IT@Intel
Efficiency through IT Hardware, Software & Process

Breakthrough technologies, solutions, and processes have optimally served the acceleration of Intel's business
Legal Notices

No product or component can be absolutely secure.

Your costs and results may vary.

Intel technologies may require enabled hardware, software or service activation.

© Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries.

Other names and brands may be claimed as the property of others.
Intel IT Environment

IT @ Intel

5,051 at 22 support ~110K at 147 in 56
Intel IT Employees Intel IT Sites Intel Employees Intel Sites Countries

IT Device Management

>205,000 Managed Devices

139,647 Mobile PCs
58,000 Smartphones
7,571 Desktops

IT Storage and Servers

17 Data Center Sites with 56 Modules

218 PB Storage
227K Servers
315 PB Storage
260K Servers
437PB Storage
297.5K Servers

2017 2018 2019

IT Spending¹

Per Employee (USD)
Against Revenue (Percent)

12,100 11,300 11,400
2.7% 2.3% 2.3%

¹Financials restated to include wholly owned subsidiaries that have since been integrated and exclude divested entities. Employee count represents an average of beginning and end of year.

IT Device Management

Intel IT Environment

IT Storage and Servers

IT Spending

IT@Intel
We operate our data center service like a factory by applying breakthrough technologies, solutions, and processes to achieve industry leadership.

**APPROACH**
Seek transformation instead of incremental change

**BEST ACHIEVABLE CAPABILITIES**
(Model of Record)

**CURRENT CAPABILITIES**
(Plan of Record)

**SCOPE**
Optimize business structure to support critical business functions

**KPIs**
Maximize business value through optimization vectors

- **Quality of Service** (Service Level Agreements)
  - TIER-1
  - TIER-3

- **Resource Utilization** +80%

- **Cost Per Service Unit** 10% YoY

**TACTICS**
- Embrace Disruptive Servers
- Adopt Tiered Storage
- Drive Network Efficiency
- Increase Facility Efficiency
- Improve Operational Efficiency

**TIME**
Continue to CLOSE THE GAP

**HEADCOUNT**

**Network**

**Facilities**

**Servers**

**OS and Management**

**Storage**

**Network Efficiency**

**Improve Facility Efficiency**

**Facility Efficiency**

**Embrace Disruptive Servers**

**Adopt Tiered Storage**

**Drive Network Efficiency**

**Increase Facility Efficiency**

**Improve Operational Efficiency**
# CPU Comparison

<table>
<thead>
<tr>
<th>Year</th>
<th>Introduction</th>
<th>Intel® Chipset</th>
<th>Process Technology</th>
<th>Cores per Socket</th>
<th>Cache</th>
<th>Interconnect Speed</th>
<th>DIMMs</th>
<th>Memory Type</th>
<th>Memory Bandwidth</th>
<th>Maximum Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2005</td>
<td>2004-2005</td>
<td>E7520</td>
<td>90nm</td>
<td>1</td>
<td>1 MB or 2 MB</td>
<td>6.4 GB/s</td>
<td>Up to 8</td>
<td>DDR2-400 MHz</td>
<td>Up to 6.4 GB/s</td>
<td>16 GB</td>
</tr>
<tr>
<td>2006-2008</td>
<td>2006-2008</td>
<td>5400</td>
<td>65nm and 45nm</td>
<td>2 or 4</td>
<td>4 MB or 6 MB</td>
<td>21-25 GB/s</td>
<td>Up to 16</td>
<td>FB-DIMM/DDR2-667 MHz or FB-DIMM/DDR2-800 MHz</td>
<td>Up to 21-25 GB/s</td>
<td>64 GB or 128 GB</td>
</tr>
<tr>
<td>2009-2011</td>
<td>2009-2011</td>
<td>5520</td>
<td>45nm and 32nm</td>
<td>4 or 6</td>
<td>8 MB or 12 MB</td>
<td>25.6 GB/s per Intel® QuickPath Interconnect</td>
<td>Up to 18</td>
<td>DDR3-1333/1600 MHz or DDR3-1333/1600 MHz</td>
<td>Up to 51.2 GB/s</td>
<td>144 GB or 288 GB</td>
</tr>
<tr>
<td>2012</td>
<td>2012</td>
<td>C600</td>
<td>32nm</td>
<td>8</td>
<td>20 MB shared</td>
<td>32 GB/s per Intel® QuickPath Interconnect</td>
<td>Up to 24</td>
<td>DDR4-2400 MHz</td>
<td>Up to 128/140 GB/s</td>
<td>Up to 128/140 GB</td>
</tr>
<tr>
<td>2013</td>
<td>2013</td>
<td>C610</td>
<td>22nm</td>
<td>10</td>
<td>30 MB shared</td>
<td>38.4 GB/s per Intel® QuickPath Interconnect</td>
<td></td>
<td>DDR4-2666/2933 MHz</td>
<td>Up to 768 GB/s</td>
<td>1536 GB</td>
</tr>
<tr>
<td>2014</td>
<td>2014</td>
<td>C620</td>
<td>14nm</td>
<td>14</td>
<td>45 MB shared</td>
<td>41.6 GB/s per Intel® UltraPath Interconnect</td>
<td></td>
<td>DDR4-2666/2933 MHz</td>
<td>Up to 3072 GB/s</td>
<td>3072 GB</td>
</tr>
<tr>
<td>2016</td>
<td>2016</td>
<td></td>
<td></td>
<td>22</td>
<td>55 MB shared</td>
<td></td>
<td></td>
<td>DDR4-2666/2933 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017-2019</td>
<td>2017-2019</td>
<td></td>
<td></td>
<td>28</td>
<td>38.5 MB shared</td>
<td></td>
<td></td>
<td>DDR4-2666/2933 MHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Data provided only for 1 MB cache. * 128 GB support with Intel® 5400 Chipset introduced in 2007. * 144 GB assumes 18 memory slots populated with 8-GB DIMMs, and validated only with Intel® Xeon® processor 5500 series. * 3072 GB assumes 24 memory slots populated with 128-GB DIMMs.
Server Refresh Cadence Evaluation

- Refresh ratios vary based on server usage and performance.

