Intel Solutions for Networking, Storage, and Solid State Drives:

**Good Ingredients Matter**

HP Discover, Dec 11th
Andreas Schneider—Intel
Shaun Rasmussen—Intel
The World Has Changed...

**Information Growth**

In 2014 data will grow 48% to a total of 3.7 ZETTABYTES (90% unstructured)

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**OpEX & CapEX**

Potential IT spend of ~$2T on IT deployment & operations thru 2015 without a more simplified infrastructure

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**Security**

Latest report “… about 46 million people in the US notified of data breach in 2012”

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**Urgency to Act**

IT companies “…will face ‘crossroads ‘ moments in 2012”

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Has the way you store & manage information changed?

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* Other names and brands may be claimed as the property of others.
Infrastructure Needs by Segment

Pressing need for Flexible, Responsive and Efficient Infrastructure

Enterprise
- Cloud Service Providers
  - Scale and maintain SLAs in face of shifting customer demands while optimizing cost of service delivery

Technical Computing
- Plan ahead for maximum scale while driving most efficient performance for applications

Telco
- Reduce network cost of operation and enable business innovation to drive incremental revenue
Intel: Balanced Solutions Designed to Scale
Available from the largest ecosystem of hardware and software vendors

**#1 Servers**
- Intel® Xeon® Processor
  - E3 product family
  - E5 product family
  - E7 product family

**#1 Networks**
- Intel® Ethernet Controllers
- Converged Network Adapters
- Switch Solutions
- Intel® True Scale Fabric
- Open Network Platforms

**#1 Storage**
- Intel® Xeon® based Intelligent Enterprise Storage
- Scale-out Storage
- Scale-up Storage
- Intel® SSDs
  - Intel® SSD 910 series
  - Intel® SSD S3700 series
  - Intel® SSD 710 series

**#1 Software**
- IA has the largest installed base across generations and applications
- Intel® Cache Acceleration Software

Sources:
- Servers: IDC's Quarterly Worldwide Server Tracker (Q4'12)
- Networking adapter market: Dell'Oro Group Market Research. Quarterly Ethernet Report Q3'12
- Intelligent Storage: IDC Worldwide Quarterly Disk Storage System Tracker 2012 Q4 and Intel estimate
- Software: devices (PCs, laptops, etc.): IDC's Quarterly Worldwide PC, server, other trackers and estimated installed base

Storage, Networking, and Solid State Drives: Good Ingredients Matter
Hadoop TeraSort 1 TB Sort
Shown to improve 1 TB sort from 4 hours to 7 minutes

<table>
<thead>
<tr>
<th>Processing Time:</th>
<th>Upgrade to Intel® Xeon® Processor E5-2690 processor</th>
<th>Upgrade to Intel® SSD 520 Series</th>
<th>Upgrade to Intel® 10GbE Adapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 4 hours</td>
<td>~ 50% reduction</td>
<td>~ 80% reduction</td>
<td>~ 50% reduction</td>
</tr>
<tr>
<td>Intel® Xeon® Processor 5690</td>
<td>7200 HDD</td>
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<tr>
<td>1GbE</td>
<td></td>
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</table>

Processing Time: ~ 7 minutes

~ 40% reduction

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: Intel internal measurements as of 26 February 2013 using Intel Distribution for Apache Hadoop * Software 2.1.1, Xeon E5-5600, Xeon E5-260 with 3 HDD and 4 SSD drives. Please reference slide speaker notes for configuration details. For more information go to http://www.intel.com/performance

*Other brands and names are the property of their respective owners.
Intel® Ethernet® Products
Intel® Xeon® processor E5-2600 with Intel® Ethernet Products

Powerful.
Intelligent.

