White Paper

Cutting-Edge and Affordable Network Performance Testing Solutions: a NEXCOM and O'Prueba Collaboration

Network performance testing can be complicated and costly, but NEXCOM and O'Prueba have collaborated to create a high-performance automated test solution.

Background

Network performance testing, especially in 5G network topology, is a highly complicated and specialized expertise in the IT industry. As network infrastructure becomes increasingly cloudified into software-defined networking (SDN) and network functions virtualization (NFV) popularized, optimization of network efficiency has become a hot topic discussed by IT engineering and operations teams in technical forums, especially concerning CAPEX and OPEX, as they reach for the ultimate goals of achieving simplified and fast-tracked trial testing with low-cost deployment.

Network and communication equipment developers used to acquire costly testing equipment from established brand names, such as IXIA and Ciena, incurring huge expenses not only from the initial purchase of hardware, application packages, and training but also subsequent maintenance services. This high capital investment has kept many network appliance producers from achieving network technology leadership.

But there's another choice. By adopting automated test solutions that are based on both NEXCOM's high-performance and reliable product lines and O'Prueba's long-established and industry-specific expertise in real-world traffic emulation and automated network testing tools with its own ACTS (automatic control testing system), developers can easily execute comprehensive test planning and validation without traversing the long route of budgeting, approval, and purchasing.

This white paper demonstrates the ACTS testing solution based on NEXCOM's NSA 7141 platform. As Figure 1

shows, NSA 7141 is an 1U rackmount appliance supporting a single Intel® Xeon® scalable processor and memory size up to 256GB DDR4 RDIMM. The system accommodates four LAN module expansions for a wide range of bandwidth configurations to allow simulation and testing of diversified network test cases and applications.

Figure 1. NEXCOM NSA 7141 network testing platform

System Configuration

As shown in Table I, the system configuration consists of NSA 7141 and NX 140F, a LAN module powered by Intel® XL710 and supporting four 10GbE SFP+ ports.

TABLE I
SYSTEM CONFIGURATION

Equipment	Description
Platform	NEXCOM NSA 7141
CPU	Intel® Xeon® Gold 6150 CPU @ 2.70GHz
Total Memory	DDR4 256GB
Storage	1 TB
LAN Module	NEXCOM NX 140F

Single NX 140F TX Throughput Test (4 Ports per LAN Module)

The topology for testing a single LAN module NX 140F is shown in Figure 2. The tester is the Spirent N4U system. This 4x 10GbE module is connected via 10G DAC cables to Spirent N4U, with packet size set to 64 bytes to generate unidirectional packet traffic. One transmit queue is allocated for each port with affinity set to unique logical cores. Table II shows the test results. Compared with the

A single throughput test of 64-byte packet size and four ports per LAN module can achieve maximum transmission rates between 81 to 83%, which reflect Intel's preset limits.

theoretical maximum throughput frame size of 64 bytes displayed in Table III, the TX rate falls between 81 to 83%. Table IV displays Intel's limits for its Ethernet Converged Network Adapter X710-DA4's 4x10 GbE performance with 64-byte packet sizes, and Figure 3's zero packet loss testing results further demonstrates that 64-byte packet sizes cannot reach a 100% TX rate.
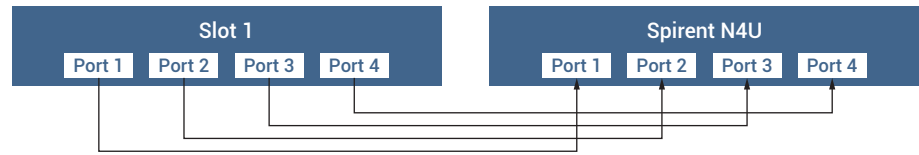

Figure 2. Single NX 140F TX throughput test (4 ports per LAN module)

TABLE II
TEST RESULTS FOR SINGLE NX140F TX THROUGHPUT TEST (4 PORTS PER LAN MODULE)

Port	Throughput (FPS)	TX Rate (%)
Port 1	12216182	81.72%
Port 2	12223121	82.14%
Port 3	12231141	81.19%
Port 4	12201234	81.99%

TABLE III
THEORETICAL MAXIMUM FRAME RATES FOR DIFFERENT FRAME SIZES

Theoretical maximum Frame Rates (frames/second) for different frame size (bytes)							
Speed	64	128	256	512	1024	1280	1518
10 Mbps	14881	8446	4529	2350	1198	962	813
100 Mbps	148810	84460	45290	23497	11973	9616	8128
1000 Mbps	1488096	844595	452899	234963	119732	96154	81275
10 Gbps	14880952	8445946	4528986	2349625	1197318	961539	812744
25 Gbps	37202380	21114864	11322463	5874060	2993295	2403846	2031859
40 Gbps	59523809	33783783	18115942	9398496	4789272	3846153	3250975
100 Gbps	148809523	84459459	45289855	23496240	11973180	9615384	8127438

