



# **INTEL® XEON® PROCESSOR D-1500 PRODUCT FAMILY: PERFORMANCE FOR STORAGE AND NETWORKING USE CASES**

November 2015

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# Legal Disclaimers - Continued

Intel® Turbo Boost Technology†

Intel® Turbo Boost Technology 2.0 automatically allows processor cores to run faster than the rated operating frequency if they're operating below power, current, and temperature specification limits.

Intel Turbo Boost Technology 2.0 is activated when the Operating System (OS) requests a frequency higher than the rated frequency of the processor. Whether the processor enters into and the amount of time the processor spends in the Intel Turbo Boost Technology 2.0 state depends on the workload, and operating environment.

Maximum turbo frequency indicates the highest possible frequency achievable when conditions allow the processor to enter turbo mode. Intel® Turbo Boost Technology frequency varies depending on workload, hardware, software and overall system configuration.

Due to varying power characteristics, some parts with Intel® Turbo Boost Technology 2.0 may not achieve maximum turbo frequencies when running heavy workloads and using multiple cores concurrently.

Availability and frequency upside of Intel Turbo Boost Technology 2.0 state depends upon a number of factors including, but not limited to the following:

- Type of workload
- Number of active cores
- Estimated current consumption
- Estimated power consumption
- Processor temperature

When the processor is operating below these limits and the user's workload demands additional performance, the processor frequency will dynamically increase until the upper limit of frequency is reached. Intel Turbo Boost Technology 2.0 has multiple algorithms operating in parallel to manage current, power, and temperature to maximize frequency and energy efficiency. Note: Intel Turbo Boost Technology 2.0 allows the processor to operate at a power level that is higher than its TDP configuration and data sheet specified power for short durations to maximize performance.

† Requires a system with Intel® Turbo Boost Technology. Intel Turbo Boost Technology and Intel Turbo Boost Technology 2.0 are only available on select Intel® processors. Consult your system manufacturer. Performance varies depending on hardware, software, and system configuration. For more information, visit <http://www.intel.com/go/turbo>

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## Optimization Notice

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Notice revision #20110804

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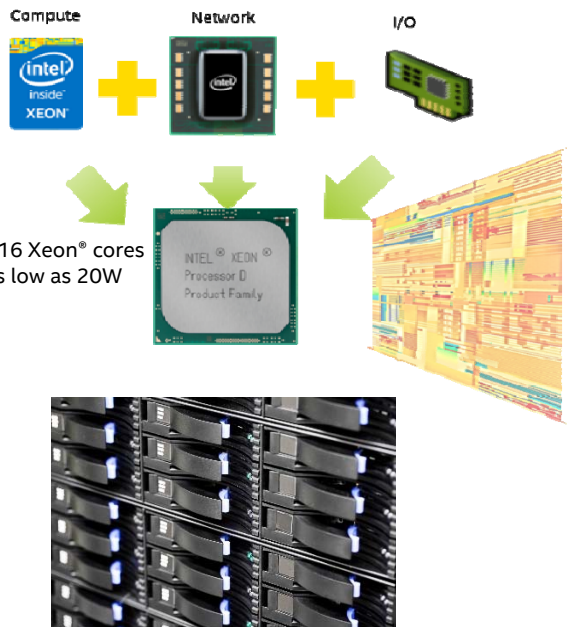
Networking Performance

# Intel® Xeon® Processor D Performance Summary



## SERVER

Up to 3.6X  
vs Atom™ C2750



## STORAGE

Up to 6X  
vs Atom™ C2750



## NETWORKING

Up to 5.4X  
vs Atom™ C2750

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# Intel® Xeon® Processor D Workload Positioning

## CLOUD

(Covered March 2015)



**Web Hosting**

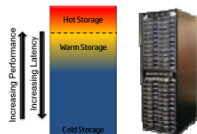


**Object Caching**



**Dedicated Hosting**

## STORAGE



**Warm Cloud Storage**



**Mid Range Enterprise SAN/NAS & Entry NAS**

## EDGE NETWORK



**Edge Routing**



**Edge Security/Firewall**



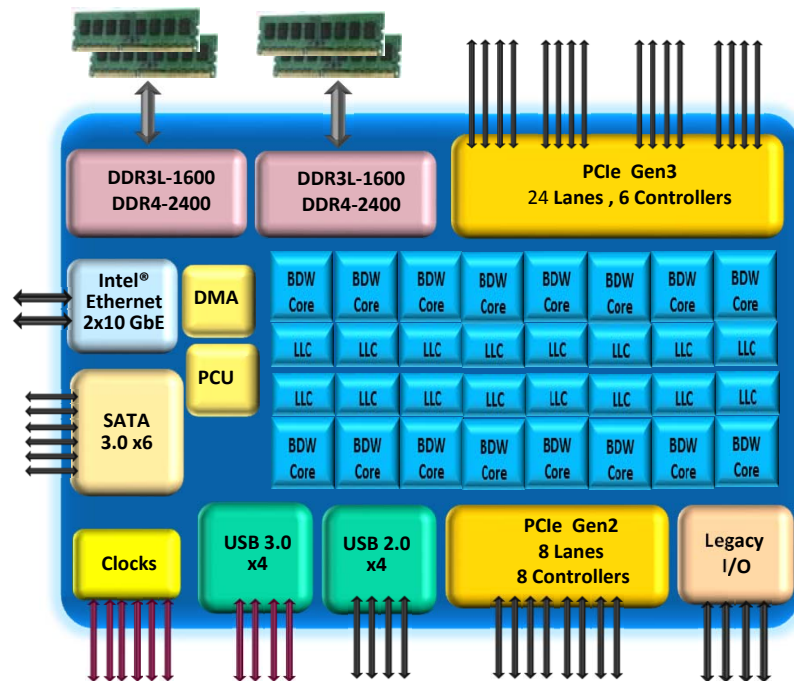
**Wireless Access**



**Wireless Base Station**

# Intel® Xeon® Processor D-1500 SoC Architecture Overview

CPU	2-16 Core Intel® Xeon™ (14nm) CPUs
L1 cache	32K data, 32k instruction per core
L2 cache	256K per core
LLC cache	1.5MB per core
Addressing	46 bits physical / 48 bits virtual
Memory	DDR4 up to 2400 MT/s DDR3L up to 1600 MT/s Two Channels (2 DIMMs/Channel)
Memory Capacity	RDIMM: 128 GB (32 GB/DIMM) UDIMM/SODIMM: 64 GB (16 GB/DIMM)
DIMM Types	SODIMM, UDIMM, RDIMM with ECC and non-ECC
Memory RAS	Enhanced ECC Single bit Error Correction – Dual bit Error Detection (SEC-DED) covers address and data paths, DDR scrambler to reduce error rate.
PCI-E*	24 PCIe* lanes Gen3 with up to 6 controllers 8 PCIe lanes Gen 2 with up to 8 controllers
Integrated IO	Intel® Ethernet 2x10 GbE, x4 USB 3.0, x4 USB 2.0, and x6 SATA 3
Technologies	Intel® VT, Core RAPL, PECC over SMBUS, PSE
Power Management	FIVR, PCPS, EET, UFS Hardware PM
Legacy I/O	SPI for boot flash, SMBus, UART LPC, GPIO, 8259, I/O APIC, 8254 Timer, RTC



\*\*not all features are available in all SKUs  
> 8 cores SKU expected to launch in Q1'16

# Intel® Xeon® Processor D-1500 SKU Line Up

Launched March 2015

Intel® Xeon® Processor D-1540  
8C, 45W, 2.0GHz

Intel® Xeon® Processor D-1520  
4C, 45W, 2.2GHz

Launching on November 9<sup>th</sup>, 2015

Intel® Xeon® Processor D-1541  
8C, 45W, 2.1GHz

Intel® Xeon® Processor D-1548  
8C, 45W, 2.0 GHz

Intel® Xeon® Processor D-1531  
6C, 45W, 2.2GHz

Intel® Xeon® Processor D-1537  
8C, 35W, 1.7 GHz

Intel® Xeon® Processor D-1528  
6C, 35W, 1.9 GHz

Intel® Xeon® Processor D-1521  
4C, 45W, 2.4GHz

Intel® Xeon® Processor D-1527  
4C, 35W, 2.2 GHz

Intel® Xeon® Processor D-1518  
4C, 35W, 2.2 GHz


Intel® Pentium® Processor D1517  
4C, 25W, 1.6GHz


Intel® Pentium® Processor D1508  
2C, 25W, 2.2 GHz


Intel® Pentium® Processor D1507  
2C, 20W, 1.2 GHz

Launching in Q1'16

Intel® Xeon® Processor D-15xx  
16, 12C

 Intel® Xeon® Processor D-15xx  
TBD

 Intel® Pentium® Processor D15xx  
TBD

 = Extended Temp

Key: Core#, TDP, Core Freq.

