Lanner

White Paper

Meet the Growing Network, Communications, and Processing Demands with Intel® Xeon® Processor E5-2600 V3 Grantley Platform

Date of Release (Y/M/D)
2015/06/25

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Overview

With the exponential growth of mobile Internet devices and the rise of cloud computing, end users demand faster, more powerful, and more secure Internet services. This unprecedented demand has presented a new challenge which Internet service provider and IT system operators maintain and manage their network traffic, especially in virtualized environments. To ensure smooth network traffic, a thoroughly enhanced architecture is necessary in order to deliver qualifying services and handle various types of data packets and security instructions. In other words, service providers require higher performance, power efficiency, scalability, and reliability for their virtualization and security management needs.

Regarding the future standard of server platforms, the previously launched Intel® Xeon® processor E5 v2 (code named Romley) platform performs reasonably in most applications. However, in today's security-sensitive, mission-critical, and heavy-traffic cloud computing ecology, Intel® Xeon® processor E5 v2 may experience performance limits at times. Therefore, Lanner launches its new network communication systems based on Intel® Xeon® processor E5 v2 successor— Intel® Xeon® processor E5 v3 (codenamed Grantley). This immensely powerful platform comes with several significant technological upgrades for today's demand of high-performance computing needs in network traffic management, virtualization, and integrated security handlings.

The new Intel Xeon processor E5 v3 platform emphasizes the integration of the next generation Intel® Xeon® processor E5-2600 v3 (Haswell-EP) family along with Intel® C612 chipset series (Wellsburg). The new Intel Xeon CPU delivers major upgrades in cores, memory bandwidth, Ethernet throughput, and I/O efficiencies.

To respond to the demands for higher network performance, Lanner Electronics has launched its high-end systems based on the new platform designed with Intel Xeon processor E5-2600 v3 family and Intel® C612 chipset. The R&D department of Lanner Electronics has conducted benchmark testing based on our high-end model FW-8896. The results of the benchmarks will demonstrate the enhanced performance and throughputs of the new Intel server platforms.

Introducing the All New Accelerated Architecture

The adoption of Intel Xeon processor E5-2600 v3 s and Intel C610 PCH, codenamed "Grantley," is to meet the challenges of today's virtualization and networking environments. There are particular revolutionary technological upgrades making this new Intel x86 architecture so efficient for consolidating virtual machines, conducting SDN, and managing heavy network traffic.