TABLE IV
INTEL[®] TEST RESULTS FOR INTEL[®] ETHERNET CONVERGED NETWORK ADAPTER X710-DA4 [2]

Packet Size (Bytes)	Throughput (Mpps)	Line Rate %
64	36.5	61.33
128	33.78	100
256	18.11	100

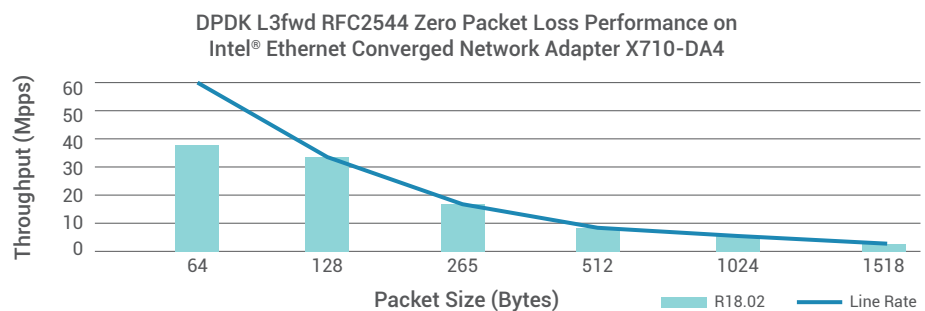* Note: All packet sizes over 128B reach line rate.

Figure 3. RFC2544 Zero packet loss test on Intel[®] Ethernet converged network adapter X710-DA4 [2]

Dual throughput tests of 64-byte packet size and either two or three ports per LAN module can both achieve a maximum transmission rate of 100%.

Dual NX 140F TX Throughput Test (2 Ports per LAN Module)

The topology for testing dual NX 140F 10GbE modules is shown in Figure 4. The tester is the Spirent N4U system. Each NX 140F module consists of 2x 10GbE, and a total of 4x 10GbEs are interconnected via 10G DAC cables. The traffic is unidirectional with packet size of 64 bytes. In this test, each slot only uses two ports. One transmit queue is allocated for each port with affinity set to unique logical cores. Test results appear in Table V. ompared with the theoretical maximum throughput frame size of 64 bytes (Table III), the TX rate reaches 100%.
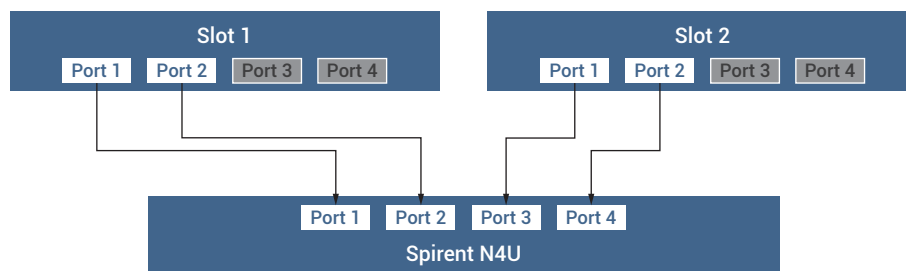

Figure 4. Dual NX 140F TX throughput test (2 ports per LAN module)

TABLE V
TEST RESULTS FOR DUAL NX 140F TX THROUGHPUT TEST (2 PORTS PER LAN MODULE)

Port	Throughput (FPS)	TX Rate (%)
Slot1-Port 1	14880952	100%
Slot1-Port 2	14880952	100%
Slot2-Port 1	14880952	100%
Slot2-Port 2	14880952	100%

Dual NX 140F TX Throughput Test (3 Ports per LAN Module)

The topology for testing dual NX 140F 10GbE modules is shown in Figure 5. The tester is the Spirent N4U system. Each NX 140F module consists of 3x 10GbE, and a total of 6x 10GbEs are interconnected via 10G DAC cables. The traffic is unidirectional with packet size of 64 bytes. In this test, each slot only uses two ports. One transmit queue is allocated for each port with affinity set to unique logical cores. Test results appear in Table VI. Compared with the theoretical maximum throughput frame size of 64 bytes (Table III), the TX rate reaches 100%.
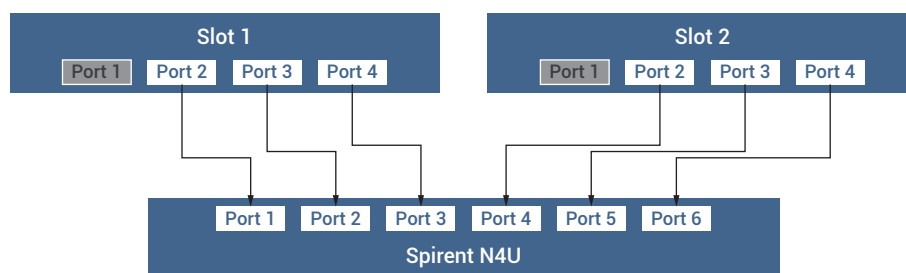

Figure 5. Dual NX 140F TX throughput test (3 ports per LAN module)

A multiple throughput test of 64-byte packet size and two ports per LAN module can achieve a maximum transmission rate of 100%.

