Intel Xeon E7 & E5 Server Family CPU Update

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Intel Federal
May 2014
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Data Center Product Lines

Intel® Xeon® Processor E7 family

Intel® Xeon® Processor E5 family

Intel® Xeon® Processor E3 family

Intel® Xeon Phi™ Coprocessor x100 product family

Intel® Xeon Phi™ Coprocessors work synergistically with Intel® Xeon® Processors
Product Line Descriptions

**Intel® Xeon Phi™ Coprocessor x100 product family**
Advanced performance for highly parallel workloads for breakthrough innovation and discovery. Based on Intel® MIC Architecture; Works synergistically with Intel® Xeon® processors. Increased developer productivity via programming models & tools common with Intel® Xeon® processors.

**Intel® Xeon® Processor E7 family**
Scalable (up to 256-way), reliable, powerful multi-core servers offering industry-leading performance, expanded memory & I/O capacity, and advanced reliability ideal for the most demanding enterprise and mission critical workloads, large scale virtualization and large-node HPC applications.

**Intel® Xeon® Processor E5 family**
Versatile (up to 4-way) servers for all your infrastructure, high-density, workstation and HPC applications with features that enable optimal performance and power efficiency for the data center.

**Intel® Xeon® Processor E3 family**
Economical (1-way) dependable general purpose servers well-suited for small businesses and education with features that optimize performance, uptime, and security.
WW11 Intel® Xeon® Processor E7 Family Server Roadmap

Brickland Platform

Intel® Xeon® processor E7 family
Up to 15 cores/30 threads
37.5MB Shared Cache

Technologies
Intel® Advanced Vector Extensions (Intel® AVX), Integrated 3Gb/s SAS, 3Gb/s and 6Gb/s SATA, Intel® Integrated I/O (Intel® IIO), Intel® Hyper-Threading Technology, Intel® Turbo Boost Technology 2.0, Intel® VT-x, -d, & -c, Intel® QuickPath Interconnect (QPI), Intel® Data Protection Technology with Advanced Encryption Standard New Instructions (AES-NI) and Secure Key, Intel® Platform Protection Technology with OS Guard, and Trusted Execution Technology (TXT), Intel® Node Manager, Intel® Run Sure Technology

Intel® Xeon® processor E7-8800/4800/2800 v2 product families (Ivy Bridge-EX)
Intel® C602J chipset
Intel® C102/C104 Scalable Memory Buffer (Jordan Creek 1)

Intel® Xeon® processor E7 v3 product families (Haswell-EX)
Intel® C602J chipset
Scalable Memory Buffer (Jordan Creek 2)
Intel® Xeon® processor E7-8800/4800/2800 v2 Product Families

- Up to 15 cores / 30 threads per socket
- Intel® Run Sure Technology including new reliability features for improved system uptime and data integrity
- Highest memory capacity for data-demanding, transaction-intensive workloads
- Improved security with Intel® Data Protection Technology with Secure Key & Intel® Platform Protection Technology with OS Guard for additional HW embedded security

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## Intel® Xeon® Processor E7 Family

**Significant Generational Improvements**

<table>
<thead>
<tr>
<th></th>
<th>Intel® Xeon® processor E7-8800/4800/2800 product families (code name Westmere EX)</th>
<th>Intel® Xeon® processor E7-8800/4800/2800 v2 product families (code name Ivy Bridge EX)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process Technology</strong></td>
<td>32nm</td>
<td>22nm</td>
</tr>
<tr>
<td><strong>Cores / Threads</strong></td>
<td>Up to 10 / 20 per processor</td>
<td>Up to 15 / 30 per processor</td>
</tr>
<tr>
<td><strong>L3 Cache Size</strong></td>
<td>Up to 30M</td>
<td>Up to 37.5M</td>
</tr>
<tr>
<td><strong>Memory Capacity</strong></td>
<td>Up to 16 DIMMs per processor 32GB max DIMM Density Up to 2TB in 4S / Up to 4TB in 8S</td>
<td>Up to 24 DIMMs per processor 64GB max DIMM Density Up to 6TB in 4S / Up to 12TB in 8S</td>
</tr>
<tr>
<td><strong>Max Memory Speed</strong></td>
<td>Up to 1066MHz</td>
<td>Up to 1600MHz</td>
</tr>
<tr>
<td><strong>I/O Bandwidth</strong></td>
<td>Up to 72 lanes PCIe* 2.0 (dual IOH)</td>
<td>Up to 32 Integrated PCIe* 3.0 lanes per processor</td>
</tr>
<tr>
<td><strong>Intel® QPI Bandwidth</strong></td>
<td>Up to 4 x 6.4 GT/s per processor</td>
<td>Up to 3 x 8.0 GT/s per processor</td>
</tr>
<tr>
<td><strong>RAS</strong></td>
<td>Advanced</td>
<td>Previous Gen + eMCA Gen 1, MCA Recovery - Execution Path, MCA IO, PCI LER</td>
</tr>
<tr>
<td><strong>Platform Technologies</strong></td>
<td>Intel® Turbo Boost Technology, Intel® TXT, Intel® Dynamic Power, Intel® VT-x, Intel® VT-d, Intel® I/OAT/CB3 Technology, Intel® Node Manager, TPM 1.2 and more</td>
<td>Previous Gen + Intel® Secure Key + Intel® OS Guard + Intel® Integrated I/O + Intel® Direct Data I/O + Node Manager 2.0 + Intel® AVX + APICv</td>
</tr>
</tbody>
</table>