## Server & Cloud Storage SKUs

- 3yr life, 5yr reliability
- Lower Tcase
- Performance Optimized

## Network & Enterprise Storage SKUs

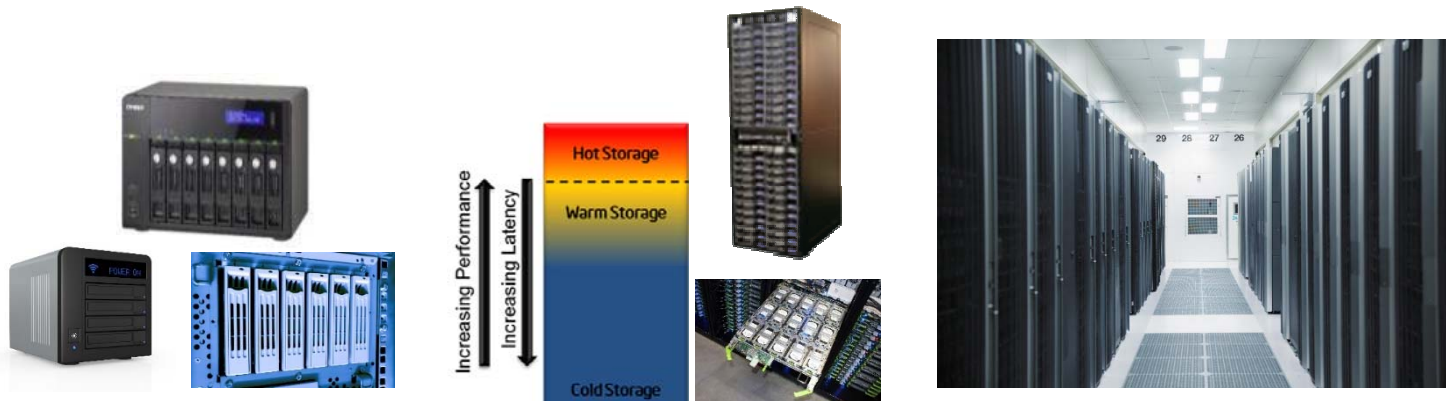
- 7yr life, 10yr reliability
- High Tcase

**All SKUs, and features are PRELIMINARY and can change without notice**

# INTEL® XEON® PROCESSOR D FAMILY PERFORMANCE

For Storage

# Intel® Architecture Advantages for Storage



**NAS/SAN Storage**

**Cold, Warm & Hot Storage**

**High Performance Scale-out/  
Distributed Database**

Architectural Consistency and Software Compatibility across all Devices

Storage Acceleration  
Library (Intel® ISA-L)  
Storage Performance  
Development Kit (Intel®SPDK)



Rapid Storage Technology (Intel® RSTe)

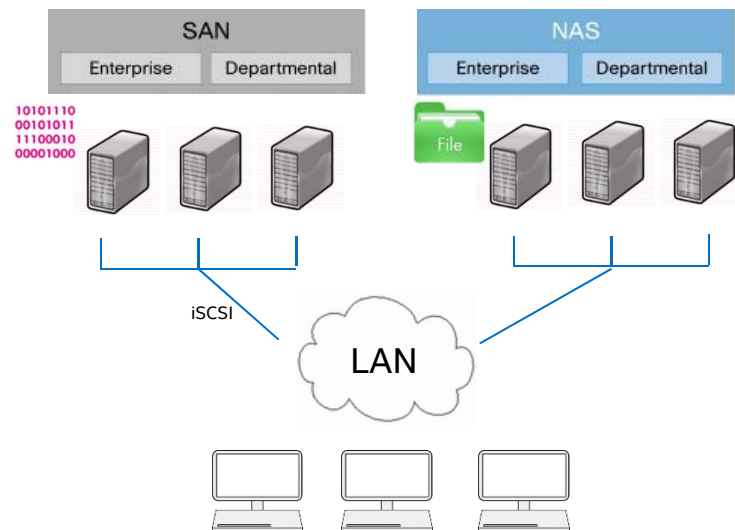
Cache Acceleration (Intel® CAS)

# Intel® Xeon® Processor D-1500 Family Target Use Cases

## Warm Cloud Storage: Cloud Storage Video on Demand, Cloud Storage Backup



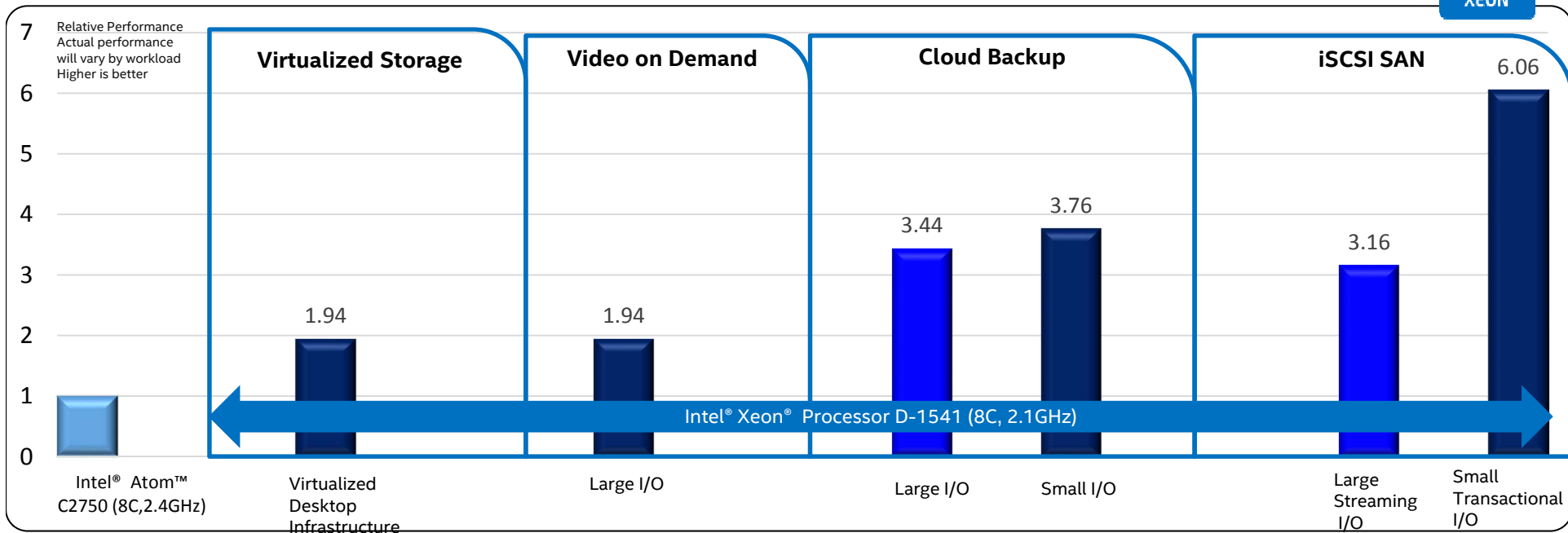
## Mid Range Enterprise SAN/NAS & Entry NAS



# Use Cases Evaluated for Storage

Usage	Description
<b>Cloud Backup</b>	Cloud Backup benchmark simulates backing up data to remote cloud-based distributed servers
<b>Video on Demand</b>	Video on Demand benchmark simulates the delivery of video upon request to receiving clients
<b>Virtualized Storage</b>	The Virtualized Desktop Storage benchmark simulates a Virtual Desktop Infrastructure environment where user data is in a centralized virtualized environment
<b>iSCSI SAN</b>	SAN iSCSI benchmark simulates the iSCSI over TCP protocol over a high speed end-to-end LAN network, presenting shared pools of storage to multiple servers allow them to access storage as if they were directly attached to the server

# Intel® Xeon® Processor D Storage Performance Summary



Up to 6x higher storage performance over Intel® Atom™ C2750 Processor

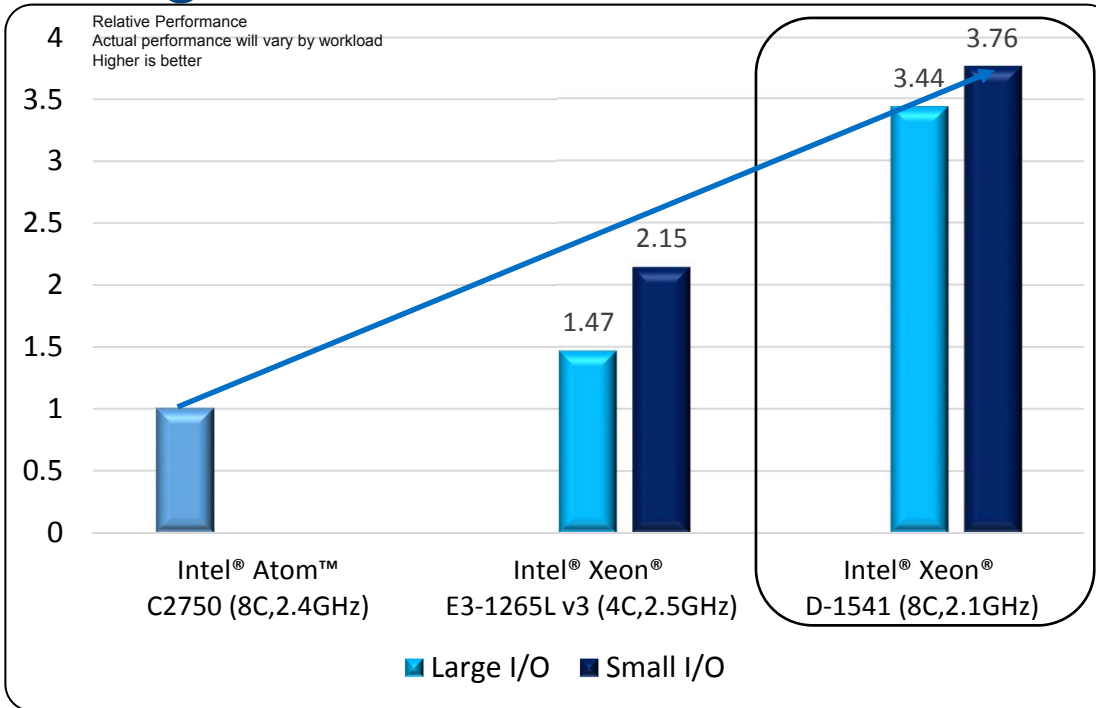
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# Intel® Xeon® Processor D Storage Performance