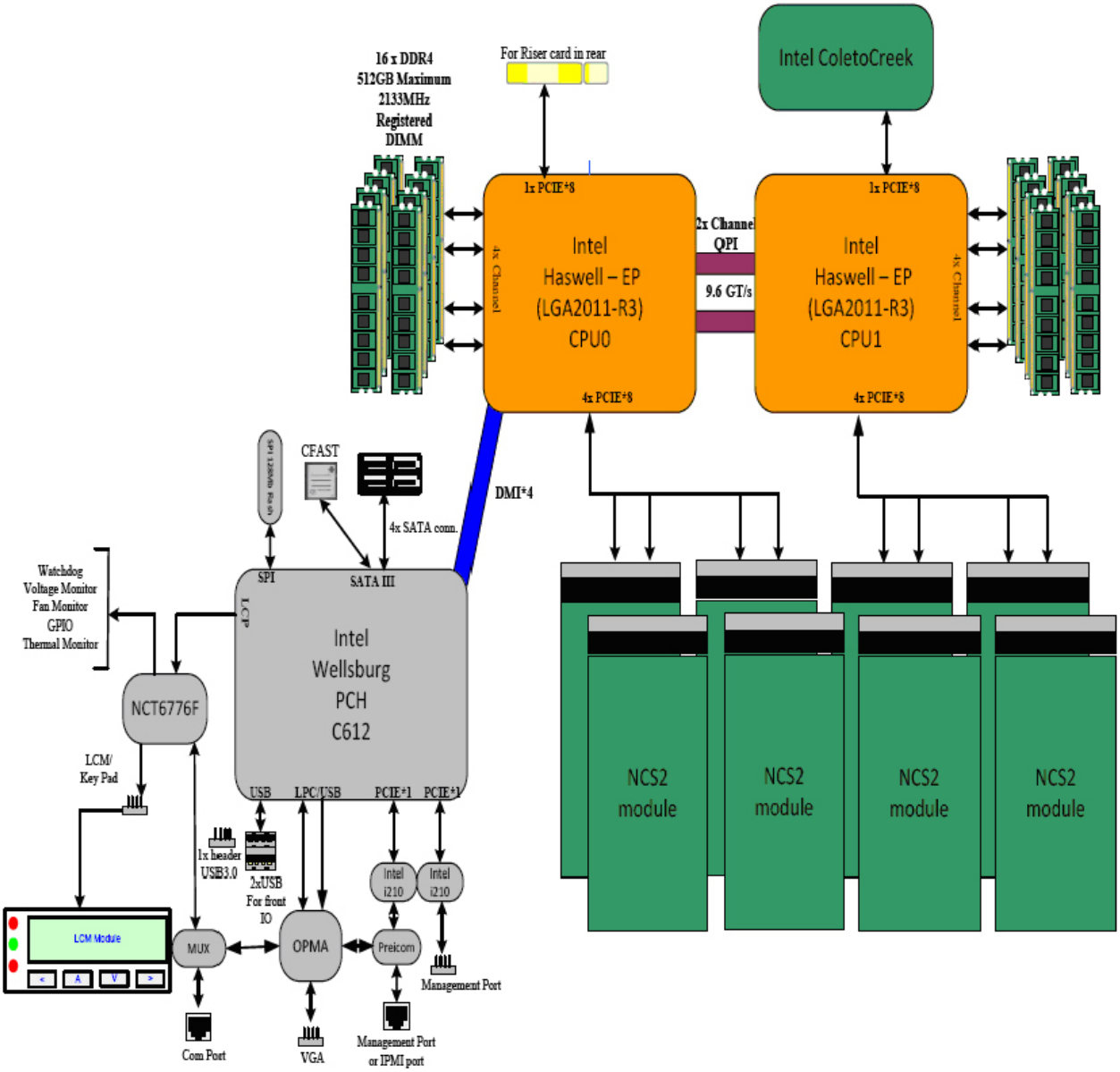
Regarding the growing concerns of ownership cost in power consumption, one of the most significant benefits for employing the new Intel x86 platform is the breakthrough acceleration of power/performance efficiency. The new Intel Xeon processor E5-2600 v3 supports Per Core P-state (Performance State), programmed to control the clock frequency and voltage of each independent core. It is announced by Intel to improve energy efficiency and also greatly reduces the ownership cost for network facility administrators.

Like its former v2 CPU platform (code named "Romley"), the Intel Xeon processor E5-2600 v3 also offers up to 16 cores and dual CPU design, with the aim of performance acceleration. Aside from multiple cores and processors, the new platform determines to further strengthen Intel® QuickPath Interconnect (Intel® QPI) up to 9.6 GT/s. This will give an even greater lift to multi-core proliferation and processor interconnect by providing higher bandwidth and lower latency between CPU communications. By offering up to 9.6 GT/s, the new architecture enables quicker processing and communication power, as well as better RAS (Reliability, Availability, and Serviceability) for mission critical applications.
Another revolutionary upgrade is the system memory. Intel Xeon processor E5 v3 is the first network platform supporting DDR4 memories, with up to 2,133 MHz clock frequency and lowered operating voltage to 1.2V from 1.5/1.35V. This is a great step for caching memory performance upgrade and greener structure than the previous DDR3 compromises. Based on researched statistics, this will improve performance and power efficiency by nearly 50 percent.

Like previous Intel Xeon processor generations, the Intel Xeon processor E5-2600 v3 features Intel® Virtualization Technology (Intel® VT), a hardware-assisted virtualization tool for software-based virtualization solutions. This upgrading mechanism not only reduces virtualization overhead of CPU utilization, but also improves data throughput, flexibility, and reliability through hardware assistance. With hardware support, the involvement of virtual machine monitoring for I/O traffic can be reduced in order to gain higher virtualization efficiency.

On the other hand, by taking VM (Virtual Machine) service quality into consideration, Intel implemented Cache Monitor (Cache QoS) in its Intel Xeon E5 v3 platform for the first time. Without Cache QoS, cache works on a FIFO (First-In-First-Out) basis. In conventional VM applications, larger VMs and smaller VMs both utilize the FIFO approach. This would downgrade the virtualization performance in the long run. On the other hand, the all new mechanism monitors and provides information on individual VMs in cache and makes better utilization of cache spaces. This will greatly improve virtualization efficiency in the long term.

With regards to the network bandwidth, the new Intel Xeon processor E5 v3 platform is the first x86 architecture to support 40 GbE Ethernet output. Together with multiple PCIe* Gen 3.0 lanes on the Intel Xeon processor E5-2600 v3 series and numerous PCIe Gen 2.0 lanes by Intel C612 PCH, the new Intel platform is able to connect to many Ethernet modules for the optimal network output and bandwidth.



