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

November 2015
Legal Disclaimers

INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

A "Mission Critical Application" is any application in which failure of the Intel Product could result, directly or indirectly, in personal injury or death. SHOULD YOU PURCHASE OR USE INTEL'S PRODUCTS FOR ANY SUCH MISSION CRITICAL APPLICATION, YOU SHALL INDEMNIFY AND HOLD INTEL AND ITS SUBSIDIARIES, SUBCONTRACTORS AND AFFILIATES, AND THE DIRECTORS, OFFICERS, AND EMPLOYEES OF EACH, HARMLESS AGAINST ALL CLAIMS COSTS, DAMAGES, AND EXPENSES AND REASONABLE ATTORNEYS' FEES ARISING OUT OF, DIRECTLY OR INDIRECTLY, ANY CLAIM OF PRODUCT LIABILITY, PERSONAL INJURY, OR DEATH ARISING IN ANY WAY OUT OF SUCH MISSION CRITICAL APPLICATION, WHETHER OR NOT INTEL OR ITS SUBCONTRACTOR WAS NEGLIGENCE IN THE DESIGN, MANUFACTURE, OR WARNING OF THE INTEL PRODUCT OR ANY OF ITS PARTS.

Intel may make changes to specifications and product descriptions at any time, without notice. Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined". Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. The information here is subject to change without notice. Do not finalize a design with this information.

The products described in this document may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Intel, the Intel logo, Intel Xeon, and Xeon logos are trademarks of Intel Corporation in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others.

Copyright © 2015 Intel Corporation. All rights reserved.
Legal Disclaimers - Continued

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 http://www.intel.com/products/processor_number

Some results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software design or configuration may affect actual performance.

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.

Intel does not control or audit the design or implementation of third party benchmarks or Web sites referenced in this document. Intel encourages all of its customers to visit the referenced Web sites or others where similar performance benchmarks are reported and confirm whether the referenced benchmarks are accurate and reflect performance of systems available for purchase.

Relative performance is calculated by assigning a baseline value of 1.0 to one benchmark result, and then dividing the actual benchmark result for the baseline platform into each of the specific benchmark results of each of the other platforms, and assigning them a relative performance number that correlates with the performance improvements reported.

SPEC, SPECint, SPECfp, SPECrate, SPECpower, SPECjbb, SPECompG, SPEC MPI, and SPECjEnterprise® are trademarks of the Standard Performance Evaluation Corporation. See http://www.spec.org for more information.
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](http://www.intel.com/go/turbo).
Risk Factors

The above statements and any others in this document that refer to plans and expectations for the third quarter, the year and the future are forward-looking statements that involve a number of risks and uncertainties. Words such as “anticipates,” “expects,” “intends,” “plans,” “believes,” “seeks,” “estimates,” “may,” “will,” “should” and their variations identify forward-looking statements. Statements that refer to or are based on projections, uncertain events or assumptions also identify forward-looking statements. Many factors could affect Intel’s actual results, and variances from Intel’s current expectations regarding such factors could cause actual results to differ materially from those expressed in these forward-looking statements. Intel presently considers the following to be the important factors that could cause actual results to differ materially from the company’s expectations.

Demand could be different from Intel’s expectations due to factors including changes in business and economic conditions; customer acceptance of Intel’s and competitors’ products; supply constraints and other disruptions affecting customers; changes in customer order patterns including order cancellations; and changes in the level of inventory at customers. Uncertainty in global economic and financial conditions poses a risk that consumers and businesses may defer purchases in response to negative financial events, which could negatively affect product demand and other related matters. Intel operates in intensely competitive industries that are characterized by a high percentage of costs that are fixed or difficult to reduce in the short term and product demand that is highly variable and difficult to forecast. Revenue and the gross margin percentage are affected by the timing of Intel product introductions and the demand for and market acceptance of Intel’s products; actions taken by Intel’s competitors, including product offerings and introductions, marketing programs and pricing pressures and Intel’s response to such actions; and Intel’s ability to respond quickly to technological developments and to incorporate new features into its products. The gross margin percentage could vary significantly from expectations based on capacity utilization; variations in inventory valuation, including variations related to the timing of qualifying products for sale; changes in revenue levels; segment product mix; the timing and execution of the manufacturing ramp and associated costs; start-up costs; excess or obsolete inventory; changes in unit costs; defects or disruptions in the supply of materials or resources; product manufacturing quality/yields; and impairments of long-lived assets, including manufacturing, assembly/test and intangible assets. Intel’s results could be affected by adverse economic, social, political and physical/infrastructure conditions in countries where Intel, its customers or its suppliers operate, including military conflict and other security risks, natural disasters, infrastructure disruptions, health concerns and fluctuations in currency exchange rates. Expenses, particularly certain marketing and compensation expenses, as well as restructuring and asset impairment charges, vary depending on the level of demand for Intel’s products and the level of revenue and profits. Intel’s results could be affected by the timing of closing of acquisitions and divestitures. Intel’s results could be affected by adverse effects associated with product defects and errata (deviations from published specifications), and by litigation or regulatory matters involving intellectual property, stockholder, consumer, antitrust, disclosure and other issues, such as the litigation and regulatory matters described in Intel’s SEC reports. An unfavorable ruling could include monetary damages or an injunction prohibiting Intel from manufacturing or selling one or more products, precluding particular business practices, impacting Intel’s ability to design its products, or requiring other remedies such as compulsory licensing of intellectual property. A detailed discussion of these and other factors that could affect Intel’s results is included in Intel’s SEC filings, including the company’s most recent reports on Form 10-Q, Form 10-K and earnings release.
Optimization Notice

Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel.

Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

Notice revision #20110804
Index

Performance Summary
Workload Positioning
Architecture Overview
SKU Line Up
Storage Performance
Networking Performance
Intel® Xeon® Processor D Performance Summary

- **SERVER**
  - Up to 3.6X vs Atom™ C2750
  - Up to 16 Xeon® cores
  - TDP as low as 20W

- **NETWORKING**
  - Up to 5.4X vs Atom™ C2758

- **STORAGE**
  - Up to 6X vs Atom™ C2750

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 Intel® website. Other names and brands may be claimed as the property of others.
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

*Other names and brands may be claimed as the property
## Intel® Xeon® Processor D-1500 SoC Architecture Overview

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

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

*Other names and brands may be claimed as the property*
Intel® Xeon® Processor D-1500 SKU Line Up

Launched March 2015

- **Intel® Xeon® Processor D-1540**
  - Core#: 8C, TDP: 45W, Core Freq.: 2.0GHz

- **Intel® Xeon® Processor D-1520**
  - Core#: 4C, TDP: 45W, Core Freq.: 2.2GHz

Launching on November 9th, 2015

- **Intel® Xeon® Processor D-1541**
  - Core#: 8C, TDP: 45W, Core Freq.: 2.1GHz

- **Intel® Xeon® Processor D-1531**
  - Core#: 6C, TDP: 45W, Core Freq.: 2.2GHz

- **Intel® Xeon® Processor D-1548**
  - Core#: 8C, TDP: 45W, Core Freq.: 2.0GHz

- **Intel® Xeon® Processor D-1537**
  - Core#: 8C, TDP: 35W, Core Freq.: 1.7GHz

- **Intel® Xeon® Processor D-1528**
  - Core#: 6C, TDP: 35W, Core Freq.: 1.9GHz

- **Intel® Xeon® Processor D-1521**
  - Core#: 4C, TDP: 45W, Core Freq.: 2.4GHz

- **Intel® Xeon® Processor D-1527**
  - Core#: 4C, TDP: 35W, Core Freq.: 2.2GHz

- **Intel® Xeon® Processor D-1518**
  - Core#: 4C, TDP: 35W, Core Freq.: 2.2GHz

- **Intel® Pentium® Processor D1517**
  - Core#: 4C, TDP: 25W, Core Freq.: 1.6GHz

- **Intel® Pentium® Processor D1508**
  - Core#: 2C, TDP: 25W, Core Freq.: 2.2GHz

- **Intel® Pentium® Processor D1507**
  - Core#: 2C, TDP: 20W, Core Freq.: 1.2GHz

Launching in Q1’16

- **Intel® Xeon® Processor D-15xx**
  - Core#: 16, 12C

- **Intel® Xeon® Processor D-15xx**
  - Core#: TBD

- **Intel® Pentium® Processor D15xx**
  - Core#: TBD

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)

*Other names and brands may be claimed as the property
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**

*Other names and brands may be claimed as the property.*
## Use Cases Evaluated for Storage

<table>
<thead>
<tr>
<th>Usage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Backup</td>
<td>Cloud Backup benchmark simulates backing up data to remote cloud-based distributed servers</td>
</tr>
<tr>
<td>Video on Demand</td>
<td>Video on Demand benchmark simulates the delivery of video upon request to receiving clients</td>
</tr>
<tr>
<td>Virtualized Storage</td>
<td>The Virtualized Desktop Storage benchmark simulates a Virtual Desktop Infrastructure environment where user data is in a centralized virtualized environment</td>
</tr>
<tr>
<td>iSCSI SAN</td>
<td>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</td>
</tr>
</tbody>
</table>
Intel® Xeon® Processor D Storage Performance Summary

Virtualized Storage

- Virtualized Desktop Infrastructure: 1.94
- Large I/O: 1.94

Video on Demand

- Large I/O: 3.44
- Small I/O: 3.76

Cloud Backup

- Large Streaming I/O: 3.16
- Small Transactional I/O: 6.06

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

Up to 6x higher storage performance over Intel® Atom™ C2750 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 Storage 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 of their respective owners.*
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