- Key cost factors:
  - Server costs and warranties
  - Data center construction
  - Power efficiencies
  - Reduced network switch costs
  - Tax impacts

  **Additional considerations:**
  - Energy/tax rebate programs
  - Green IT
  - Productivity impacts

Internal cost evaluation is the primary driver in determining optimal refresh cadence:

4-Year Cadence at enterprise level
Disaggregated Server Innovation & Value

- CPU + DRAM
- NIC + Drives
- Network Switch
- Fans
- Power Supply

- CPU + DRAM
- NIC + Drives
- Network Switch
- Fans
- Power Supply

- CPU + DRAM
- NIC + Drives
- Chassis Manager
- Battery Pack
- Fans
- Power Supply

- CPU + DRAM
- NIC + Drives
- Battery Pack
- Fans
- Power Supply

Acquisition Cost 100%

Upgrade Cost 83%
Savings 17%
Savings 44%
Upgrade Cost 56%

77% percent savings in technician time
82% savings in shipping/materials
Refresh Savings Example

3U Chassis with 14 Blades

Our disaggregated server architecture has the potential to dramatically change how data centers around the world perform server refreshes.
Effective 10 GbE Port Utilization

PORT UTILIZATION

40% 45% 51% 60% 61% 62% 68% 71% 70% 70%

1.75x UTILIZATION

PORT UTILIZATION
2010-2019
Design: Compute and Storage Demand

Despite continuing growth in compute and storage demand, our Design data centers are using powerful Intel® technology to meet demand.

![Diagram](image-url)

- **Average Annual Growth of Compute Demand Over the Last 10 Years**
- **Average Annual Growth of Raw Storage Demand Over the Last 10 Years**

### Key Points:
- **2013**
  - High-Density racks are introduced allowing 140–180 servers per rack.
- **2016**
  - Disaggregated servers are introduced allowing 280 servers per rack.

---

**Design Servers (1k) | EDA-MIPS (10K) | Cores (10K) | Raw Storage (PB)**
Office and Enterprise: Compute and Storage Demand

A high rate of virtualization combined with Intel® architecture has enabled us to meet growing Office and Enterprise compute and storage demand while significantly decreasing the number of required virtualization host servers.
Design: Register Transfer Logic Performance with NUMA-Booster

System with 2x Intel® Xeon® processor X5570, 72 GB DDR3-1333 RAM, 1x 900 GB 10K RPM SAS hard drive, with Linux 2.6 OS, running Intel silicon design simulation workload.
System with 2x Intel® Xeon® processor X5675, 96 GB DDR3-1333 RAM, 1x 900 GB 10K RPM SAS hard drive, with Linux 2.6 OS, running Intel silicon design simulation workload.
System with 2x Intel® Xeon® processor E5-2670, 128 GB DDR3-1333 RAM, 1x 900 GB 10K RPM SAS hard drive, with Linux 2.6 OS, running Intel silicon design simulation workload.
System with 2x Intel® Xeon® processor E5-2680 v2, 256 GB DDR3-1600 RAM, 1x 900 GB 10K RPM SAS hard drive, with Linux 2.6 OS, running Intel silicon design simulation workload.
System with 2x Intel® Xeon® processor E5-2680 v3, 256 GB DDR4-2133 RAM, 1x 900 GB 10K RPM SAS hard drive, with Linux 3.0 OS, running Intel silicon design simulation workload.
System with 2x Intel® Xeon® processor E5-2680 v4, 256 GB DDR4-2400 RAM, 1x 1.2 TB 10K RPM SAS hard drive, with Linux 3.0 OS, running Intel silicon design simulation workload.
System with 2x Intel® Xeon® Gold 6150 processor, 768 GB DDR4-2666 RAM, 2x 1.2TB 10K RPM SAS hard drive, with Linux 3.0 OS, running Intel silicon design simulation workload.
System with 2x Intel® Xeon® Gold 6240 processor, 768 GB DDR4-2933 RAM, 2x 1.2TB 10K RPM SAS hard drive, with Linux 3.0 OS, running Intel silicon design simulation workload.
Intel® DCM

**REAL-TIME**
**POWER, THERMAL, HEALTH**
Monitoring & analytics

**IMPROVES UPTIME**
By health monitoring & prediction

**CROSS-PLATFORM**
**SUPPORT**
Easy to integrate or install

**AGGREGATED DATA**
To physical groups (e.g. room/row/rack) & logical groups

**BETTER DATA CENTER**
Capacity planning

**INCREASED EFFICIENCY**
By identifying under utilized devices
Summary

- Data Center Transformation Strategy
- Hardware Refresh On Time
- Effective Resource Utilization
- Adopting Software Capabilities
Learn More

By applying breakthrough technologies, solutions, and processes, we have optimally served the acceleration of Intel’s business.

Read our paper “IT@Intel: Data Center Strategy Leading Intel’s Business Transformation” for additional details.
IT@Intel: Sharing Intel IT Best Practices with the World

Learn more about Intel IT’s initiatives at: www.intel.com/IT →