Block diagram of Intel® Xeon® processor E5 v3 platform-implemented System

Lanner's High-End Solution with Intel® Xeon® processor E5 v3 – FW-8896

Lanner FW-8896 leverages all the technological advantages discussed above. Aside from performance and efficiency upgrades, FW-8896 also delivers high scalability in Ethernet port density. The Intel Intel Xeon processor E5-2600 v3 series -based networking appliance supports a wide range of NIC modules, up to 8 Ethernet modules with 64 x 1GbE, 32 x 10 GbE, or 16 x 40 GbE ports for customization, a much wider bandwidth than other similar devices in the market. The following will demonstrate the performance of FW-8896.

Lanner's FW-8896

CPU Performance Scoring

The performance results of Intel Xeon processor E5-2600 v3 series were conducted by CPU benchmarks CPUMARK 2.1 and CPUMARK 99. In CPUMARK 2.1, three different types of testing methods were carried out to experiment with the performance scoring capabilities of Intel® Xeon® processor E5 v3 processors. Another testing benchmark, CPUMARK 99, provides an overall statistics of CPU performances[2]. The results may vary depending on the items in the test environment.

Table 1. Processor Test Environment

CPU	Intel® Xeon® processor E5-2600 v3 family
DRAM	Transcend* 16GB DDR4 2133 REG
Graphics	IAC-AST2300
Storage	320GB WD3200SD-01KNB0
Operating System	Windows* 7 Professional 64bit
Power Supply	GIN-3800V 800W
BIOS	MB-8896 Ver.AA0

Table 2. CPU Benchmark Test Results (based on CPUMARK 2.1 benchmark)

CPU model[3]	Test 1[a]	Test 2[a]	Test 3[a]	Final Score[b]
Intel® Xeon® processor E5-2609 v3	933	382	6302	5721
Intel® Xeon® processor E5-2608L v3	933	400	6302	5735
Intel® Xeon® processor E5-2658 v3	1050	442	8403	7496
Intel® Xeon® processor E5-2699 v3	1096	458	8403	7527
Intel® Xeon® processor E5-2680 v3	1200	494	8403	7598
Intel® Xeon® processor E5-2643 v3	1575	681	12605	11259

[a] Test 1 – Registry Operation Test; Test 2 – Floating-point Operation Test; Test 3 – Integer Operation Test

[b] Final Score = Test 1 Score x 40% + Test 2 Score x 80% + Test 3 Score x 80%

[1]Intel does not control or audit the design or implementation of third party benchmark data or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmark data are reported and confirm whether the referenced benchmark data are accurate and reflect performance of systems available for purchase.
[2]Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.
[3]Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families: Go to: Learn About Intel® Processor Numbers

Table 3. CPU Benchmark Test Results (based on CPUMARK 99 benchmark)

CPU model	Result
Intel® Xeon® processor E5-2609 v3	196
Intel® Xeon® processor E5-2608L v3	346
Intel® Xeon® processor E5-2658 v3	382
Intel® Xeon® processor E5-2699 v3	393
Intel® Xeon® processor E5-2680 v3	424
Intel® Xeon® processor E5-2643 v3	588

Memory Efficiency Testing

According to official information, the new Intel Xeon processor E5 v3 platform works preferably with DDR4 memory, while the previous Intel Xeon processor E5 v2 platform works with DDR3. It is necessary to compare the memory efficiency between the two platforms.

From the tables below, it is obvious to see that the Intel Xeon processor E5 v3 platform offers greater memory caching efficiency than the Intel Xeon processor E5 v2 counterpart due to the utilization of DDR4, though hardware items in test environments may slightly influence the results.[2]

Table 4. Intel Xeon processor E5 v3 Test Environment

CPU	Intel® Xeon® Processor E5-2680 v3
DRAM	Transcend* 16GB DDR4 2133 REG
Graphic	IAC-AST2300
Storage	320GB WD3200SD-01KNB0
Operating System	DOS
Power Supply	GIN-3800V 800W
BIOS	MB-8896 Ver.AA0

Table 5. Intel Xeon processor E5 v3 Memory Test Setting and Results

RAM module	Transcend* 16GB DDR4 2133 REG	
Type	REG	
Frequency	2133	
Voltage	1.2V	
CAS Latency	15	
Temperature	25℃	
Test Results	L1 Cache	64K / 142,722 MB/s
	L2 Cache	256K / 33,478 MB/s
	L3 Cache	30M / 23,674 MB/s
	Memory	256G / 9,857 MB/s
Channel	4	

Table 6. Intel Xeon processor E5 v2 Test Environment

CPU	Intel® Xeon® Processor E5-2658
DRAM	InnoDisk* DDR3-1333 ECC REG 8GB
Graphic	IAC-AST2300
Storage	1TB WD1003FBYX
Operating System	DOS mode
Power Supply	Zippy* R2G-5500V4V 500W
BIOS	MB-8895 Ver.T04

[2]Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.