## Cloud Storage: Cloud Backup

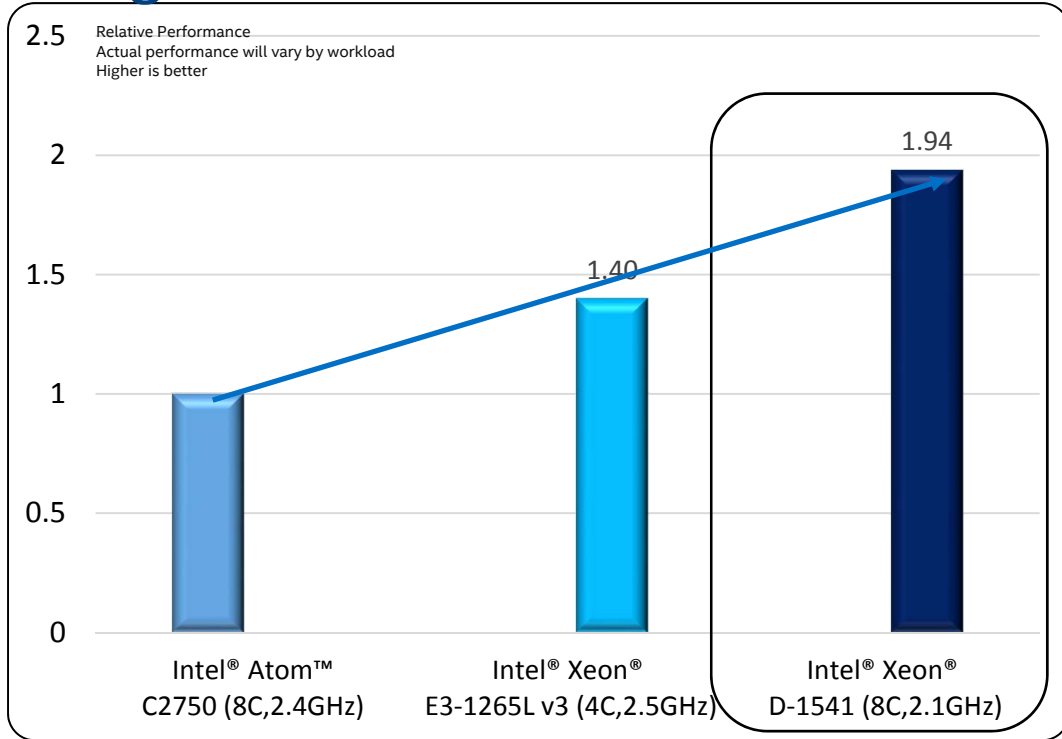


Backup data to the cloud more efficiently with up to 3.7x better performance over Intel® Atom™ C2750 Processor

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# Intel® Xeon® Processor D Storage Performance

## Cloud Storage: Video on Demand

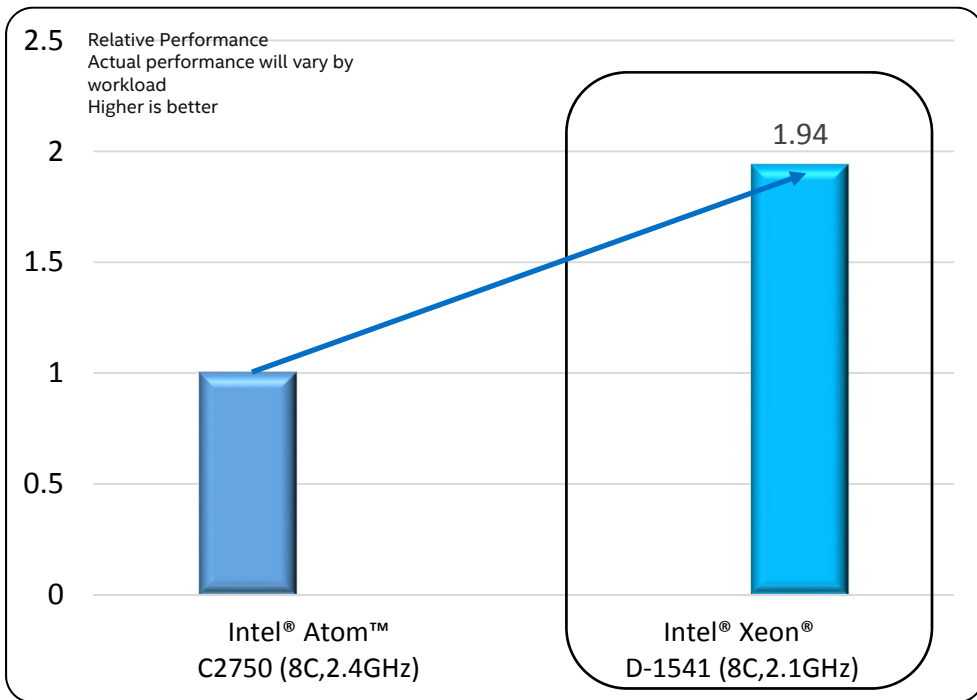
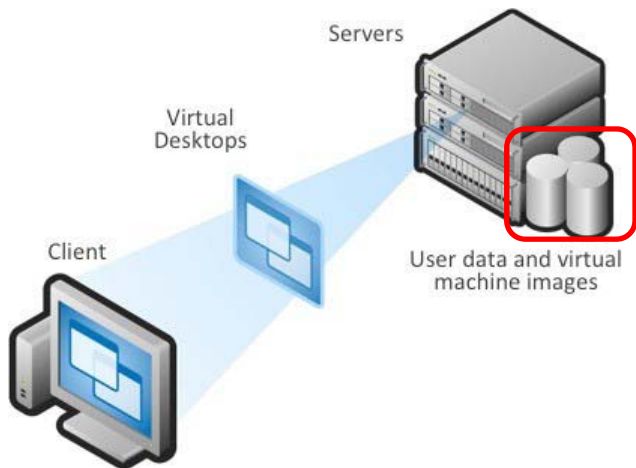


Offer Video on Demand Faster with up to 1.9x better performance over Intel® Atom™ C2750 Processor

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# Intel® Xeon® Processor D Storage Performance

## Virtualized Desktop Storage

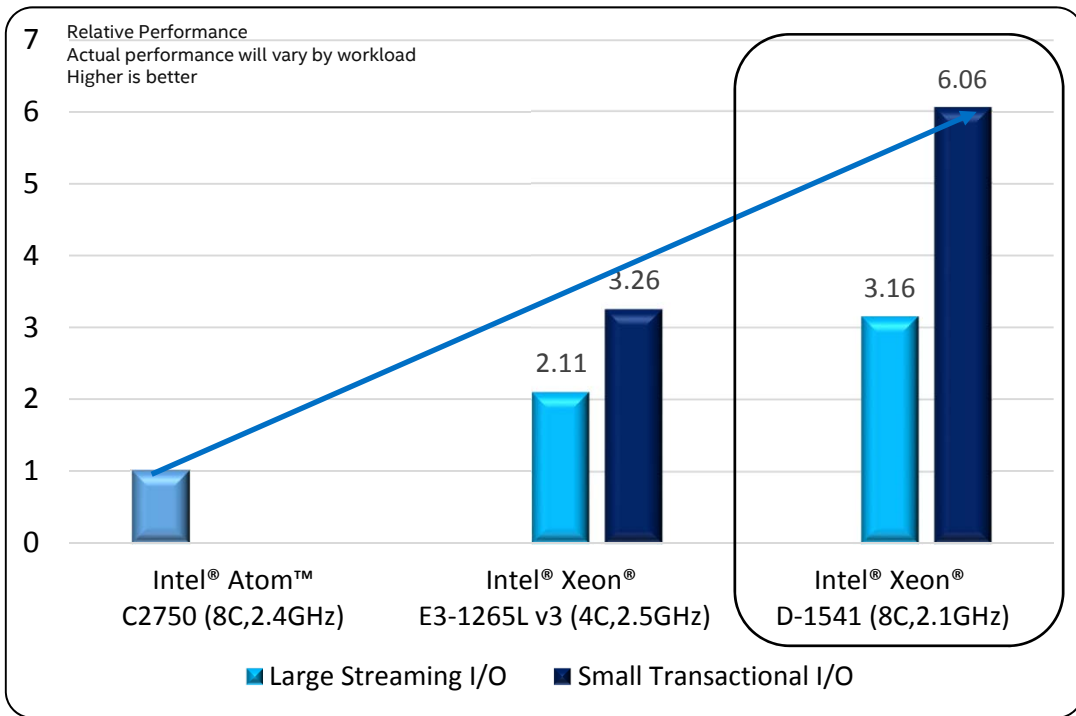
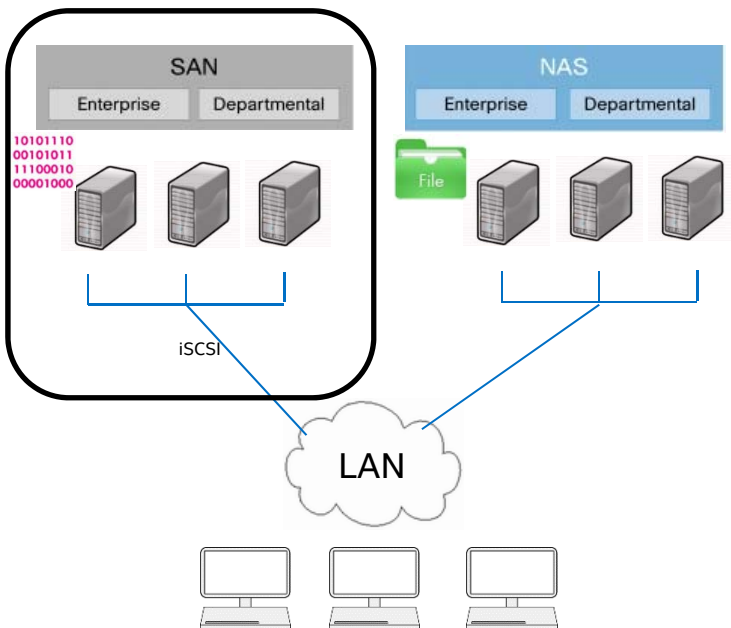