TABLE VI
TEST RESULTS FOR DUAL NX 140F TX THROUGHPUT TEST (3 PORTS PER LAN MODULE)

Port	Throughput (FPS)	TX Rate (%)
Slot1-Port 1	14880952	100%
Slot1-Port 2	14880952	100%
Slot1-Port 3	14880952	100%
Slot2-Port 1	14880952	100%
Slot2-Port 2	14880952	100%
Slot1-Port 3	14880952	100%

Multiple NX 140 TX Throughput Test (2 Ports per LAN Module)

Topology for testing multiple NX 140F 10GbE modules is shown in Figure 6. The tester is the Spirent N4U system. Each NX 140F module consists of 2x 10GbE, and a total of 6x 10GbEs are interconnected via 10G DAC cables to

NSA 7141. The traffic is unidirectional with packet size of 64 bytes. In this test, each slot only uses two ports. One transmit queue is allocated for each port with affinity set to unique logical cores. Test results appear in Table VII. Compared with the theoretical maximum throughput frame size of 64 bytes (Table III), the TX rate reaches 100%.
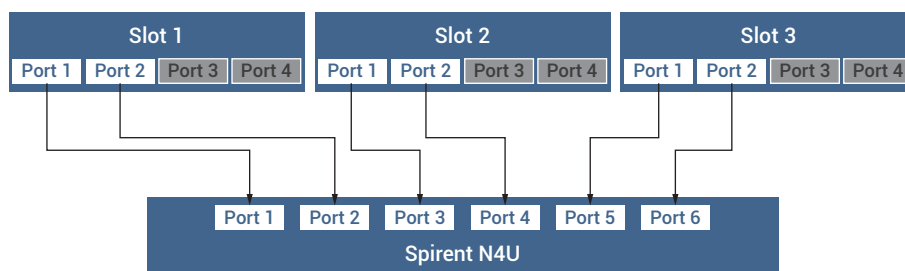

Figure 6. Multiple NX 140F TX throughput test (2 ports per LAN module)

TABLE VII
TEST RESULTS FOR MULTIPLE NX 140F TX THROUGHPUT TEST (2 PORTS PER LAN MODULE)

Port	Throughput (FPS)	TX Rate (%)
Slot1-Port 1	14880952	100%
Slot1-Port 2	14880952	100%
Slot2-Port 1	14880952	100%
Slot2-Port 2	14880952	100%
Slot3-Port 1	14880952	100%
Slot3-Port 2	14880952	100%

Conclusion

Testing results of the above configurations leads to the conclusion that NSA 7141 paired with NX 140F's 10GbE ports can realize a 100% TX rate in 64-byte packet sizes, with utilization of up to two ports per LAN module and integrated with optimized DPDK, CPU core allocation, and software. The solution thus offers a stable 10GbE line rate as with other branded packet generators. Because

of the collaboration between NEXCOM, a leading network and communication solution provider focused on high- performance and reliable computing platforms and network technology, and O'Prueba, dedicated to building easy-to-use and cost-effective testing solutions for the network and communications industry, state-of-the-art network performance benchmark testing solutions are now affordable, reliable, and serviceable.

References

[1] Spirent Communications, FS S5800-48F4S switch 1/10GE Ethernet performance validation. Calabasas: 2014. https://img-en.fs.com/file/report/fs-s5800-48f4s-1ge-and-10ge-ethernet-switch-performance-test-report.pdf

[2] Intel DPDK Validation Team, DPDK Intel NIC performance report release 18.02. 2018. https://fast.dpdk.org/doc/perf/DPDK_18_02_Intel_NIC_performance_report.pdf

NEXCOM
COMMITTED TO CUSTOMER SUCCESS

Founded in 1992 and headquartered in Taipei, Taiwan, NEXCOM is committed to being your trustworthy partner in building the intelligent solutions. NEXCOM integrates its capabilities and operates ten global businesses, which are Network and Communication Solutions (NCS), Intelligent Platform & Services (IPS), Mobile Computing Solutions (MCS), Medical & Healthcare Informatics(MHI), Intelligent Digital Security (by Green Base), Smart Manufacturing Solutions (by NexAIoT), Robot & Smart Machines (by NexCOBOT), Industrial Wireless Solutions (by EMBUX), Education & E Commerce (by AIC), and IoT Security Solutions (by TMRTek). This strategic deployment enables NEXCOM to offer time-to-market, time-to-solution products and service without compromising cost.

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O'PRUEBA

O'Prueba Technology Inc.(O'Prueba) was founded in 2018 as the first spin-off research service company of National Chiao Tung University (NCTU) in Taiwan.

O'Prueba dedicates on building easily used and cost-effective testing solution for network and communication industry. The focused areas are including SDN, NFV and 4G/5G systems. O'Prueba design a series of testing methodologies, frameworks and services as the solution to connect the related technologies to the future network.

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