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All products, computer systems, dates and figures specified are preliminary based on current expectations, and are subject to change without notice.
### Processor Options – Compute Speed

<table>
<thead>
<tr>
<th>Marked estimated unless published at SPEC.org</th>
<th>4x E7-4870</th>
<th>4x E7-4890v2</th>
<th>4x E7-4880v2</th>
<th>4x E7-4830v2</th>
<th>4x E7-4809v2</th>
<th>4x E7-8880L v2</th>
<th>4x E7-8857v2</th>
<th>2x E5-2697 v2</th>
<th>2x E5-2690 v2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core count</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>12</td>
<td>10</td>
<td>6</td>
<td>15</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Marked frequency (GHz)</td>
<td>2.4</td>
<td>2.8</td>
<td>2.5</td>
<td>2.6</td>
<td>2.2</td>
<td>1.9</td>
<td>2.2</td>
<td>3.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Steady Turbo Freq (GHz)</td>
<td>2.8</td>
<td>3.3</td>
<td>3.1</td>
<td>3.2</td>
<td>2.7</td>
<td>1.9</td>
<td>3.1</td>
<td>3.6</td>
<td>3.5</td>
</tr>
<tr>
<td>SPECint(R)_base2006</td>
<td>38</td>
<td>55.4</td>
<td>2.5</td>
<td>50.4</td>
<td>40.4</td>
<td>29.2</td>
<td>44.4</td>
<td>53.5</td>
<td>55.9</td>
</tr>
<tr>
<td>SPECfp(R)_base2006</td>
<td>61</td>
<td>95.6</td>
<td>2.8</td>
<td>94.5</td>
<td>77.3</td>
<td>60.1</td>
<td>88.1</td>
<td>94.1</td>
<td>98</td>
</tr>
</tbody>
</table>

### Performance Comparison

- E7-4890 v2 shows 1.46X integer and 1.57X floating-point performance against previous gen E7-4870.
- E7-4890 v2 shows 0.99X integer and 0.98X floating-point performance against 2x E5-2697 v2.

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4-processor RISC Server Competitive Performance Summary
4S Intel® Xeon® Processor E7 Family vs. 4S IBM POWER7+ (POWER750)*

Up to 1.9x performance gains vs. IBM POWER7+ (POWER750)
IBM POWER7+* RISC Server Competitive Summary

Backup

Source: Intel estimates and published results as of 18 February 2014

(+1.29x to 1.60x) OLTP Database based on leading database benchmark:
1. IBM POWER7+ (3746K tpm) based on Intel estimates
2. Intel Xeon processor E7-4890 v2 (4849K tpm with 1TB or 6000 tpm with 6TB) based on Intel estimates

(+1.78x) Memory Bandwidth STREAM Triad GB/s
1. IBM POWER7+ (138GB/s) source: https://www.ibm.com/developerworks/community/wikis/home?lang=en#!/wiki/W51a7ffcf4dfd_4b40_9d82_446ebc23c550/page/POWER7+_SCM+and+DCM+systems
2. Intel Xeon processor E7-4890 v2 (246GB/s Triad) base on intel internal measurements Technical Report #1340

(+1.83x) HPC Application Throughput based on SPECfp_rate_base2006*:
1. IBM POWER7+ (946 baseline score) source: http://www.spec.org/cpu2006/results/res2013q3/cpu2006-20130805-26128.html

(+1.89x) Commercial General Purpose based on SPECint_rate_base2006*:

NOTE: public claim based on early internal estimates of +80% on SPECint_rate_base2006
4-processor RISC Server Competitive Performance Summary
4S Intel® Xeon® Processor E7 Family vs. 4S SPARC*

4-processor Intel Xeon processor E7-4800 v2 Family
SPARC T5-4 Enterprise Competitive Performance Summary

Normalized to 1.0. Higher is better.

