.034 µs	95.178 µs	83.443 µs	8.388 µs
Test Type L3 9000 Bytes	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	Drop Packet	19.9 Gbps	NO	NO	39.2 Gbps
Packet/Second	Drop Packet	0.276M	NO	NO	0.543M
Latency	Drop Packet	52.281 µs	NO	NO	26.455 µs

L4 – TCP Traffic

- The goal of this suite of tests was to find the maximum L4 performance of the device under test.
- We are checking the maximum new TCP connection per second, the maximum concurrent TCP connections and the maximum TCP bandwidth.

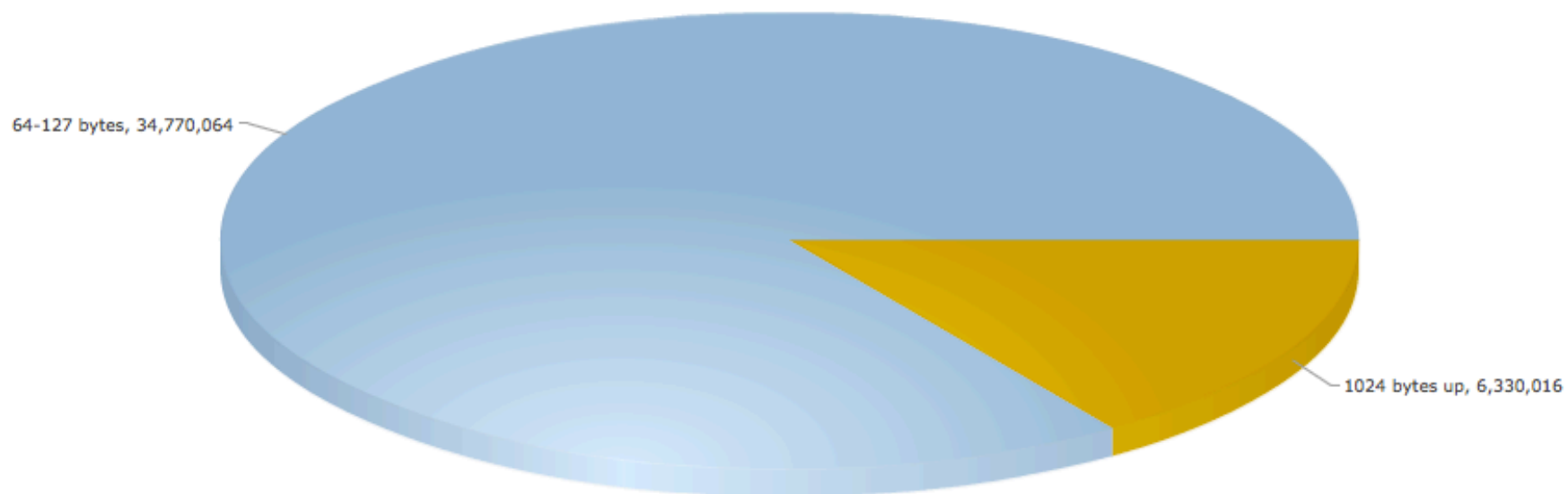