Up to 1.9x more performance on virtualized desktop infrastructure over Intel® Atom™ C2750 Processor

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# Intel® Xeon® Processor D Storage Performance

## iSCSI SAN Storage Performance



Example of Large I/O: Streaming Media  
Example of Small I/O: Database Lookup

Up to 6x more performance on Small I/O,  
up to 3x on Large I/O over Intel® Atom™ C2750 Processor

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# Intel® Xeon® Processor D Performance

Intel® Storage Acceleration Library (ISA-L)



Intel® Xeon® Processor D-1541 (8C, 2.1GHz)



COMPRESSION

Up to 2.4X



DATA  
PROTECTION

Up to 2.4X



CRYPTOGRAPHIC  
HASHING

Up to 6.4X

=  
79054025  
255fb1a2  
6e4bc422  
aef54eb4



ENCRYPTION

Up to 8.9X



DATA  
INTEGRITY

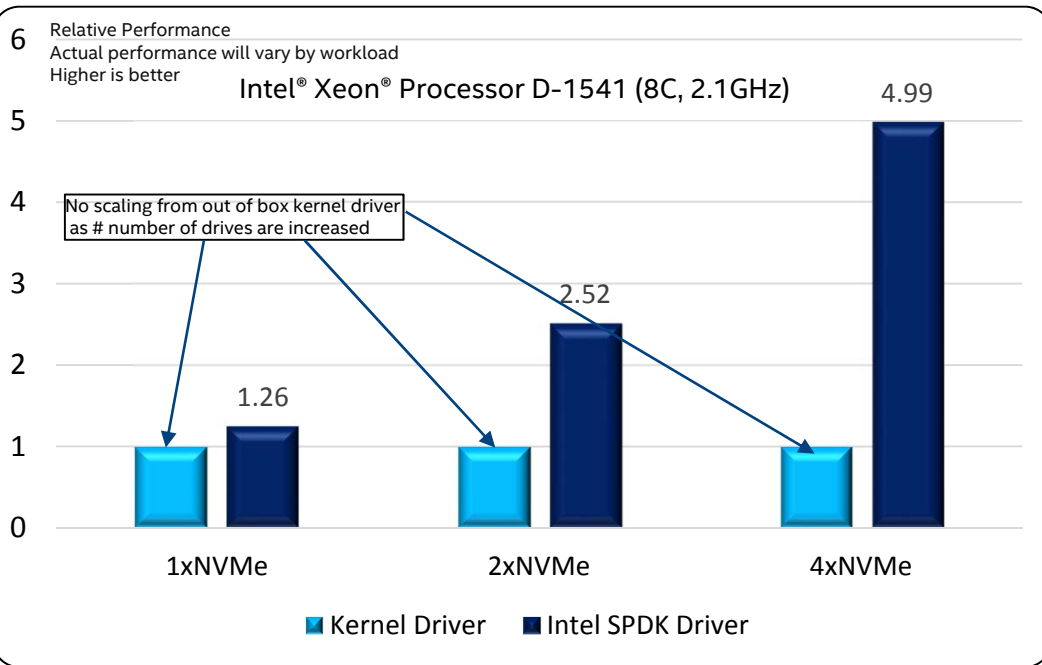
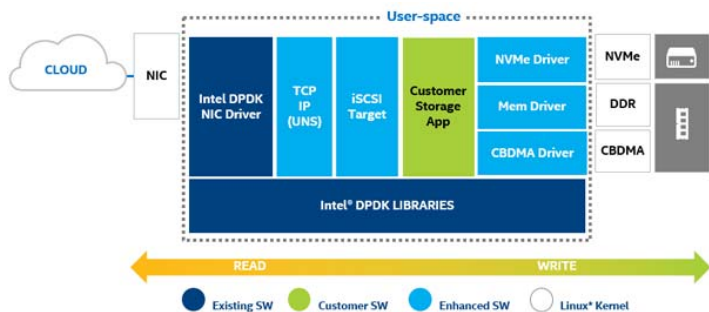
Up to 12.5X

**\*\*vs Intel® Atom™ Processor C2750**

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# Intel® Xeon® Processor D Performance

## Storage Performance Development Kit (SPDK)



Unleash the Full Platform Potential with Intel® SPDK vs Out of Box Driver

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# Storage Performance Summary

Cloud Storage**	Performance
Cloud Backup	Up to 3.7X
Video on Demand	Up to 1.9X
Virtualized Storage	Up to 1.9X
SAN Performance**	
Large Streaming I/O	Up to 3.1X
Small Transactional I/O	Up to 6X
Intel® Storage Acceleration Libraries (ISA-L)**	
Compression	Up to 2.4X
Data Protection	Up to 2.4X
Cryptographic Hashing	Up to 6.4X
Encryption	Up to 8.9X
Data Integrity	Up to 12.5X
Intel® Storage Performance Development Kit (SPDK)	
Kernel Driver (vs Out of Box)	Up to 4.9X



\*\*vs Atom™ C2750 Processor

Up to 6x higher storage performance over Intel® Atom™ C2750 Processor

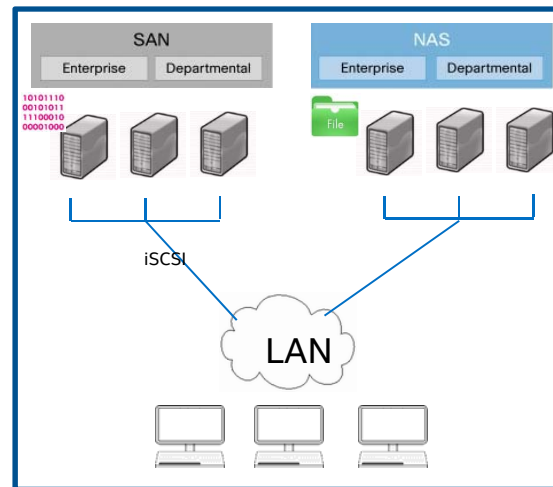
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# The Intel® Xeon® Processor D for Storage

**Warm Cloud Storage:** Cloud Storage  
Video on Demand, Cloud Storage Backup



**Mid Range Enterprise SAN/NAS & Entry NAS**



Delivering the Performance and Advanced Intelligence of Intel® Xeon® processors to dense and low power Storage designs



# INTEL® XEON® PROCESSOR D FAMILY PERFORMANCE

For Networking



# Intel® Xeon® Processor D-1500 Family

## Target Use Cases for Edge Network



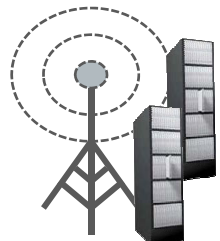
### Switches & Routers

- Switch Control Plane
- Branch Office Router
- Edge Router
- Router Services Module



### Security Appliances

- Next Generation Firewall
- Wide Area Network Acceleration
- Intrusion Detection / Prevention System
- Content Security
- Application Delivery