- SPARC* T5-4 (4P/16C/128T, 3.60 GHz)
- Intel® Xeon® Processor E7-4890 v2 (4P/15C/30T, 2.80 GHz)

Relative performance improvement. Source: estimated Intel and published T5-4 results as of 18 February 2014.

1. NOTE: Max memory configuration assumed – 2TB on SPARCT5-4 and 6TB on Xeon E7 v2

Up to 1.3x faster performance compared to SPARC T5-4*

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SPARC* RISC Server Competitive Summary
Backup

Source: Intel estimates and published results as of 18 February 2014

(+1.1x to 1.23x) OLTP Database based on leading database benchmark:
1. SPARC T5-4 (4859.4K tpm with 2TB) based on Intel estimates
2. Intel Xeon processor E7-4890 v2 (5333K tpm with 2TB or 6000 tpm with 6TB) based on Intel estimates

(+0.94x) Memory Bandwidth STREAM Triad GB/s
1. SPARC T5-4 (262GB/s) source: https://oraclecn.activeevents.com/connect/fileDownload/session/04B2DF1CFA4791BF01B55AA386453471/C0N2181_Chen-CON2181-Chen.pptx
2. Intel Xeon processor E7-4890 v2 (246GB/s Triad) base on intel internal measurements Technical Report #1340

(+1.25x) HPC Application Throughput based on SPECfp_rate_base2006*:
1. SPARC T5-4 (1385 baseline score est. based on T5-8 scaling source: http://www.spec.org/cpu2006/results/res2013q2/cpu2006-20130325-25622.html)

(+1.33x) Commercial General Purpose based on SPECint_rate_base2006*:
1. SPARC T5-4 (1745 baseline score est. based on T5-8 scaling source: http://www.spec.org/cpu2006/results/res2013q2/cpu2006-20130325-25621.html)
4-processor Server x86 Competitive Performance Summary
Intel® Xeon® Processor E7 Family vs. AMD Opteron® Processor 6300 Series

4-processor Intel Xeon processor E7 Family Enterprise Competitive Performance Summary

<table>
<thead>
<tr>
<th>Relative Performance Improvement</th>
<th>AMD Opteron® 6386 SE (4P/16C/16T, 2.80 GHz)</th>
<th>Intel® Xeon® Processor E7-4890 v2 (4P/15C/30T, 2.80 GHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory Bandwidth</td>
<td>1.7</td>
<td>2.2</td>
</tr>
<tr>
<td>HPC Application Throughput</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Commercial General Purpose</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>OLTP Database</td>
<td></td>
<td>2.9</td>
</tr>
</tbody>
</table>

Max Memory: 1TB

Relative performance improvement. Source: estimated and published Intel and AMD Opteron® results as of 18 February 2014.

Up to 2.9x better performance compared to AMD Opteron® 6300 series

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AMD Opteron* 6300 Competitive Summary
Backup

Source: Intel estimates and published results as of 18 February 2014

(+1.67x) Memory Bandwidth STREAM Triad GB/s
1. AMD Opteron 6386 SE (source: Intel Xeon processor E7-4890 v2 (246GB/s Triad) base on intel internal measurements Technical Report #1340

(+2.17x) Commercial General Purpose based on SPECint_rate_base2006:

(+2.18x) HPC Application Throughput based on SPECfp_rate_base2006:

(+2.33x to 2.89x) OLTP Database based on leading database benchmark:
1. AMD Opteron 6386 SE (2077K tpm) based on Intel estimates
2. Intel Xeon processor E7-4890 v2 (4849K tpm or 6000K tpm) based on Intel estimates
## WW11 Intel® Xeon® Processor E5 Family Server Roadmap

<table>
<thead>
<tr>
<th>Q1’14</th>
<th>Q2’14</th>
<th>Q3’14</th>
<th>Q4’14</th>
<th>Q1’15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel® C600 series chipset</td>
<td>Intel® C600 series chipset</td>
<td>Intel® C610 series chipset</td>
<td>Intel® C610 series chipset</td>
<td>Intel® C600 series chipset</td>
</tr>
<tr>
<td><strong>Efficient Performance Four Socket</strong></td>
<td><strong>Efficient Performance Two Socket</strong></td>
<td></td>
<td></td>
<td><strong>Entry Two Socket</strong></td>
</tr>
<tr>
<td><strong>Technologies:</strong></td>
<td><strong>New Technologies:</strong></td>
<td>Up to 12 cores/24 threads, Intel® Data Protection Technology with Advanced Encryption Standard New Instructions (AES-NI) and Secure Key, Intel® Platform Protection Technology with OS Guard and Trusted Execution Technology (TXT), APICv</td>
<td></td>
<td>Up to 10 cores/20 threads; rest same as Romley-EP</td>
</tr>
</tbody>
</table>