L4 New TCP connections per sedons packet distribution



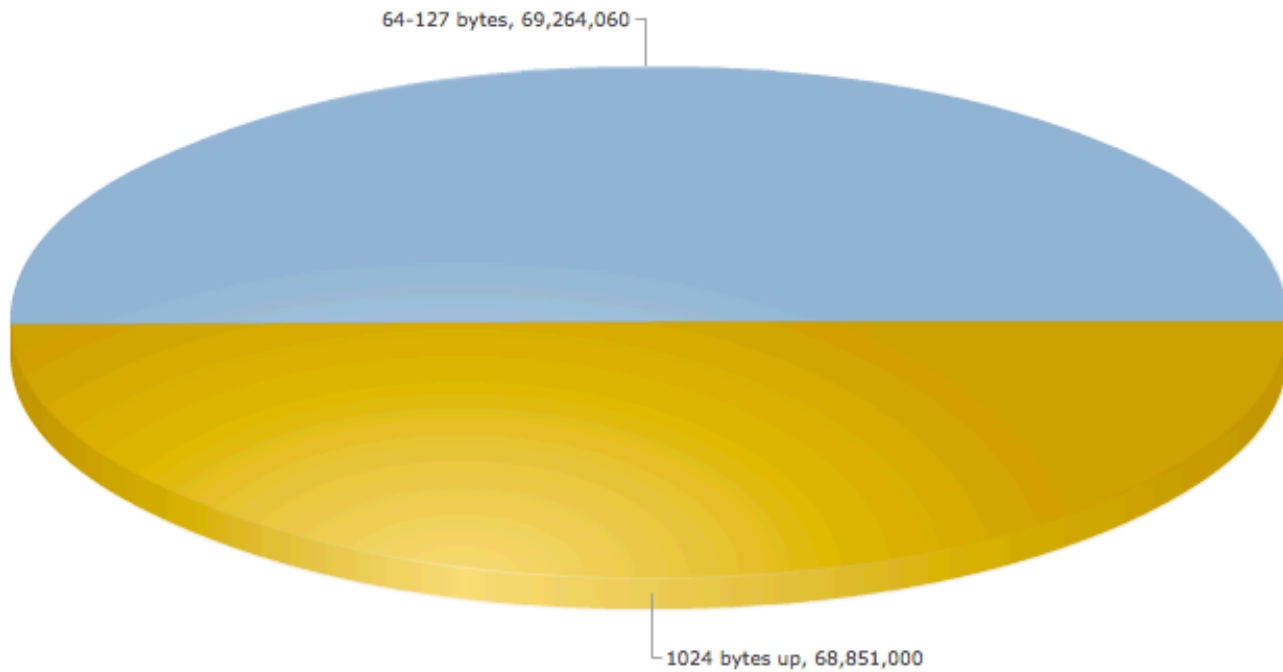


L4 concurrent TCP connections packet distribution





L4 TCP bandwidth packet distribution





L4 Performance test – TCP traffic

Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
NEW TCP/SEC	280,000	55,000	55,000	130,000	80,000

Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
TCP OPEN	7.3M	4.1M	12M	30M	6.5M

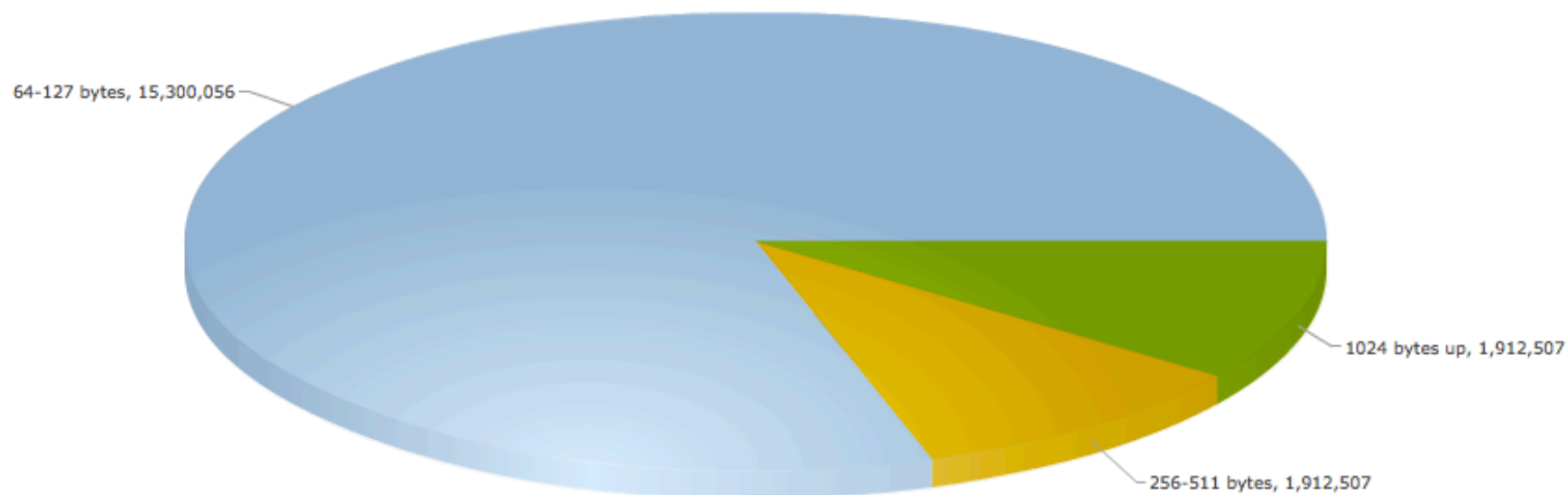
Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
TCP BANDWIDTH	35 Gbps	19.9 Gbps	19.9 Gbps	25 Gbps	35.9 Gbps