### Wireless Access

- Macro Base Station
- Cloud Radio Access Network
- Edge Cloud

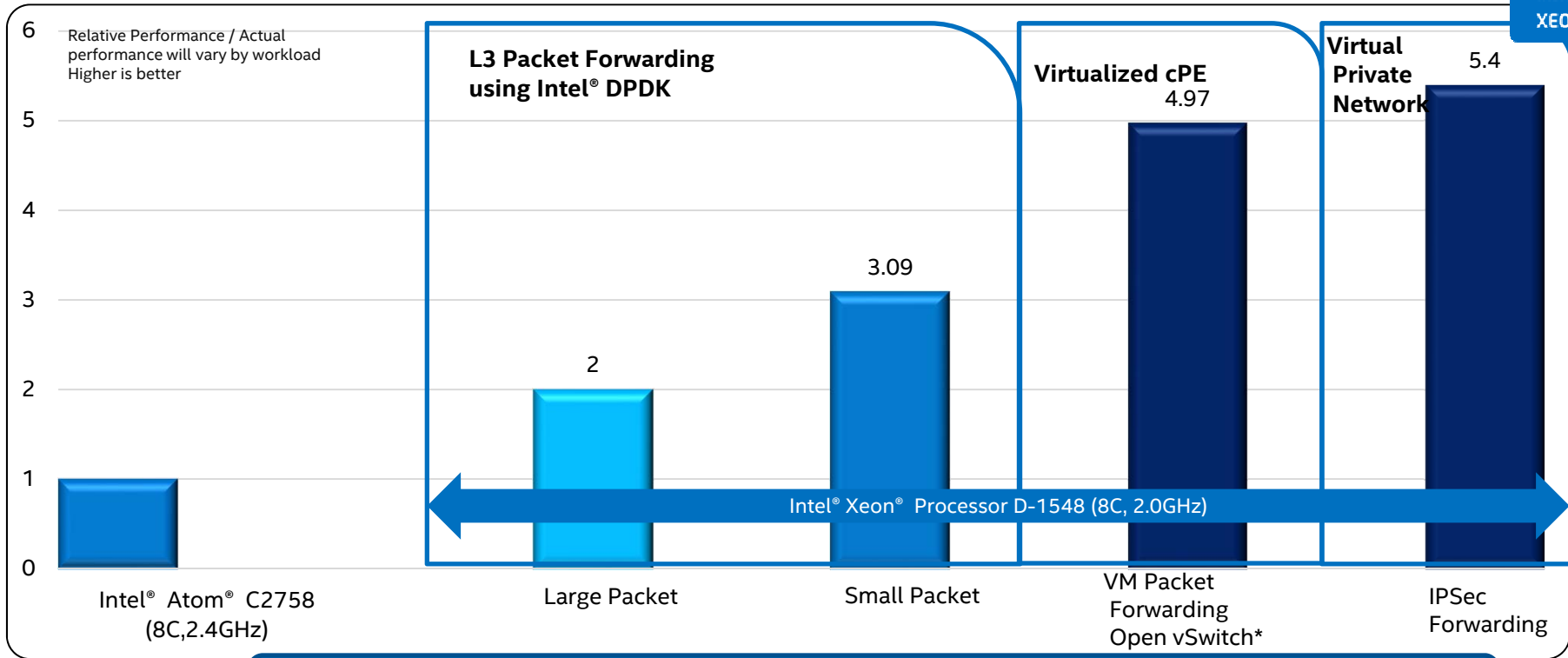
- ✓ HW and SW Scalability
- ✓ High Performance
- ✓ Intel RAS
- ✓ Larger Memory Capability
- ✓ Integrated Intel® Ethernet
- ✓ Intel® QuickAssist Technology Crypto Accelerator (Coleto Creek) Support
- ✓ Extended Temperature Option

Intel Architecture Consistency, Software Compatibility, Rich Ecosystem

# Use Cases Evaluated for Networking

Usage	Description
<b>L3 Packet Forwarding</b>	L3 Packet Forwarding measures layer 3 (IP) packet forwarding performance utilizing Intel® Data Plane Development Kit (DPDK). It examines incoming from network ports and transfer packets based on packet headers and IP destination to networking ports. The communications equipment typically handles small packets (64 B), IT datacenters often handle larger packets (1528 B).
<b>Virtual Private Network</b>	IPSec Forwarding benchmark uses Internet Protocol (IP) by authenticating and encrypting each networking packet from an incoming port to destination ports as it would be used in a VPN environment
<b>Virtualized Customer Premise Equipment (vCPE)</b>	Benchmark simulates the packet forwarding under a virtual machine using Open vSwitch* as it would be used in a vCPE environment.

# Intel® Xeon® Processor D Network Performance Summary



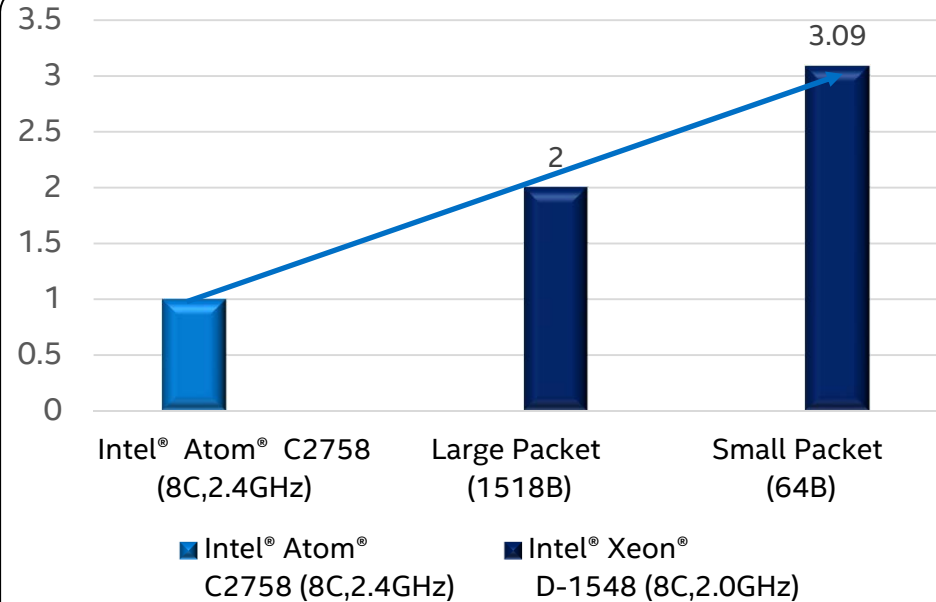
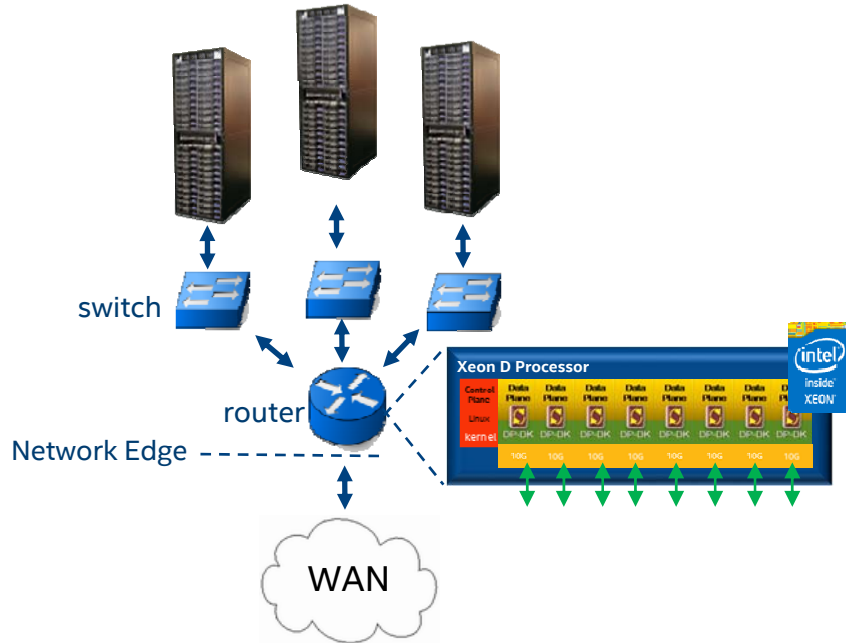
Up to 5.4x higher performance over Intel® Atom™ C2758 Processor

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# Intel® Xeon® Processor D Performance