Intel® Xeon® processor E5-2600 with Intel® Ethernet Products

I/O Virtualization

Platform Optimization

Unified Networking

Intel® VT-d
Flexible Port Partitioning
Hypervisor Port Partitioning

Intel® Integrated I/O

Intel® Direct Data I/O Technology

Intelligent Offloads
Storage (FCoE, iSCSI)
Networking Virtualization

30 years of delivering leading Ethernet products

Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM). Functionality, performance or other benefits will vary depending on hardware and software configurations. Software applications may not be compatible with all operating systems. Consult your PC manufacturer. For more information, visit http://www.intel.com/go/virtualization

Intel® Virtualization Technologies for Connectivity (Intel® VT-c); Intel® Virtualization Technology (Intel® VT) for Directed I/O (Intel® VT-d); Virtual Machine Device Queues (VMDQ)
30 years of delivering leading Ethernet products

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Intel® Virtualization Technologies for Connectivity (Intel® VT-c); Intel® Virtualization Technology (Intel® VT) for Directed I/O (Intel® VT-d); Virtual Machine Device Queues (VMDQ)
Intel driving standards (SR-IOV)

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Intel® Virtualization Technologies for Connectivity (Intel® VT-c); Intel® Virtualization Technology (Intel® VT) for Directed I/O (Intel® VT-d); Virtual Machine Device Queues (VMDQ)
Upgrade the Data Center Network Architecture to 10 Gigabit Ethernet

Reduce Costly Network Complexity
- Respond faster to business needs
- Accommodate current growth
- Meet increasing network demand

Intel® Ethernet Converged Networking Adapters
HP Networking FlexibleLOM Adapters

Reduced network cost in our virtualized environment by 18 to 25 percent.

1GB and 10 GB Solutions Available, Compatible with a broad range of Gen 8 Servers

1. For more information, refer to “Upgrading Data Center Network Architecture to 10 Gigabit Ethernet.”
Intel® Xeon®
Processors Powering
HP Storage Solutions
Virtualized servers are storage challenges

**Challenge:**
Don’t lose your virtualization savings on storage
- Fragmented and underutilized storage resources
- Inflexible storage architectures

**Solution:**
A highly flexible storage infrastructure
- Standards-based storage hardware delivering unparalleled flexibility and investment protection
- Intelligent storage supporting automated operations

Reap the benefits
- Better capacity utilization
- Improved availability
- Maximized performance
- Lower IT costs
- Improved efficiency
MORE EFFICIENT STORAGE
HIGH PERFORMING INTEL® XEON®
PROCESSOR

De-duplication

before
de-duplication
after

95% smaller backup*

Real Time Compression

Up to 80% data reduction**

Intelligent Tiering

Up to 80% reduction in disk expenses***

Thin Provisioning

Traditional Allocation

Thin Provisioning

Up to 25% reduction in annual storage CapEx growth****

*: IBM storage simulcast, November 9, 2011
**: IBM storage simulcast, November 9, 2011
***: Dell “Fluid Data Storage: Driving Flexibility in the Data Center”, February 2011
****: Intel IT study “Solving Intel IT’s Data Storage Growth Challenges”
SDI Driving Architectural Transformation

From This...
- Firewall
- VPN
- Intrusion Detection System
- Storage

Proprietary OS & SW
- ASIC, DSP, FPGA, ASSP
- Xeon® CPU

To This...
- VM: Firewall
- VM: VPN
- VM: Intrusion Detection System
- VM: Storage

- Intel Ethernet NIC
- Intel Chipset Acceleration
- Intel Switch Silicon
- Linux
Common Tier 1 Data Services
From Midrange, High End and Flash.

Powered by:

**CALL TO ACTION**
Customers Need Storage AND Backup Solutions
Huge Opportunity Sell 3PAR StorServ Stack With StoreOnce Product Line
Intel® Solid State Drives for the Enterprise
IT Challenges

Performance

40%
Data Growth per Year

Cost and Reliability

35%
Cost of Operating Revenue Due to Poor Data Management

Space

40.8%
Average Storage Utilization
What Are We Going To Talk About Today?

- IT Challenges In Cloud and Big Data
- How SSDs Address These Challenge
- Intel Datacenter SSD – S3500, S3700
Big Data Storage Access - HDD

Import → Processing → Export

Mapper → Mapper → Mapper → Mapper → Mapper

Shuffle / Sort / Reduce

Temp → Storage
Cloud Storage Access - HDD
Legacy System vs. SSD Comparison

400x IOPS
100x Latency
MS Latency

200 IOPS

75K IOPS
US Latency
Typical Data Center Hardware

- HD to support 500 VMs
- Storage Cost ($) 145K
- Rackspace (U) 42
- Storage Power (kW) 7.5
- Storage Cooling Power (kW) 9.4