Table 7. Intel Xeon processor E5 v2 Memory Test Setting and Results

RAM module	InnoDisk* DDR3-1333 ECC REG 8GB	
Type	ECC	
Frequency	1333	
Voltage	1.35V/1.5V	
CAS Latency	11	
Temperature	25℃	
Test Results	L1 Cache	32K / 70001 MB/s
	L2 Cache	256K / 31819 MB/s
	L3 Cache	20480 / 20588 MB/s
	Memory	128G / 9333 MB/s
Channel	2	

Windows PCMark Benchmark

Windows PCMark benchmark is an aggregated CPU and memory for computing performance and efficiency. The following tables will show that Grantley outperforms Romley in CPU and memory scoring, though operating system in test may slightly affect the test results.

Table 8. Intel Xeon processor E5 v3 Test Environment

CPU	Intel® Xeon® Processor E5-2600 family
DRAM	Transcend* 16GB DDR4 2133 REG
Graphic	IAC-AST2300
Storage	320GB WD3200SD-01KNB0
Operating System	Windows* 7 Professional 64bit
Power Supply	GIN-3800V 800W
BIOS	MB-8896 Ver.AA0

Table 9. Intel Xeon processor E5 v3 PCMark Results

CPU model	Operating System	CPU Score	Memory Score
Intel® Xeon® processor E5-2608L v3	Windows 7 Professional 64bit	7,882	8,286
Intel® Xeon® processor E5-2609 v3	Windows 7 Professional 64bit	7,470	8,227
Intel® Xeon® processor E5-2658 v3	Windows 7 Professional 64bit	8,697	10,331
Intel® Xeon® processor E5-2699 v3	Windows 7 Professional 64bit	9,068	10,640
Intel® Xeon® processor E5-2680 v3	Windows 7 Professional 64bit	9,873	11,605

Table 10. Intel Xeon processor E5 v2 Test Environment

CPU	Intel® Xeon® Processor E5-2658
DRAM	Transcend* 4GB DDR3 1333 ECC
Graphic	IAC-AST2300
Storage	1TB WD1003FBYX
Operating System	Windows* 7 Professional 32bit
Power Supply	Zippy* R2G-5500V4V 500W
BIOS	MB-8895 Ver.T04

[3]Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families: Go to: Learn About Intel® Processor Numbers

Table 11. Intel Xeon processor E5 v2 PCMark Results

CPU model	Operating System	CPU Score	Memory Score
Intel® Xeon® processor E5-2658	Windows 7 Professional 32bit	7446	7531
		7447	7540
		7450	7573

Open SSL Throughput Benchmark

This is perhaps the most approved benchmark for verifying the security instruction capability of a networking system. SSL, abbreviation of "Secure Sockets Layer," is the security standard for network encryptions and communication authorizations. The standard ensures the privacy and safety of web communications. The following results will demonstrate FW-8896's capability in running SSL related applications.[3]

Table 12. Test Environment

CPU	Intel® Xeon® Processor E5-2658 v3
DRAM	Transcend* 16GB DDR4 2133 REG
Graphic	IAC-AST2300
Storage	320GB WD3200SD-01KNB0
Operating System	Lanner Test-bed
Power Supply	GIN-3800V 800W
BIOS	MB-8896 Ver.AA0

Benchmark Results of Cipher Performance (using Intel® Communications Chipset 8900 series)

Terminologies:

- AES – Advanced Encryption Standard, which comes in 128 or 256 bits.
- KASUMI – KASUMI is a block cipher for mobile communication confidentiality and/or integrity. KASUMI is widely adopted in systems such as GSM, GPRS, and UMTS. This test aims at the F8 series programmed for confidentiality cipher.

