Intel Corporation’s High Density Data Center
An Operational Review

Paul Vaccaro / Intel – Data Center Architect
David Seger / IDC Architects – Principal Mechanical Technologist
Legal Notices

This presentation is for informational purposes only. INTEL MAKE NO WARRANTIES, EXPRESS OR IMPLIED, IN THIS SUMMARY.

Intel and the Intel logo 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 © 2013, Intel Corporation. All rights reserved.
JFS1 High Density Data Center
HPC for Silicon Design

Global Design Computing Environment

- User System
- CCC Systems
- Interactive & Batch Compute Cycles
- Interactive Compute Servers
- Large Memory Compute Servers
- Infrastructure Servers
- Storage & Backup

Large Site Datacenter (Hub)

- Batch cycles from Hub
- Latency/Bandwidth

Medium Site Datacenter

- User System
- CCC Systems
- Interactive
- Interactive Compute Servers
- Large Memory Compute Servers (Interactive)
- Infrastructure Servers
- Storage & Backup

Small Site Closet

- User System
- CCC Systems
- Interactive
- Interactive Compute Servers
- Infrastructure Servers
- Storage (Backup)

- Batch cycles from Hub
- Latency/Bandwidth
HPC for Silicon Design

<table>
<thead>
<tr>
<th>Growth of Design</th>
<th>2006</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDA-MIPS</td>
<td>75,392</td>
<td>533,554</td>
</tr>
<tr>
<td>Linux Compute Servers</td>
<td>62,137</td>
<td>38,927</td>
</tr>
<tr>
<td>Number of Cores</td>
<td>132,282</td>
<td>451,990</td>
</tr>
<tr>
<td>Compute Batch</td>
<td>~58%</td>
<td>~86%</td>
</tr>
</tbody>
</table>

This is growth specific to Intel silicon design engineering environment and does not include overall corporate IT demand.

Intel Design Computing Capacity

Silicon Design Compute and Storage Demand vs. Utilization

- Compute Servers (K)
- EDA MPS (10K)
- Storage (PB)
Data Center Compute Dashboard
Site and Facility Configuration
Chilled Water Plant
Waterside Economizer
Chilled Water Plant Economization

Outside Air Wetbulb (Deg F)

- Mechanical Cooling: 6,415,500 Ton-Hours
- Economizer Cooling: 14,608,500 Ton-Hours
Data Center Modules
Recirculation Air Handlers
Cooling Coils & Filtration
Electrical Distribution
Air Pathway to IT space
Hot Aisle Isolation

Cold Aisle

Hot Aisle
Non-Isolated Low Power IT
Airflow Model – White Space

Network Racks
Airflow Model – Utility Level
Temperature & Pressure Control Zones

**Cold Aisle**

**Average Temperatures**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Temp</th>
<th>STPT</th>
<th>Cooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td>67.90 F</td>
<td>72.00 F</td>
<td>15 %</td>
</tr>
<tr>
<td>Zone 2</td>
<td>72.17 F</td>
<td>72.00 F</td>
<td>33 %</td>
</tr>
<tr>
<td>Zone 3</td>
<td>71.18 F</td>
<td>72.00 F</td>
<td>15 %</td>
</tr>
<tr>
<td>Zone 4</td>
<td>72.05 F</td>
<td>72.00 F</td>
<td>19 %</td>
</tr>
<tr>
<td>Zone 5</td>
<td>72.42 F</td>
<td>72.00 F</td>
<td>24 %</td>
</tr>
<tr>
<td>Zone 6</td>
<td>71.82 F</td>
<td>72.00 F</td>
<td>16 %</td>
</tr>
</tbody>
</table>

**Zone Pressure Control**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Press IWC</th>
<th>STPT IWC</th>
<th>SPD STPT LOOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>0.063</td>
<td>0.071</td>
<td>46 %</td>
</tr>
<tr>
<td>C</td>
<td>0.063</td>
<td>0.071</td>
<td>42 %</td>
</tr>
<tr>
<td>S</td>
<td>0.684</td>
<td>0.672</td>
<td>33 %</td>
</tr>
</tbody>
</table>
Cascading Energy Efficiency

- Hot aisle containment
- Increased supply air temperature
- High temperature chilled water system
- Variable speed infrastructure fans
- Infrastructure fan output tracks IT airflow demand
- Water side economizer
- Variable speed chilled water pumps
- Variable speed cooling tower fans
- Adiabatic humidification
### Energy Efficiency - PUE

#### Operational PUE Range *
- 1.35 without economizer
- 1.21 With 100% Free Cooling
  
* Calculated

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Load</td>
<td>6,217 kW</td>
</tr>
<tr>
<td>IT Load</td>
<td>5,114 kW</td>
</tr>
<tr>
<td>Facility Load</td>
<td>1,103 kW</td>
</tr>
</tbody>
</table>

#### Current PUE *
- Current PUE: 1.22
- Current DCIE: 0.812

* Calculated

Source: US Energy Information Administration, [http://www.eia.gov/consumption/commercial/census-maps.cfm](http://www.eia.gov/consumption/commercial/census-maps.cfm)

* April 12, 2013
JFS1 Power Demand Forecast

Customer Load Projections
75% of Customer Projections
50% of Customer Projections
PGE Demand Requirements
Actual Load Peak values TOTAL
Thank You