Cloud Solution with HDDs

1 From 42u to 2u rackspace. Performance based on VM latency per equal number of VMs supported.
2 Capital cost of server and SSDs only divided by number of active users. Additional savings of rack space, power and cooling not included.
<table>
<thead>
<tr>
<th></th>
<th>Cloud Solution with HDDs</th>
<th>Cloud Solution with Intel® SSDs</th>
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<tbody>
<tr>
<td>VMs Supported</td>
<td>500</td>
<td>500</td>
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<tr>
<td>Storage Cost ($)</td>
<td>~$145K</td>
<td>~$12K</td>
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<tr>
<td>Storage Rackspace (U)</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>Storage Power (kW)</td>
<td>7.5</td>
<td>0.06</td>
</tr>
<tr>
<td>Storage Cooling Power (kW)</td>
<td>9.4</td>
<td>0.075</td>
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</table>

*Integrating McAfee ePolicy Orchestrator (ePO) with Intel TXT requires custom integration work.*
Broad Portfolio of Intel® Datacenter SSD Products

PCle Workload Accelerator

- Intel 910 Series

Enterprise Performance

- Intel DC S3700 Series

Enterprise Mainstream

- Intel DC S3500 Series
Intel’s 3rd Generation SSD for the Data Center is Here!

Gen 1
- X25-E
- X25-M
- Fast Random IOPS

Gen 2
- 710 Series
- 320 Series
- Faster Random IOPS
- High-Endurance Technology

Gen 3
- S3700 Series
- S3500 Series
- Fast & Consistent Performance
- High-Endurance Technology
- Stress-Free Protection

Nov ‘12

“Marks the beginning of the third era in SSD evolution”
Consistently Amazing Performance of the Intel® Solid State Drive DC Family

Competitor SSD: 4K Random Write Workload

DC S3500: 4K Random Write Workload

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1 As measured by Intel: Micron C400 measured 4K Random Writes QD=1

2 Configuration: Intel DH67CFB3, CPU i5 Sandy Bridge i5-2400S LGA1155 2.5GHz 6MB 4 cores CM8062300835404; Heatsink: HS-DHA-B LGA1156 73W Intel E81997-002 and E97379-001; 2GB 1333 Unbuf non-ECC DDR3; 250GB HDD 7200RPM Seagate ST9250410AS; Black Sentey 2421 SATA Combo 24 in. Orange EndPCNoise Sata fp7lp4
Adoption Growing Great Technology...

Source: Gartner June 2012
Non Volatile Memory
Changing The Game In Datacenter Storage

90% Lower Power Consumption

4x More IOPS vs. HDD

Ideal for Accelerating Throughput-bound Applications

Source: SNIA, 2011
Summary and Call to Action
Thank You
Storage, Networking, and Solid State Drives: Good Ingredients Matter

**Converged Storage Solutions**

3PAR Utility Storage Products
Dynamically tiered storage arrays built for public and private cloud computing and the delivery of enterprise IT as a utility service

- StoreServ 10400 E5140
- StoreServ 10800 E5345
- StoreServ 7400/7200 → E5-2428Lh

**Traditional Storage Solutions**

HP Storage
XP P9500 – High End Disk Array
Mission Critical data storage
Harpertown - E5440

**StoreVirtual**

HP Storage P4000 G2 SAN Solutions
(LeftHand)
Enterprise, scale-out SAN managed with BladeSystem infrastructure
HP ProLiant BL460

**HP StorageWorks P4000 G2 Unified NAS Gateway**
IP-based gateway services for P4000 SAN Solutions
- DL320 G6 → E5503
- BL460 G6 → E5520
- BL460 G7 → E5620
- DL180 G6 → E5520

**HP Storage X1000/3000 G2 Network Storage Systems**
SAN gateway solutions that are highly available & clusterable w/ ext. block-based storage solutions – massive scalesout storage Windows Storage Server R2 Ent.