## Layer 3 Packet Forwarding using Intel® Data Plane Development Kit (DPDK)

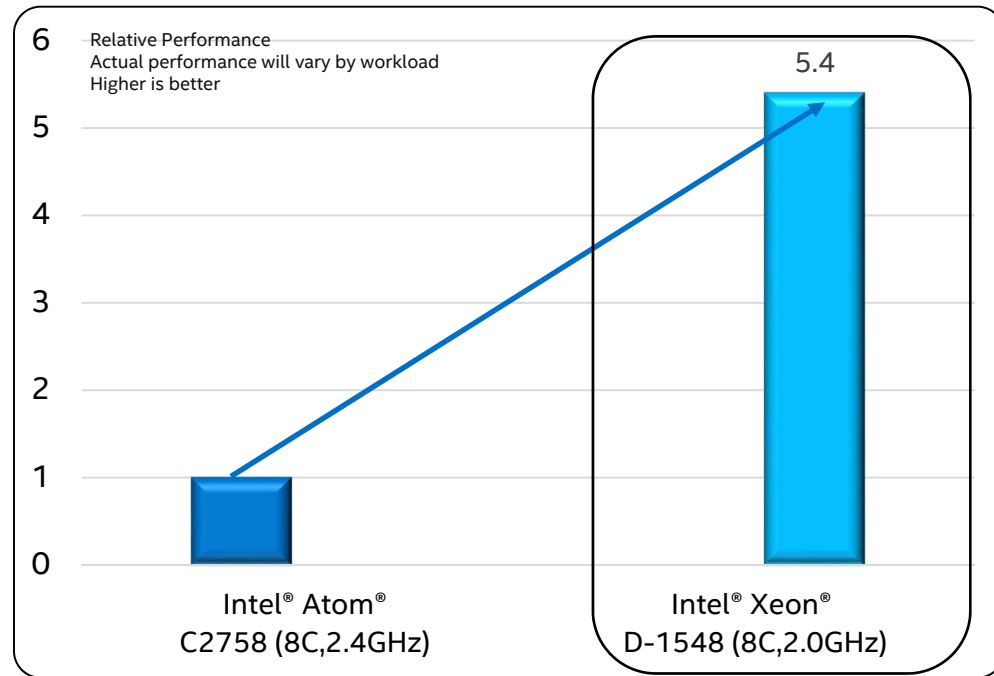
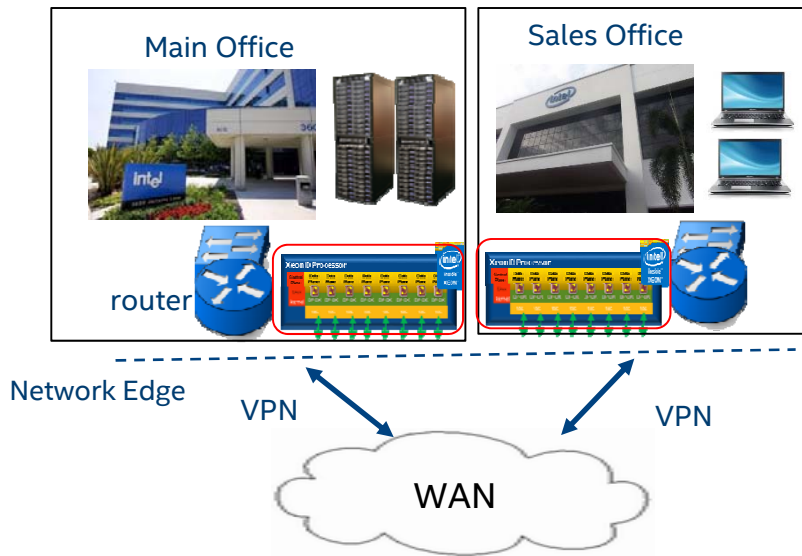


Up to 3x higher Layer 3 Packet Forwarding Performance over Intel® Atom™ C2758 Processor

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. Configurations: Refer to Configuration Summary Networking in Configuration section for detailed configurations. For more complete information visit <http://www.intel.com/performance>. \*Other names and brands may be claimed as the property

# Intel® Xeon® Processor D Performance

## IPSec Forwarding with Wind River\* INP stack – Virtual Private Network

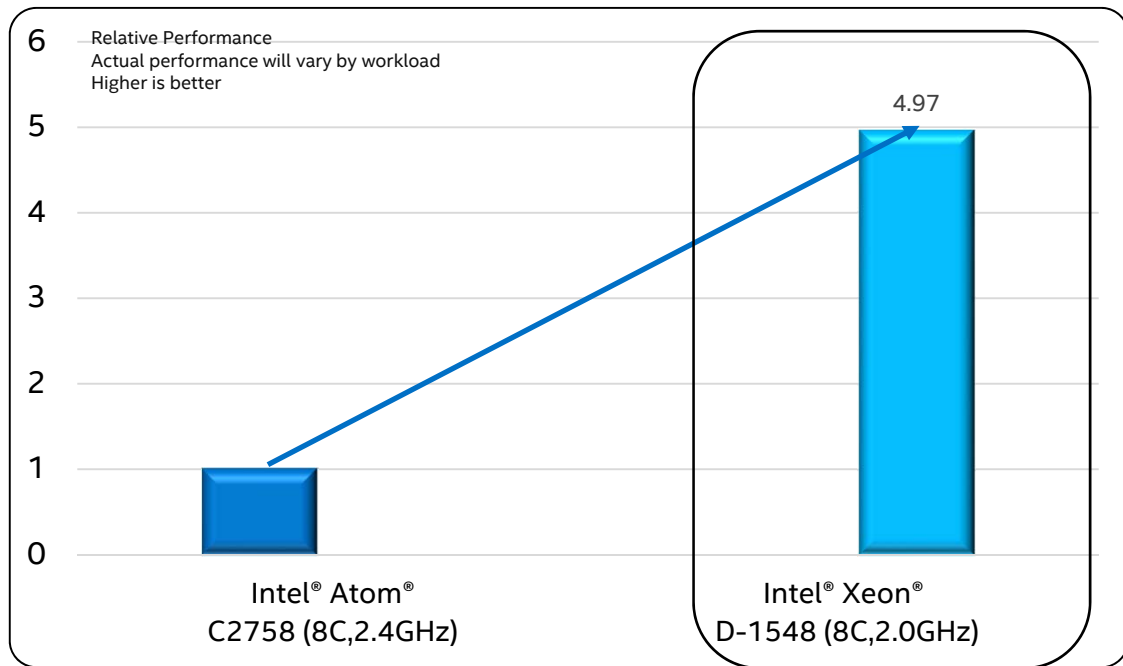
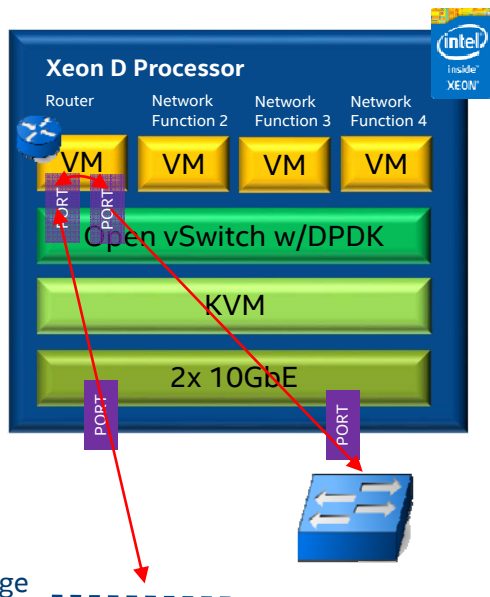


Up to 5.4x advantage over Intel® Atom™ C2758 Processor in securing the network

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# Intel® Xeon® Processor D Performance

Forwarding performance with Intel® DPDK- accelerated Open vSwitch\* – SDN/NFV Performance



Up to 4.9x advantage over Intel® Atom™ C2758 Processor in a Virtual Environment

*Open vSwitch provides Virtual Networking services in the Network Function Virtualization Infrastructure (NFVI)*

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# The Intel® Xeon® Processor D for Networking



**Edge Routing**



**Edge Security/Firewall**



**Wireless Access**



**Wireless Base Station**

Extending Intel® Xeon® Processor Intelligence to the Network Edge



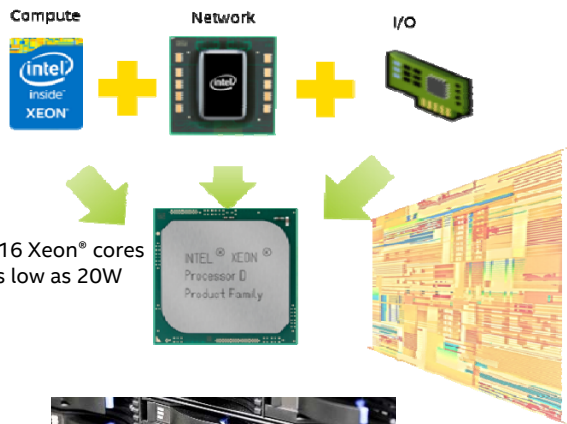
# Intel® Xeon® Processor D Performance Summary



## SERVER

Up to 3.6X  
vs Atom™ C2750

**Intel® Xeon® Performance  
to Dense Scale out Servers**



- ✓ Up to 16 Xeon® cores
- ✓ TDP as low as 20W



## STORAGE

Up to 6X  
vs Atom™ C2750

**Intel® Xeon® Intelligence  
to Dense and Low Power  
Storage Devices**

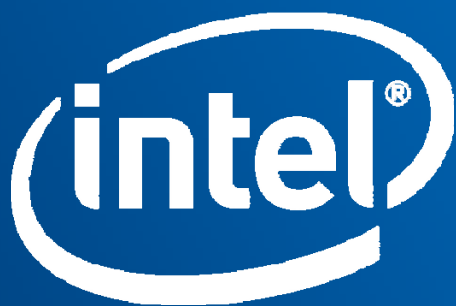


## NETWORKING

Up to 5.4X  
vs Atom™ C2758

**Intel® Xeon® Intelligence  
to Network Edge**

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. Configurations: Server: Xeon D-1540 Dynamic Web Serving, Storage: Xeon D-1541 iSCSI SAN small transactional I/O, Networking: Xeon D-1548 IPSec forwarding. Refer to Configuration Server, Storage, Networking Summary in Configuration section for detailed configurations. For more complete information visit <http://www.intel.com/performance>. \*Other names and brands may be claimed as the property



# Configurations

# Configuration Server, Storage, Networking Summary

## Dynamic Web Serving

**New Configuration:** Intel® Xeon Processor D-based reference platform with one Xeon Processor D 1540 (8C, 2.0GHz, 45W), Turbo Boost Enabled, Hyper-Threading enabled, 64GB memory (4x16GB DDR4-2133 RDIMM ECC), 2x10GBase-T X552, 3x S3700 SATA SSD, Ubuntu\* 14.10 (3.16.0-23 generic), Nginx\* 1.4.4, Php-fpm\* 15.4.14, memcached\* 1.4.14, Simultaneous users=47152