L7 – HTTP Traffic

- The goal of this test was to find the maximum L7 performance of the device under test.
- We are checking the maximum HTTP transactions per second, the maximum concurrent HTTP transactions and the maximum HTTP bandwidth.

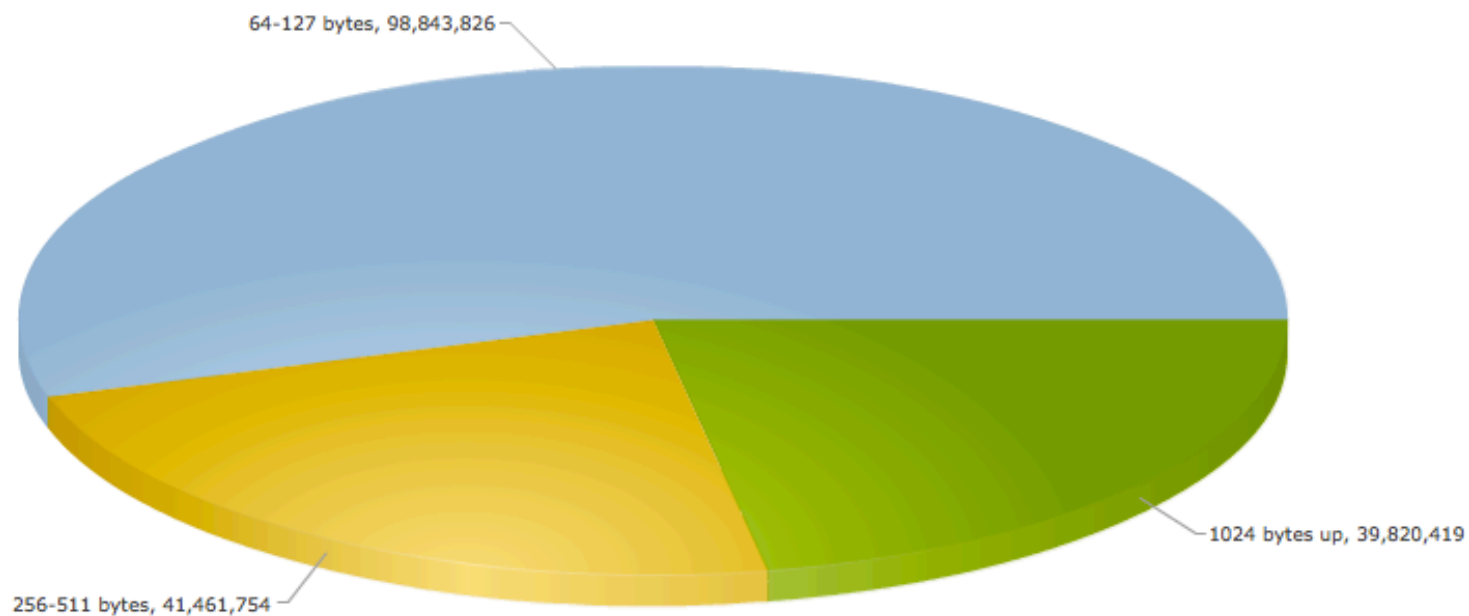


L7 New HTTP sessions per second packet distribution



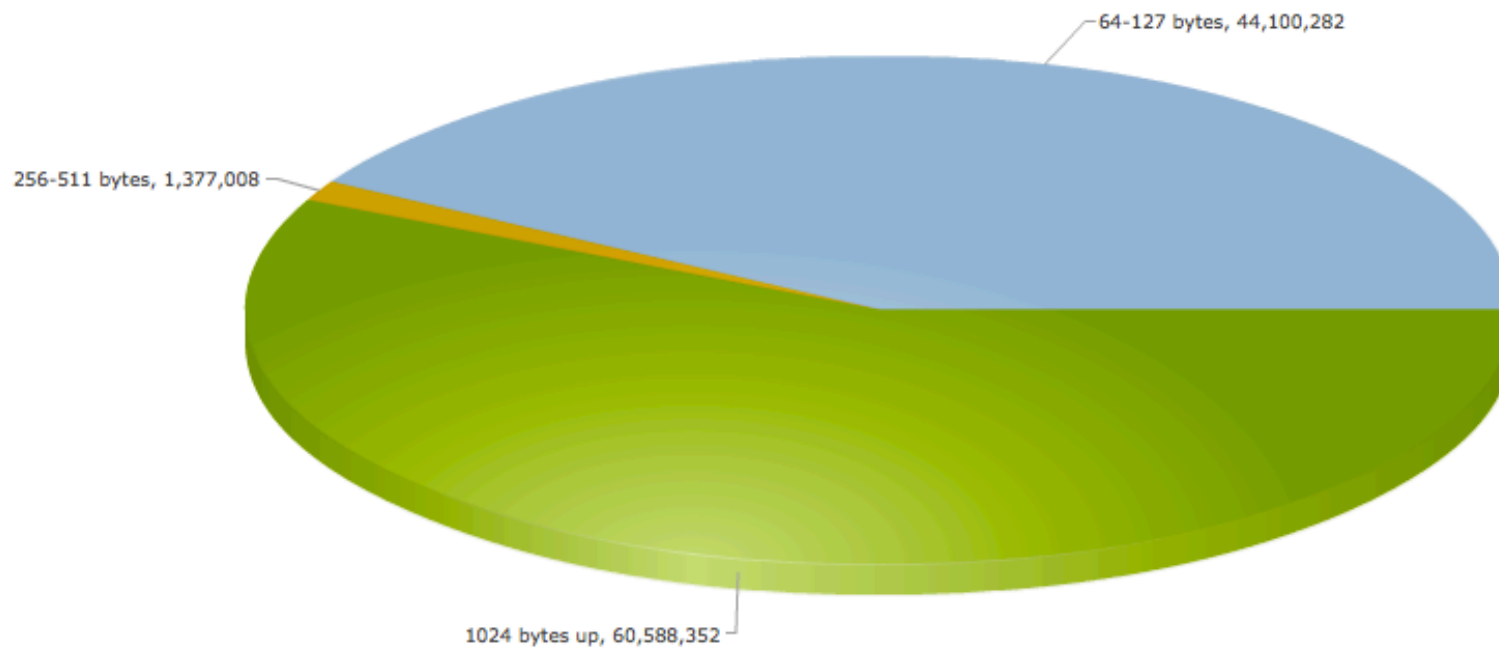


L7 Concurrent HTTP transactions packet distribution





L7 HTTP bandwidth packet distribution





L7 HTTP performance test

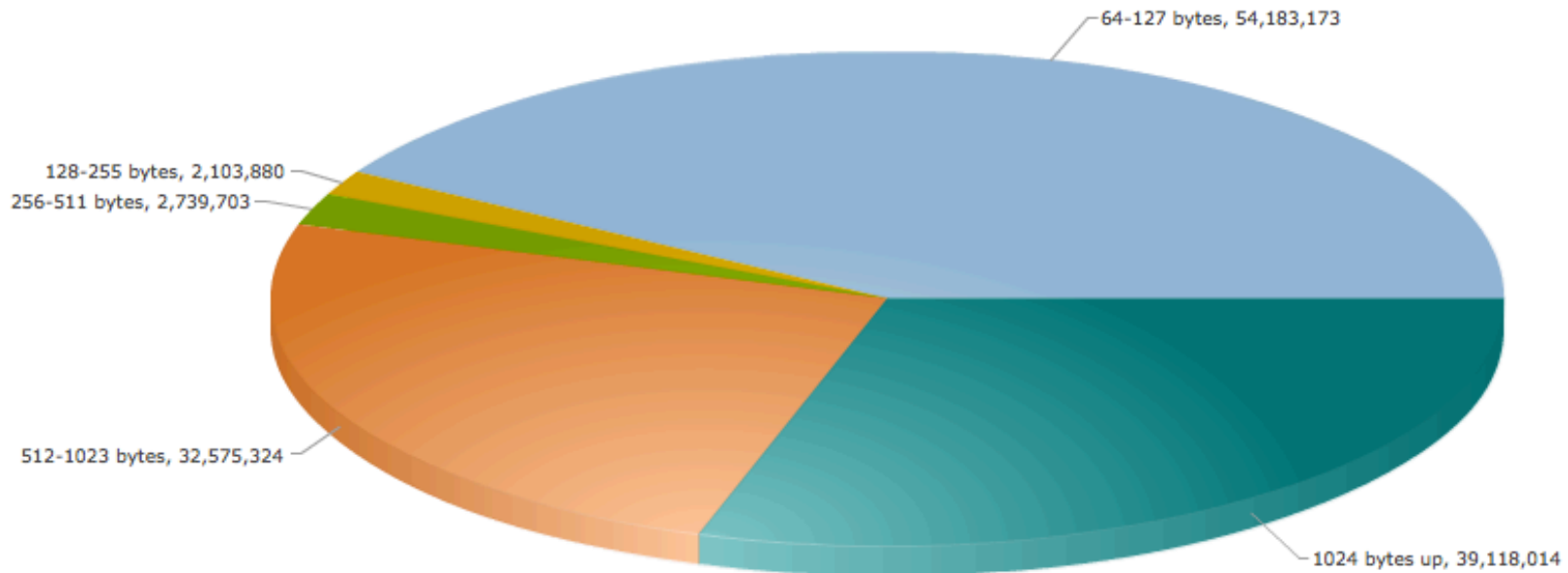
Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
NEW HTTP/SEC	250,000	18,000	50,000	80,000	60,000

Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
HTTP OPEN	6M	4M	10M	11.6M	6.5M

Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