**StoreOnce**

HP Storage D2D Backup Systems
StoreOnce deduplication provides disk-based data protection
- DL370 → E5-5620
- DL370 → E5-5660
- DL180 → X5690/5680

**StoreAll**

HP Storage X9000 Network Storage Systems (Ibrix & Polyserve)
Scales affordably, seamlessly and with zero downtime
- DL380 G6 → E5520
- DL380 G7 → E5620

**HP Storage X5000 G2 NAS Appliance**
Ideal for midsize companies - helps control and file and data growth cost effectively - Massive Scaleout storage Windows Storage Server R2 Ent. HP BladeSystem → E5620

**HP Storage - EVA 6400/8400 Midrange / Ent. SAN Solutions**
Power PC

**Are these in your data center?**

HP Storage G3 P2000 MSA - Entry
Excellent price/performance arrays for entry-level customers
G3 Tolapai – Entry

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Storage, Networking, and Solid State Drives: Good Ingredients Matter
Overview

A dual port 10Gb Ethernet FlexibleLOM mezzanine adapter for select HP ProLiant Blade System c-Class Gen8 servers based on the Intel® 82599 10 Gigabit Ethernet controller

Ideal for...

Enterprise and midrange customers seeking to simplify data center network infrastructure by consolidating multiple 1Gb ports to 10Gb ports.

Key benefits

• Dual port 10GbE FlexibleLOM for HP BladeSystem Gen8 servers offers virtualization and scalability
• Support for latest virtualization features include enhanced Virtualization features for VMware NetQueue and Microsoft VMQ using VMDq and SR-IOV to achieve the highest I/O throughput at the lowest TCO
• The 560FLB ships with advanced server features including support for failover and load balancing, TCP/IP checksum offloading, large send offloading, Wake-on-LAN, PXE, jumbo frames, VLAN tagging, and EFI/uEFI
• New I/O technologies with Intel® Integrated I/O and Intel® Data Direct I/O technology to reduce system power, increase I/O performance, and reduce I/O latency
**Intel® Ethernet with Flexible Port Partitioning**

Effectively Partitions and Controls 10 Gigabit Ethernet ports

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**Technology**

10Gb Port with FPP
- Single 10Gb Port seen as Multiple 10Gb Ports in OS

Flexible Port Partitioning enabled by Industry Specification

**Industry Support**

Virtual and non-virtual server support with SR-IOV and Intel® VT-d

**Unified Networking**

Balanced bandwidth allocation and improved I/O scalability across multiple usage models

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**Additional Resources**

- http://twitter.com/#!/IntelEthernet-- Intel Ethernet Group
- http://twitter.com/#!/thehevy -- Brian Johnson

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Virtual Functions (VFs): ‘Lightweight’ PCIe functions that contain the resources necessary for data movement but have a carefully minimized set of configuration resources.

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**Intel® Ethernet Controllers**

- **1Gb Ethernet – 8 VFs per Port**
  - Intel® 82576EB Gigabit Ethernet Controllers
  - Intel® Ethernet Controller I350

- **10Gb Ethernet – 64 VFs per Port**
  - Intel® 82599 10 Gigabit Ethernet Controllers
  - Intel® Ethernet Controller X540

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Storage, Networking, and Solid State Drives: Good Ingredients Matter
## Apache Hadoop Performance Test Configuration - 4 Hours to 7 Minutes

<table>
<thead>
<tr>
<th>Cluster Configuration</th>
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<th>Cluster Configuration</th>
<th>Cluster Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1 Head Node (name node, job tracker)</td>
<td>• Intel Distribution for Apache Hadoop 2.1.1</td>
<td>• 1 x Dell r710 1U servers</td>
<td>• 10 x Dell r720 2U servers</td>
</tr>
<tr>
<td>• 10 Workers (data nodes, task trackers)</td>
<td>• Apache Hadoop 1.0.3</td>
<td>– Intel: 2x3.47GHz Intel® Xeon® processor X5690</td>
<td>– Intel: 2 x 2.90Ghz Intel® Xeon® processor E5-2690</td>
</tr>
<tr>
<td>• 10-Gigabit Switch: Cisco Nexus 5020</td>
<td>• RHEL 6.3</td>
<td>– Memory: 48G RAM</td>
<td>– Memory: 128G RAM</td>
</tr>
<tr>
<td></td>
<td>• Oracle Java 1.7.0_05</td>
<td>– Storage: 10K SAS HDD</td>
<td>– Storage: 520 Series SSDs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Intel® Ethernet 10 Gigabit SFP+</td>
<td>– Intel® Ethernet 10 Gigabit SFP+</td>
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<tr>
<td></td>
<td></td>
<td>– Intel® Ethernet 1 Gigabit</td>
<td>– Intel® Ethernet 1 Gigabit</td>
</tr>
</tbody>
</table>