**Base Configuration:** Supermicro SuperServer\* 5018A-TN4 with one Intel Atom Processor C2750 (8C, 2.4GHz, 20W), Turbo Boost Enabled, 32GB memory (4x8GB DDR3-1600 SO-DIMM ECC), 1x10GBase-T X520, 2x S3700 SATA SSD, Ubuntu\* 14.10(3.16.0-23 generic), Nginx\* 1.4.4, Php-fpm\* 15.4.14, memcached\* 1.4.14, Simultaneous users=12896

## iSCSI SAN Performance

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 4x Intel P3700 800 GB SSDs, 40GbE add-in network adapter (Intel XL710) + 20GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), FIO- 32 Queue Depth per iSCSI LUN- 8 connections per 10GbE- 1 connection per LUN- 1 worker per target, 4KB 100% Reads= 1060000 IO/s, 512KB 100% Reads= 7076 MB/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz, 20W), Turbo Boost Disabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 2x Intel P3700 800GB SSDs, 2x10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), FIO- 32 Queue Depth per iSCSI LUN- 8 connections per 10GbE- 1 connection per LUN- 1 worker per target, 4KB 100% Reads= 175000 IO/s, 512KB 100% Reads= 2242 MB/s

## Virtual Private Network

**New Configuration:** Intel® Xeon Processor D-based reference platform with one Intel® Xeon® D-1548 (8C, 2.0GHz), Turbo Boost disabled, Hyper-Threading enabled, 16GB memory (2x8GB DDR4-2133 RDIMM ECC), 2x Quad port X520 (8x10GbE), Intel® Quick Assist Adapter 8950-SCCP, Fedora\* Core 16 (Verne) x86\_64, Wind River INP-3.4, Quickassist L1.3.0\_90, DPDK Revision L1.4.0-30. IPSec forwarding rate (1024B Ethernet clear text packet size)= 37.4 Gbits/s. 2 Cores/4Threads are used

**Base Configuration:** Intel Atom Processor C2000-reference platform based platform with one Intel Atom Processor C2758 (8C, 2.4GHz), 4GB memory (2x2GB DDR3-1600 DIMM), 1x Dual port X520 (4x10GbE), Fedora\* Core 16 (Verne) x86\_64, Wind River INP-3.4, Quickassist L1.3.0\_90, DPDK Revision L1.4.0-30. B IPSec forwarding rate (1024B Ethernet clear text packet size) =6.98 Gbits/s 2 Cores are used.

# Configuration Summary Storage

## Cloud Backup

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 20x 4TB WD SATA 64MB cache, 2x LSI 9207 HBA, 2x 10GbE Bonded, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64)

*Large I/O:* Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container, 32MB 10%Reads 90% Writes= 1480 MB/s

*Small I/O:* Ceph hammer , FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 1MB Sequential10% Reads 90% Writes = 1359 MB/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz,20W), Turbo Boost Enabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 10x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64)

*Large I/O:* Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container) 32MB 10%Reads 90% Writes)= 430 MB/s

*Small I/O:* Ceph hammer , FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 1MB Sequential10% Reads 90% Writes = 361 MB/s

## Video on Demand

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 20x 4TB WD SATA 64MB cache, 2x LSI 9207 HBA, 2x 10GbE Bonded, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container, 32MB 90%Reads 10% Writes= 943 MB/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz,20W), Turbo Boost Disabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 10x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container, 32MB 90%Reads 10% Writes= 484 MB/s

## Virtualized Storage

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 20x 4TB WD SATA 64MB cache, 2x LSI 9207 HBA, 2x 10GbE Bonded, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Ceph hammer , FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 4KB 90%Reads 10% Writes= 1372 IO/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz,20W), Turbo Boost Disabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 10x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Ceph hammer , FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 4KB 90%Reads 10% Writes= 707 IO/s

## iSCSI SAN

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 4x Intel P3700 800 GB SSDs, 40GbE add-in network adapter (Intel XL710) + 20GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), FIO- 32 Queue Depth per iSCSI LUN- 8 connections per 10GbE- 1 connection per LUN- 1 worker per target, 4KB 100% Reads= 1060000 IO/s, 512KB 100% Reads= 7076 MB/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz,20W), Turbo Boost Disabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 2x Intel P3700 800GB SSDs, 2x10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), FIO- 32 Queue Depth per iSCSI LUN- 8 connections per 10GbE- 1 connection per LUN- 1 worker per target, 4KB 100% Reads= 175000 IO/s, 512KB 100% Reads= 2242 MB/s

# Configuration Cloud Backup

## Cloud Backup

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 20x 4TB WD SATA 64MB cache, 2x LSI 9207 HBA, 2x 10GbE Bonded, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64)

*Large I/O:* Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container, 32MB 10%Reads 90% Writes= 1480 MB/s

*Small I/O:* Ceph hammer , FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 1MB Sequential10% Reads 90% Writes = 1359 MB/s

**Xeon- E3 Configuration:** SuperMicro X10SLH-F with Intel Xeon-E3 1265Lv3 (4C, 2.5GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 16 GB memory (2x8GB DDR3-1600 UDIMM ECC), 12x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64)

*Large I/O:* Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container) 32MB 10%Reads 90% Writes)= 634 MB/s

*Small I/O:* Ceph hammer , FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 1MB Sequential10% Reads 90% Writes = 775 MB/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz,20W), Turbo Boost Enabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 10x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64)

*Large I/O:* Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container) 32MB 10%Reads 90% Writes)= 430 MB/s

*Small I/O:* Ceph hammer , FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 1MB Sequential10% Reads 90% Writes = 361 MB/s

# Configuration Video on Demand

## Video on Demand

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 20x 4TB WD SATA 64MB cache, 2x LSI 9207 HBA, 2x 10GbE Bonded, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container, 32MB 90%Reads 10% Writes= 943 MB/s

**Xeon-E3 Configuration:** SuperMicro X10SLH-F with Intel Xeon-E3 1265Lv3 (4C, 2.5GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 16 GB memory (2x8GB DDR3-1600 UDIMM ECC), 12x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container, 32MB 90%Reads 10% Writes= 681 MB/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz,20W), Turbo Boost Disabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 10x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Swift 2.2.x, COSBench 4.2.x, 512 Workers- 4 Drivers- 1000C- 1000 Objects per container, 32MB 90%Reads 10% Writes= 484 MB/s

# Configuration Virtualized Storage

## Virtualized Storage

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 20x 4TB WD SATA 64MB cache, 2x LSI 9207 HBA, 2x 10GbE Bonded, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64, Ceph hammer, FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 4KB 90%Reads 10% Writes= 1372 IO/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz, 20W), Turbo Boost Disabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 10x 3TB WD SATA 64MB cache, 1x LSI 9207 HBA, 1x 10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), Ceph hammer, FIO 2.2.9, FIO- 40 RBDs- 4 Clients- 32 Queue Depth per RBD- 1 worker per RBD volume, 4KB 90%Reads 10% Writes= 707 IO/s



# Configuration iSCSI SAN

## iSCSI SAN

**New Configuration:** Intel® Xeon Processor D-based reference platform with Xeon-D 1541 (8C, 2.1GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 32 GB memory (2x16GB DDR4-2400 RDIMM ECC), 4x Intel P3700 800 GB SSDs, 40GbE add-in network adapter (Intel XL710) + 20GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), FIO- 32 Queue Depth per iSCSI LUN- 8 connections per 10GbE- 1 connection per LUN- 1 worker per target, 4KB 100% Reads= 1060000 IO/s, 512KB 100% Reads= 7076 MB/s

**Xeon-E3 Configuration:** Intel® Xeon E3- based reference platform with Intel Xeon-E3 1265Lv3 (4C, 2.5GHz), Turbo Boost Disabled, Hyper-Threading Enabled, 16 GB memory (2x8GB DDR3-1600 UDIMM ECC), 3x Intel P3700 800 GB SSDs, 40GbE add-in network adapter (Intel XL710), Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), FIO- 32 Queue Depth per iSCSI LUN- 8 connections per 10GbE- 1 connection per LUN- 1 worker per target, 4KB 100% Reads= 570000 IO/s, 512KB 100% Reads= 4720 MB/s

**Base Configuration:** Intel® Atom C2000-based reference platform with one Intel Atom C2750 (8C, 2.4GHz,20W), Turbo Boost Disabled, Hyper-Threading Disabled, 16 GB memory (2x8GB DDR3-1600 RDIMM ECC), 2x Intel P3700 800GB SSDs, 2x10GbE, Ubuntu 14.04.2 (3.16.0-30-generic x86\_64), FIO- 32 Queue Depth per iSCSI LUN- 8 connections per 10GbE- 1 connection per LUN- 1 worker per target, 4KB 100% Reads= 175000 IO/s, 512KB 100% Reads= 2242 MB/s

# Configuration ISA-L

## Intel® Xeon Processor D-1541

- 8C, 2.1 GHz
- Intel Xeon Processor D Storage Customer Reference Board
- 2x8 GB DDR4 2133 MT/s ECC RDIMM

## Intel® Atom™ Processor C2750

- 8C, 2.4 GHz
- Intel Atom C2000 Customer Reference Board
- 2x8 GB DDR3 1600 MT/s ECC RDIMM