HTTP BANDWIDTH	39.9 Gbps	19.6 Gbps	19.9 Gbps	26.9 Gbps	31.5 Gbps

L7 – Real World application mix 1

- The goal of this test was to find the maximum L7 application performance of the device under test based on the end customer's specific application mix. Simulating exactly the production environment network traffic to validate accurately the performance of the device under test under production conditions.
- We were checking the maximum application bandwidth, maximum packet per second and maximum new application session per second.





L7 Application mix 1 performance test

Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
Bandwidth	15.2 Gbps	12 Gbps	13.5 Gbps	19.4 Gbps	20.6 Gbps
Packet/Second	3.1M	2.5M	2.9M	3.8 Gbps	4.1 Gbps
Session/Sec	60,000	40,000	45,000	70,000	75,000

Summary of test results – session 2



Summary of test results – session 2

Test Type	Vendor 2	Vendor 3	Vendor 4	Vendor 5	Vendor 6
L3-64 Bytes Packet/Sec	Drop Packet	10.7M	14M	4.5M	28.4M
L3-1518 Bytes BWD	Drop Packet	19.9 Gbps	19.9 Gbps	39.8 Gbps	39.2 Gbps
L3-9000 Bytes BWD	Drop Packet	19.9 Gbps	NO	NO	39.2 Gbps
TCP/SEC	280,000	55,000	55,000	130,000	80,000
TCP OPEN	7.3M	4.1M	12M	30M	6.5M
TCP BWD	35 Gbps	19.9 Gbps	19.9 Gbps	25 gbps	35.9 Gbps
HTTP/SEC	250,000	18,000	50,000	80,000	60,000
HTTP OPEN	6M	4M	10M	11.6M	6.5M
HTTP BWD	39.9 Gbps	19.6 Gbps	19.9 Gbps	26.9 Gbps	31.4 Gbps
APP MIX 1 BWD	15.2 Gbps	12 Gbps	13.6 Gbps	19.4 Gbps	20.5 Gbps



Enabling a Converged World™

Thank You

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