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. **Note:** The below disclaimer should be included whenever the general performance disclaimer is used, but should be numbered separately: Configurations: [describe config + what test used + who did testing]. For more information go to [http://www.intel.com/performance](http://www.intel.com/performance)
<table>
<thead>
<tr>
<th>Part Number</th>
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<th>Availability</th>
<th>Speed</th>
<th>Ports, Media</th>
<th>Form Factor</th>
<th>Technology</th>
<th>Controller</th>
<th>MSRP</th>
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<td>615729-B21</td>
<td>HP NC366M Quad Port Gigabit BL-c Adapter</td>
<td>June 2013</td>
<td>1GbE</td>
<td>Quad Port, KX</td>
<td>Mezzanine Card</td>
<td>VMDq Support², VMDq Support², PCI-SIG SR-IOV Capable¹ Max port density ProLiant and Integrity support Support on Virtual Connect, switch, and pass-through models</td>
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<td>Mezzanine Card</td>
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<td>Intel® Ethernet Controller X520</td>
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<td>655639-B21</td>
<td>HP 36FLB Dual Port 10 Gigabit FlexLOM for BladeSystems</td>
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<td>10GbE/1GbE</td>
<td>Dual Port, 1000BASE-T</td>
<td>Flex-LOM Blades</td>
<td>Support on Gen8 BladeSystem Advanced I/O Virtualization VMDq Support², PCI-SIG SR-IOV Capable¹ with DDIO Optimization⁴ Supported on Virtual Connect, switch, and pass-through models</td>
<td>Intel® Ethernet Controller X520</td>
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<td>HP 560FLB Quad Port Gigabit BL-c Adapter</td>
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<td>Dual Port, KX</td>
<td>Flex-LOM Blades</td>
<td>Intel® VMDq², Intel® DD/IO⁴, Intel® VT-c⁴ with Flexible Port Partitioning: Unified Networking⁵, Intel® DD/IO⁴</td>
<td>Intel® Ethernet Controller X520</td>
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<td>655497-B21</td>
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<td>Server Adapter</td>
<td>Intel® VMDq², Intel® DD/IO⁴</td>
<td>Intel® Ethernet Controller X520</td>
<td>$59</td>
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</table>

1. Intel® VT-c: Intel® Virtualization Technology for Converged I/O includes VMDq Support², PCI-SIG SR-IOV Support², PCI-SIG SR-IOV Capable¹, and Intel® DD/IO⁴.
2. VMDq: Virtual Machine Device Queues
3. Networking and Storage: Good Ingredients Matter
4. Intel® DD/IO is part of Intel® Advanced I/O, improving system bandwidth, power usage and latency.
5. EEE: Energy Efficient Ethernet is an Ethernet industry standard
### HP INTEL® ETHERNET NETWORKING SOLUTIONS

#### BLADE ADAPTERS

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Intel:</th>
<th>HP:</th>
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<tbody>
<tr>
<td>615729-B21</td>
<td>Vaca Key</td>
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<td>665246-B21</td>
<td>Duck Key</td>
<td>Izzy</td>
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<td>652500-B21</td>
<td>Badger Flat</td>
<td>Ivanhoe</td>
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<td>Racehorse Flat</td>
<td>Ingram</td>
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<td>665240-B21</td>
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#### BLADE ADAPTERS

<table>
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#### RACK ADAPTERS

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#### Notes

1. Intel® VT-c: Intel® Virtualization Technology for Connectivity includes VMDq and SR-IOV
2. VMDq: Virtual Machine Device Queues
3. Unified Networking includes iSCSI acceleration, iSCSI Remote Boot, and Fiber Channel over Ethernet
4. Intel® DDI/O is part of Intel® Integrated IO, improving system bandwidth, power usage and latency.
5. EEIE: Energy Efficient Ethernet is an Ethernet industry standard