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Intel® Xeon® processor E5-2600 v2
Product Family

Socket compatible replacement for Intel® Xeon® processor E5-2600 product family

Up to 12 cores and 24 threads cache

Improved security with Intel® Secure Key & Intel® OS Guard for additional HW embedded security

Integrated
PCI Express* 3.0
Up to 40 lanes per socket

4 channels of up to DDR3 1866 MHz memory

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Intel Confidential—NDA Platform Roadmap, All Dates and Plans are Subject to Change Without Notice
Intel® Xeon® Processor E5-2600 v2 Product Family
Ivy Bridge Improvements

<table>
<thead>
<tr>
<th>Feature</th>
<th>Xeon E5-2600</th>
<th>Xeon E5-2600 v2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Technology</td>
<td>32 nm</td>
<td>22 nm</td>
</tr>
<tr>
<td>Cores/Threads</td>
<td>Up to 8 cores /16 Threads</td>
<td>Up to 12 Cores/24 Threads</td>
</tr>
<tr>
<td>Last-level Cache</td>
<td>Up to 20 MB</td>
<td>Up to 30 MB</td>
</tr>
<tr>
<td>Max Memory Speed (MHz)</td>
<td>Up to 1600</td>
<td>Up to 1866</td>
</tr>
<tr>
<td>Max DIMM Capacity</td>
<td>12 Slots/Processor</td>
<td></td>
</tr>
<tr>
<td>PCIe* Lanes / Controllers/Speed</td>
<td>40 / 10 (PCiex 3.0 at 8 GT/s)</td>
<td></td>
</tr>
<tr>
<td>TDP (W)</td>
<td>150 (Workstation only), 130, 115, 95, 80, 70, 60</td>
<td></td>
</tr>
</tbody>
</table>

Additional Feature Improvements:
- Intel® Secure Key & Intel® OS Guard
- Advanced Programmable Interrupt Controller virtualization (APICv)
Intel® Xeon® Processor E5-4600 v2
Product Family

Latest micro-architecture on leading 22nm manufacturing process

Up to 50% more cores and cache for up to 1.4x average top bin performance increase

Improved HW embedded security with Intel® Data Protection Technology & Intel® Platform Protection Technology

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## Generational Comparison
### Intel® Xeon® Processor E5-4600/E5-4600 v2 Product Families

<table>
<thead>
<tr>
<th></th>
<th>Intel® Xeon® processor E5-4600 product family (code name Sandy Bridge-EP 4S)</th>
<th>Intel® Xeon® processor E5-4600 v2 product family (code name Ivy Bridge-EP 4S)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process Technology</strong></td>
<td>32nm</td>
<td>22nm</td>
</tr>
<tr>
<td><strong>Cores / Threads</strong></td>
<td>Up to 8 / 16 per socket</td>
<td>Up to 12 / 24 per socket</td>
</tr>
<tr>
<td><strong>L3 Cache Size</strong></td>
<td>Up to 20M</td>
<td>Up to 30M</td>
</tr>
<tr>
<td><strong>TDP</strong></td>
<td>130W, 155W, 95W</td>
<td></td>
</tr>
<tr>
<td><strong>Memory Capacity</strong></td>
<td>Up to 1.5TB (up to 12 DIMMs per socket)</td>
<td>Up to 3TB&lt;sup&gt;1&lt;/sup&gt; (up to 12 DIMMs per socket)</td>
</tr>
<tr>
<td><strong>Max Memory Speed</strong></td>
<td>Up to 1600MHz</td>
<td>Up to 1866MHz</td>
</tr>
<tr>
<td><strong>I/O Bandwidth</strong></td>
<td>Up to 40 Integrated PCIe* 3.0 lanes per socket</td>
<td></td>
</tr>
<tr>
<td><strong>Intel® QPI Bandwidth</strong></td>
<td>Up to 2 x 8.0 GT/s per socket (1x pass-through)</td>
<td></td>
</tr>
<tr>
<td><strong>Platform Technologies</strong></td>
<td>Intel® Turbo Boost Technology, Intel® TXT, Intel® Dynamic Power, Intel® VT-x, Intel® VT-d, Intel® I/OAT/CB3 Technology, Intel® Integrated I/O, Intel® Direct Data I/O, Node Manager 2.0, Intel® AVX and more</td>
<td>Previous Gen + Intel® Secure Key + Intel® OS Guard + APICv</td>
</tr>
</tbody>
</table>