Table 13. Open SSL Throughput Results

	Throughput (Mbps)									
Frame Size / Type	64	128	256	512	1024	2048	4096	8192	16384	Mix
Cipher Encrypt										
AES-128-XTS (API: Traditional)	3657	7314	12288	17066	21095	23461	25206	25566	25886	19678
AES-128-XTS (API: Data_Plane)	4876	9600	14804	19351	22861	24824	25666	25920	26135	20710
AES-256-XTS (API: Traditional)	3572	6751	11702	16384	20652	23350	25206	25368	25818	19334
AES-256-XTS (API: Data_Plane)	5036	8904	13963	18618	22341	24637	25666	25683	26066	20254
AES-128-CBC (API: Traditional)	3614	7314	13653	18340	22041	24035	25368	25650	25920	20404
AES-128-CBC (API: Data_Plane)	5206	10072	16832	21005	23976	25600	25835	25989	26170	21600
AES-256-CBC (API: Traditional)	3572	7062	12288	16948	21095	23350	25206	25401	25826	19678
AES-256-CBC (API: Data_Plane)	4876	9600	14804	19351	22861	24761	25666	25717	26083	20556
	40	64	256	320	512	1024				

[3]Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families: Go to: Learn About Intel® Processor Numbers

AES-256-CBC (API: Data_Plane)	4876	9600	14804	19351	22861	24761	25666	25717	26083	20556
	40	64	256	320	512	1024				
KASUMI_F8 (API: Traditional)	2232	3614	11930	13128	16832	16329				
KASUMI_F8 (API: Data_Plane)	3047	4876	14288	15360	16384	16329				
Algorithm Chaining										
	64	128	256	512	1024	2048	4096	8192	16384	Mix
AES-128-CBC HMAC-SHA1 (API: Traditional)	2953	6023	11070	16493	20739	21652	24950	25319	25700	19402
AES-128-CBC HMAC-SHA1 (API: Data_Plane)	3268	6467	12288	18618	22443	23574	25401	25666	25954	20329
AES-256-CBC HMAC-SHA512 (API: Traditional)	2898	5742	9990	14716	19200	22598	24730	25157	25683	16961
AES-256-CBC HMAC-SHA512 (API: Data_Plane)	3200	6269	11592	16384	20739	23687	25173	25566	25971	17226
AES-256-CBC HMAC-AES-XCBC (API: Traditional)	2982	5965	10874	15653	19980	22041	24950	25254	25708	19067
AES-256-CBC HMAC-AES-XCBC (API: Data_Plane)	3268	6400	12166	17554	21652	23802	25401	25616	25980	19890

Other Significant Benchmark Results for Network Security Algorithms

Several security algorithms were benchmarked using the Grantley platform (Table 14) to evaluate how well it processes these compute-intensive tasks.

Terminologies:

- RSA – Reliability, Serviceability, and Availability.
- CRT – Chinese Remainder Theorem, often complemented with RSA algorithm.
- Diffie-Hellman – Specific method for securely exchanging cryptographic keys over a public channel. This test specifies Phase 2 of this OpenSSL method.
- DSA – Digital Signature Algorithm, a commonly used crypto method in OpenSSL applications.
- ECDSA – Elliptic Curve Digital Signature Algorithm, an enhanced deviation of the DSA. By using elliptic curves, it offers faster and more secured cryptography than DSA.

Table 14. Network Security Algorithm Testing Results

Frame Size / Type	1024	2048	4096
	Operations Per Second		
RSA CRT Decrypt	109110	23539	3271
	2048	4096	
Diffie-Hellman Phase 2	66371	13909	
	1024		
DSA Verify	92707		
	384		
ECDSA Verify	9590		

Ethernet Throughput Benchmark

The new Intel® Xeon® E5 v3 platform supports up to 40 GbE Ethernet output, enlarging the network bandwidth for cryptography operations. Lanner's Intel® Xeon® processor E5 v3 based system FW-8896 comes with a selection of compatible Ethernet modules. This section will focus on the promoted models, which are NCS2-IXM407 and NCS2-IQM201.

Table 15. Ethernet Throughput Test Environment

CPU	Intel® Xeon® Processor E5-2680 v3
DRAM	Transcend* 16GB DDR4 2133 REG
Graphic	IAC-AST2300
Storage	320GB WD3200SD-01KNB0
Operating System	Lanner Test-bed
Power Supply	GIN-3800V 800W
BIOS	MB-8896 Ver.AA0
Test Equipment	IXIA 400T / XM12

NCS2-IQM201 Benchmark

Lanner's NCS2-IQM201 Ethernet module is a two-port 40Gbps Ethernet module with QSFP Fiber connectors. The module can be installed onto the FW-8896 to expand the network connectivity to 2 x 40Gbps Ethernet transmission capability. It is driven by the Intel® Ethernet Controller XL710 series, using a PCI Express Gen 3.0 x8 interface. The port allocations are shown in Table 16, while the results are shown in Table 17.