## BIOS Configuration

- P-States: Disabled
- Turbo: Disabled
- Speed Step: Disabled
- C-States: Disabled
- Power Performance Tuning: Disabled
- ENERGY\_PERF\_BIAS\_CFG: PERF
- Isochronous: Disabled
- Memory Power Savings: Disabled

# Configuration SPDK Storage

<b>CPU</b>	No. of Cores	8 Cores, 16 Threads
	CPU Name	Intel Xeon-D 1541
	Frequency	2.1 GHz
<b>Memory</b>	Spec	DDR4 2400 MT/s
	Size	32 GB, 2 Memory Channels 2 x 16GB DIMMs per channel
<b>Storage Backend</b>	Drive Configuration	4x Intel P3700 800GB
	PCI Slot	1x 16 bifurcated to 4x 4 Gen3.0 slots
<b>Operating System</b>	Distribution	Ubuntu Server 14.04.2
	Kernel	3.16.0-30-generic kernel

## Performance/Core

### Kernel NVMe\* Driver

```
# ./bdevperf <storage.conf> <block size>  
<queue depth> <randread/write> <time>
```

### SPDK NVMe Driver

```
# ./bdevperf <nvme.conf> <block size>  
<queue depth> <randread/write> <time>
```

SPDK NVMe driver is an open-source driver available at <https://github.com/spdk/spdk>

# Configuration Summary Networking

L3 Packet Forwarding: Layer 3 Packet Forwarding using Intel® Data Plane Development Kit (DPDK)

**New Configuration:** Intel® Xeon Processor D-based reference platform with one Intel® Xeon® D-1548 (8C, 2.0GHz), Turbo Boost disabled, Hyper-Threading enabled, 16GB memory (2x8GB DDR4-2400 RDIMM ECC), 2x Quad port X520 (8x10GbE), Ubuntu\* 12.04 (3.2.553.2.0-23-generic), Intel DPDK 1.7.0, 64B L3 forwarding=92.6MPackets/s, 1518B L3 forwarding=80Gb/s.

**Base Configuration:** Intel Atom Processor C2000-reference platform based platform with one Intel Atom Processor C2758 (8C, 2.4GHz), 32GB memory (4x8GB DDR3-1600 SO-DIMM ECC), 2x Dual port X520 (4x10GbE), Fedora\* Core 16 (Verne) x86\_64 (3.1.0-7.fc16.x86\_64), Intel DPDK 1.3.0-183, 64B L3 forwarding=30MPackets/s, 1518B L3 forwarding=40Gb/s

Virtual Private Network: IPsec Forwarding with Wind River\* INP stack

**New Configuration:** Intel® Xeon Processor D-based reference platform with one Intel® Xeon® D-1548 (8C, 2.0GHz), Turbo Boost disabled, Hyper-Threading enabled, 16GB memory (2x8GB DDR4-2133 RDIMM ECC), 2x Quad port X520 (8x10GbE), Intel® Quick Assist Adapter 8950-SCCP, Fedora\* Core 16 (Verne) x86\_64, Wind River INP-3.4, Quickassist L1.3.0\_90, DPDK Revision L.1.4.0-30. IPsec forwarding rate (1024B Ethernet clear text packet size)= 37.4 Gbits/s. 2 Cores/4Threads are used

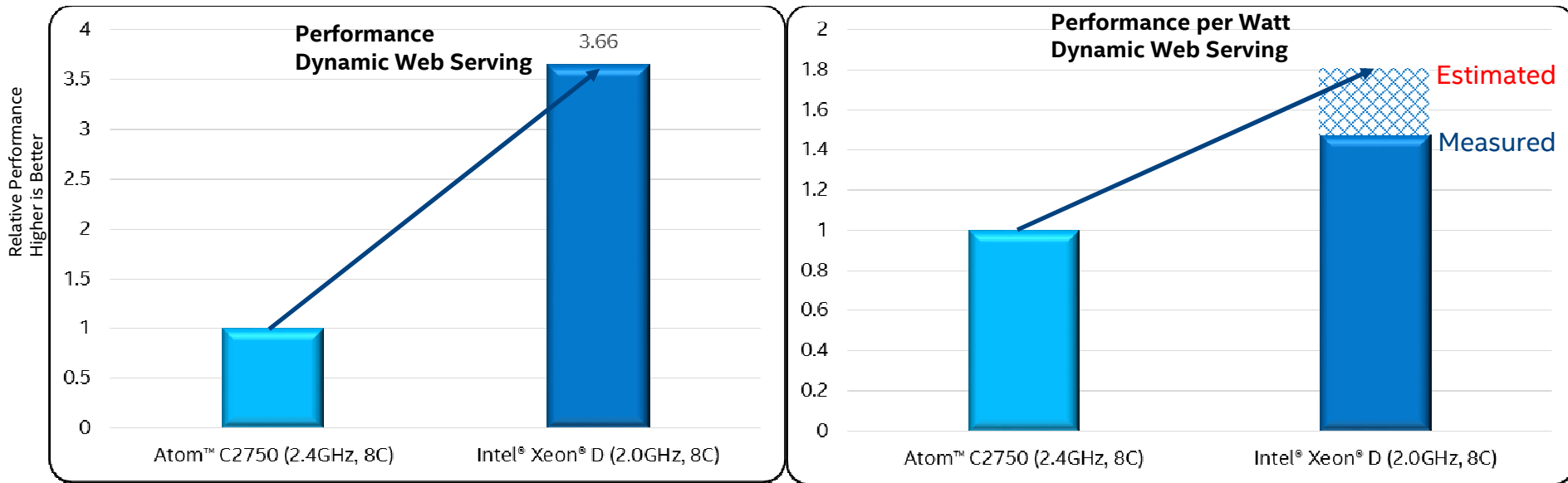
**Base Configuration:** Intel Atom Processor C2000-reference platform based platform with one Intel Atom Processor C2758 (8C, 2.4GHz), 4GB memory (2x2GB DDR3-1600 DIMM), 1x Dual port X520 (4x10GbE), Fedora\* Core 16 (Verne) x86\_64, Wind River INP-3.4, Quickassist L1.3.0\_90, DPDK Revision L.1.4.0-30. B IPsec forwarding rate (1024B Ethernet clear text packet size) =6.98 Gbits/s 2 Cores are used.

Virtualized Customer Premise Equipment (vCPE): Forwarding performance with Intel® DPDK- accelerated Open vSwitch

**New Configuration:** Intel® Xeon Processor D-based reference platform with one Intel® Xeon® D-1548 (8C, 2.0GHz), Turbo Boost disabled, Hyper-Threading enabled, 32GB memory (2x16GB DDR4-2400 RDIMM ECC, Integrated X522 (2x10GbE) ports, Fedora core 21 x86\_64, OVS Release 2.4 with DPDK acceleration. Forwarding rate under Virtual Machine (256B packet size)= 3.8 MPackets/s. 1 Core/2Threads are used as OVS-DPDK PMD thread

**Base Configuration:** Intel Atom Processor C2000-reference platform based platform with one Intel Atom Processor C2758 (8C, 2.4GHz), 16GB memory (2x8GB DDR3-1600 DIMM), 1x Dual port X520 (2x10GbE), Fedora\* Core 21 x86\_64, , OVS Release 2.4 with DPDK acceleration. Forwarding rate under Virtual Machine (256B packet size)= 0.76 MPackets/, 1 Core is used as OVS-DPDK PMD thread.

# Intel® Xeon® Processor D Server Web Server Performance



**Up to 3.6X estimated better performance vs Atom™ C2750**

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Configurations: Dynamic Web Serving. Intel Xeon Processor D (8C, 2.0GHz, 64GB, HT on, Turbo on) vs Intel Atom C2750(8C, 2.4GHz, 32GB, Turbo on). Refer to Configuration Slide "Intel Xeon Processor D Energy Efficiency" for detailed configurations. For more complete information visit <http://www.intel.com/performance>. \*Other names and brands may be claimed as the property

# Configuration

## Intel Xeon Processor D Web Performance

Intel internal testing as of May 27, 2015

Dynamic Web Serving (Performance and Performance per Watt)

**New Configuration:** Intel® Xeon Processor D-based reference platform with with one Xeon Processor D 1540 (8C, 2.0GHz, 45W), Turbo Boost Enabled, Hyper-Threading enabled, 64GB memory (4x16GB DDR4-2133 RDIMM ECC), 2x10GBase-T X552, 3x S3700 SATA SSD, Ubuntu\* 14.10 (3.16.0-23 generic), Nginx\* 1.4.4, Php-fpm\* 15.4.14, memcached\* 1.4.14, Simultaneous users=47152, Maximum un-optimized CRB wall power =114W, Perf/W=413.6 users/W . **Note: Intel CRB (customer reference board) platform is not power optimized. Expect production platforms to consume less power.** Other implementations based on microserver chassis, power=90W (estimated), Perf/W=523.9 users/W

**Base Configuration:** Supermicro SuperServer\* 5018A-TN4 with one Intel Atom Processor C2750 (8C, 2.4GHz,20W), Turbo Boost Enabled, 32GB memory (4x8GB DDR3-1600 SO-DIMM ECC), 1x10GBase-T X520, 2x S3700 SATA SSD, Ubuntu\* 14.10 (3.16.0-23 generic), Nginx\* 1.4.4, Php-fpm\* 15.4.14, memcached\* 1.4.14, Simultaneous users=12896. Maximum wall power =46W, Perf/W=280.3 users/W