<sup>1</sup> Memory capacity possible by populating maximum number of DIMMs (48 in a 4S system) with 64GB DDR3 LR-DIMMs

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Intel® Xeon® Processor E5-4600 Product Family

Comparing Two Platforms for Different Customer Needs

Intel® Xeon® processor E7 family

- Top of the line enterprise performance
- Richest Xeon RAS feature set to support mission critical applications
- Highest memory capacity
- Scales 2S, 4S, 8S natively and beyond 8S with customer node controllers

Best for enterprise apps (database, BI, virtualization, etc) needing large, scale-up servers

Intel Xeon processor E5-4600 product family

- Optimized for higher density
- Lower system price points¹
- Excellent floating point performance and performance per watt (PPW)¹

Best for dense 4-socket designs, 4-socket HPC apps, and entry 4-socket servers

¹Source: Intel internal assessment
Intel E7 & E5 Server CPU Roadmap

2014

Brickland Platform
- Intel® Xeon® processor E7-8800/4800/2800 v2 product families/Intel® C602J chipset, Intel® C104/C102 Scalable Memory Buffer

Romley-EP 4S Platform
- Intel® Xeon® processor E5-4600 product family/Intel® C600 series

Romley-EP Platform
- Intel® Xeon® processor E5-2600 v2 product family/Intel® C600 series chipset

Romley-EN Platform
- Intel® Xeon® processor E5-2400 v2 product family/Intel® C600 series chipset

2015

Grantley-EP 4S Platform
- Intel® Xeon® processor E5-4600 v3 product family/Intel® C610 series chipset

Grantley-EP Platform
- Intel® Xeon® processor E5-2600 v4 product family/Intel® C610 series chipset

Efficient Performance 4S

Efficient Performance 2S

Expandable

September ‘14
Unparalleled Capability vs. Cost

Robust Hardware Ecosystem

Vibrant Software Ecosystem

A robust, high value operating environment

Increased Energy Efficiency

Processor innovation

Intel® Intelligent Power technology
Intel® Turbo Boost technology
Intel® Intelligent Power Node Manager
Intel® Data Center Manager

Efficiency and Control

World's most efficient OS
Intel and Red Hat’s Enterprise-Ready Platform

Performance and Scalability
- Up to 4,096 processors, 64 TB memory, 100 TB file systems
- NUMA optimization
- SR-IOV

Mission-critical RAS
- Intel® Advanced Reliability Technology
  - Machine check architecture recovery

Energy Efficiency
- Tickless kernel
  - Automated workload balancing

Enhanced Security
- Intel® AES-NI
- Intel® TXT
- SELinux

redhat + Intel Xeon = Mainstream mission-critical platform
Red Hat Enterprise Linux 6

Tremendous headroom for growth, for up to:
- 4,096 processors
- 64 TB of memory
- 100 TB file systems

Advanced feature set
- NUMA technology
- Ticketed spinlocks
- Transparent huge pages
- Control groups
- Dramatic performance improvements

Support for mission-critical workloads

Most comprehensive release in the history of Red Hat Enterprise Linux
Comprehensive Mission-Critical RAS

- Advanced error detection, correction, & containment
- Intel Machine Check Architecture Recovery (MCA Recovery)
- Partial memory mirroring

- Advanced error logging and management
- Control groups
- Advanced error reporting
- PCI hot plug
- Multipath I/O
- Hardware-based checksumming
- KVM hypervisor
Intel® and Cloudera's Distribution of Apache Hadoop

Intel® Datacenter Software | Intel® and Cloudera's Distribution of Apache Hadoop

Support

Intel has entered into a strategic agreement with Cloudera® to create the platform of choice for big data. This partnership engagement will accelerate the growth of datacenter technology deployment and drive Intel’s technology growth including processors, flash, networking, fabrics and security.

The partnership brings together Cloudera, the industry leader in enterprise data management powered by Apache Hadoop®, with Intel, the leader in data center technology. This is our largest Data Center equity investment so far and will dramatically benefit our customers with enhanced enterprise feature readiness, ease of deployment, and optimized solutions to allow businesses to more easily derive insights from big data.

Our agreement with Cloudera supports our strategy to enable open, enterprise-class Hadoop solutions optimized for IA to accelerate enterprise adoption and fuel data center TAM. Intel will continue silicon enabling and optimization with the broad range of vendors in the data management and analytics domain. Cloudera will develop and optimize CDH, Cloudera’s distribution for Apache Hadoop, for Intel Architecture as its preferred platform. Intel will market and promote Cloudera