Table 16. NCS2-IQM201 LAN Port Allocations

Slot 3	Slot 4	Slot 7	Slot 8
LAN 5 LAN 6	LAN 7 LAN 8	LAN 13 LAN 14	LAN 15 LAN 16
Slot 1	Slot 2	Slot 5	Slot 6
LAN 1 LAN 2	LAN 3 LAN 4	LAN 9 LAN 10	LAN 11 LAN 12

Table 17. NCS2-IQM201 Ethernet Throughput Test Results

Frame Size / Type	64	128	256	512	1024	1280	1518
	Throughput %						
2-port pair	Protocol: IP / Cable length: 1.8m						
LAN 1 to LAN 2	1.566	2.793	5.210	10.055	19.564	24.373	28.126
LAN 7 to LAN 8	1.578	2.775	5.185	9.988	19.594	24.422	28.865
LAN 11 to LAN 12	1.554	2.732	5.082	9.823	19.594	23.988	28.431
LAN 15 to LAN 16	1.511	2.659	4.966	9.604	18.734	23.665	27.571
LAN 1 to LAN 3	1.920	3.373	6.290	11.673	23.787	29.609	35.035

NCS2-IXM407 Benchmark

Lanner's NCS2-IQM201 Ethernet module is a 4-port 10Gbps Ethernet module with SFP+ Fiber connectors. The module can be installed onto the FW-8896 to expand the network connectivity to 4 x 10Gbps Ethernet capability. It is driven by Intel Ethernet Controller XL710 series, using a PCI Express Gen 3.0 x8 interface. The port allocations are shown in Table 18, while the results are shown in Table 19.

Table 18. NCS2-IXM407 LAN Port Allocations

Slot 3	Slot 4	Slot 7	Slot 8
LAN 9 ~ 12	LAN 13 ~ 16	LAN 25 ~ 28	LAN 29 ~ 32
Slot 1	Slot 2	Slot 5	Slot 6
LAN 1 ~ 4	LAN 5 ~ 8	LAN 17 ~ 20	LAN 21 ~ 24

Table 19. NCS2-IXM407 Ethernet Throughput Test Results

Frame Size / Type	64	128	256	512	1024	1280	1518
	Throughput %						
2-port pair	Protocol: IP / Cable length: 1.8m						
LAN 13 to LAN 14	6.253	11.306	21.071	41.034	79.677	100	100
4-port							
LAN 1 to LAN 4	6.143	10.844	20.203	38.922	76.299	95.122	100
LAN 9 to LAN 12	5.868	10.356	19.612	36.941	72.793	90.360	100
LAN 13 to LAN 16	5.783	10.275	18.868	36.194	72.323	90.650	100
8-port							
LAN 21 to LAN 28	5.124	9.042	12.503	33.027	63.676	79.012	93.201

Test Summary

1. When smaller frame sizes are used, it results in more frames to manage with the same network bandwidth. Thus, CPU loading is increased. In contrast, when larger frame sizes are used, the throughput is improved while CPU loading is reduced.
2. When more LAN ports are in operation, CPU loading is increased.
3. The results are based on IXIA. The numbers indicate the percentage of packet handling with zero loss under full loading condition of network bandwidth. For instance, in the test of NCS2-IQM201, LAN1-to-LAN2 is tested to have 1.566% of perfect packet handling under 64-byte frames.

Conclusion

From the features and benchmark results above, Lanner's Intel® Xeon® processor E5 v3 driven networking appliance FW-8896 delivers outstanding performance and excellent throughput to meet today's challenging virtualization and cryptography environments. With technological upgrades in processor and memory, as well as other hardware-assisted features, FW-8896 proves itself more than capable in mission-critical applications through numerous benchmark tests.

About Lanner Electronics Inc.

Founded in 1986 and publicly listed (TAIEX 6245) since 2003, Lanner Electronics, Inc. is an ISO 9001 certified designer and manufacturer of network application platforms, network video platforms and applied computing hardware for first-tier companies. Lanner's expertise also extends to include driver and firmware support, enabling customers to optimize hardware and software communication to achieve faster time to market. With headquarters in Taipei, Taiwan and branches in the U.S. and China, Lanner is uniquely positioned to deliver custom technical solutions with localized, value-added service.

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