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 Cloud 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 of other companies.
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

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 Video on Demand 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 Storage Performance

Virtualized Desktop Storage

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

iSCSI SAN Storage Performance

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

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

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 iSCSI SAN 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
Intel® Storage Acceleration Library (ISA-L)

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

Up to 2.4X vs Intel® Atom™ Processor C2750

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 ISA-L 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
Storage Performance Development Kit (SPDK)

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

Relative Performance
Actual performance will vary by workload
Higher is better

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

- 1xNVMe: 1.26
- 2xNVMe: 2.52
- 4xNVMe: 4.99

Kernel Driver vs Intel SPDK Driver

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 SPDK Storage in Configuration section for detailed configurations. For more complete information visit http://www.intel.com/performance.
## Storage Performance Summary

<table>
<thead>
<tr>
<th><strong>Cloud Storage</strong></th>
<th><strong>Performance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Backup</td>
<td>Up to 3.7X</td>
</tr>
<tr>
<td>Video on Demand</td>
<td>Up to 1.9X</td>
</tr>
<tr>
<td>Virtualized Storage</td>
<td>Up to 1.9X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SAN Performance</strong></th>
<th><strong>Performance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Streaming I/O</td>
<td>Up to 3.1X</td>
</tr>
<tr>
<td>Small Transactional I/O</td>
<td>Up to 6X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Intel® Storage Acceleration Libraries (ISA-L)</strong></th>
<th><strong>Performance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>Up to 2.4X</td>
</tr>
<tr>
<td>Data Protection</td>
<td>Up to 2.4X</td>
</tr>
<tr>
<td>Cryptographic Hashing</td>
<td>Up to 6.4X</td>
</tr>
<tr>
<td>Encryption</td>
<td>Up to 8.9X</td>
</tr>
<tr>
<td>Data Integrity</td>
<td>Up to 12.5X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Intel® Storage Performance Development Kit (SPDK)</strong></th>
<th><strong>Performance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kernel Driver (vs Out of Box)</td>
<td>Up to 4.9X</td>
</tr>
</tbody>
</table>

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

*Other names and brands may be claimed as the property

Intel Architecture Consistency, Software Compatibility, Rich Ecosystem
## Use Cases Evaluated for Networking

<table>
<thead>
<tr>
<th>Usage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>L3 Packet Forwarding</strong></td>
<td>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).</td>
</tr>
<tr>
<td><strong>Virtual Private Network</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Virtualized Customer Premise Equipment (vCPE)</strong></td>
<td>Benchmark simulates the packet forwarding under a virtual machine using Open vSwitch* as it would be used in a vCPE environment.</td>
</tr>
</tbody>
</table>

*Other names and brands may be claimed as the property*
Up to 5.4x higher 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 of their owners.
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

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/performancemore names and brands may be claimed as the property
Intel® Xeon® Processor D Performance
Forwarding performance with Intel® DPDK- accelerated Open vSwitch* – SDN/NFV Performance

Intel® Atom® C2758 (8C, 2.4GHz)
Intel® Xeon® D-1548 (8C, 2.0GHz)

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)

Relative Performance
Actual performance will vary by workload
Higher is better

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.
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

*Other names and brands may be claimed as the property.*
Intel® Xeon® Processor D Performance Summary

**SERVER**
- Up to 3.6X vs Atom™ C2750
- **Intel® Xeon® Performance to Dense Scale out Servers**

**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 of others.
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= 948 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 I/O/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 I/O/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 I/O/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 I/O/s, 512KB 100% Reads= 2242 MB/s

*Other names and brands may be claimed as the property of their respective owners.*
**Configuration 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

*Other names and brands may be claimed as the property*
Configuration 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

*Other names and brands may be claimed as the property*
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

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

*Other names and brands may be claimed as the property
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

*Other names and brands may be claimed as the property*
## Configuration SPDK Storage

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

### 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](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 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.

**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

**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/s, 1 Core is used as OVS-DPDK PMD thread.

*Other names and brands may be claimed as the property...
Intel® Xeon® Processor D Server Web Server Performance

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

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: 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](http://www.intel.com/performance). "Other names and brands may be claimed as the property.

---

**Graph 1:**
- **Performance Dynamic Web Serving:**
  - Atom™ C2750 (2.4GHz, 8C)
  - Intel® Xeon® D (2.0GHz, 8C)

**Graph 2:**
- **Performance per Watt Dynamic Web Serving:**
  - Atom™ C2750 (2.4GHz, 8C)
  - Intel® Xeon® D (2.0GHz, 8C)
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 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 SSD 3700 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 SSD 3700 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

*Other names and brands may be claimed as the property