Intel in the Data Center

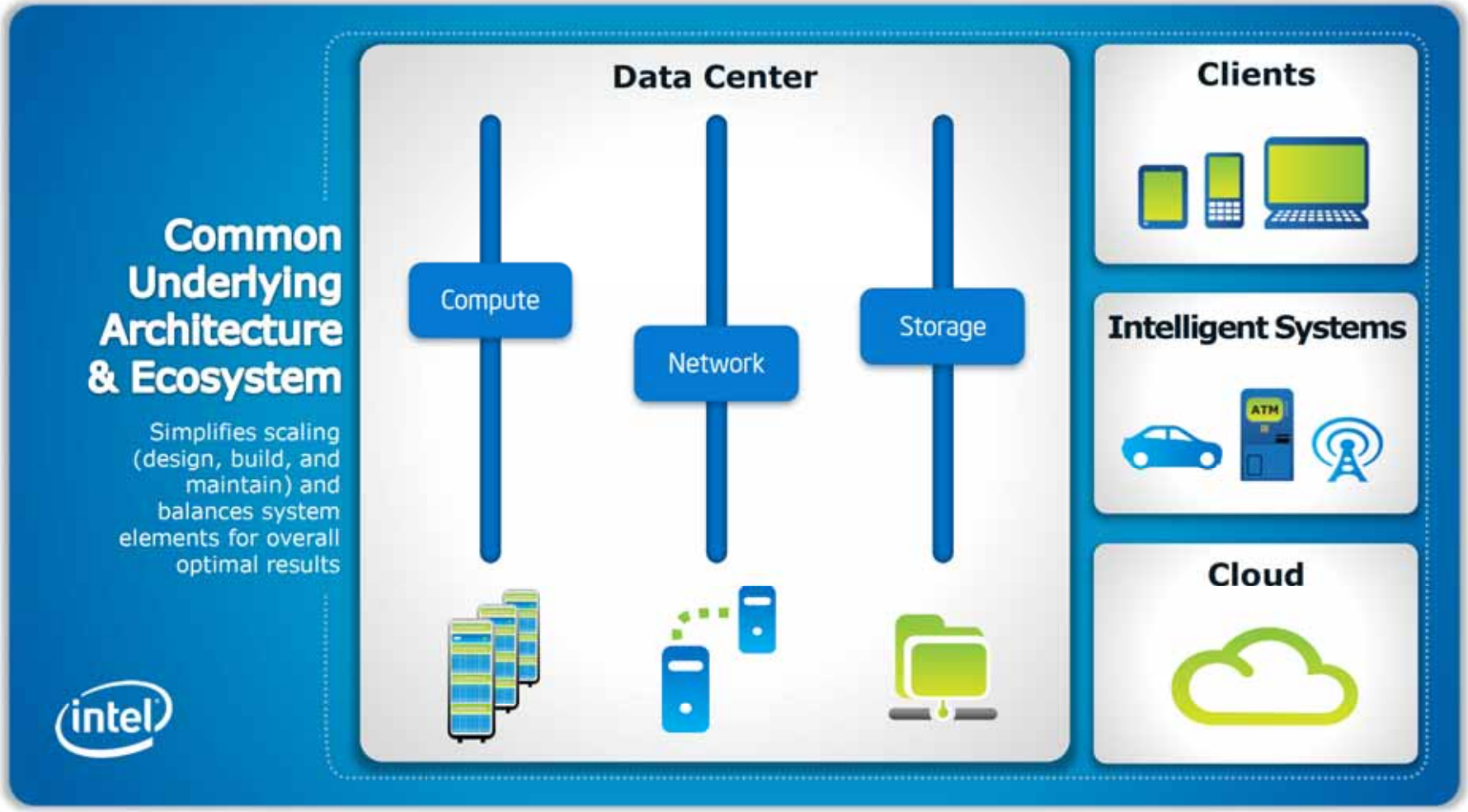
Helping Business Innovate

Rui Monteiro

ATEC Security Forum, Oct 9th 2013

Balance and Scale Required

Bigger data centers require ease of scale and balanced designs



Intel in the Data Center

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

INFINIBAND™

Open Network Platforms

#1 Storage

Intel® Xeon ® based Intelligent Enterprise Storage

Scale-out Storage | Scale-up Storage[1]

Intel® SSDs

- Intel® SSD 910 series
- Intel® SSD S3700 series
- Intel® SSD 710 series

Intel® Cache Acceleration Software

#1 Software

x86 installation base

IA has the largest installed base across generations and applications

McAfee

hadoop lustre

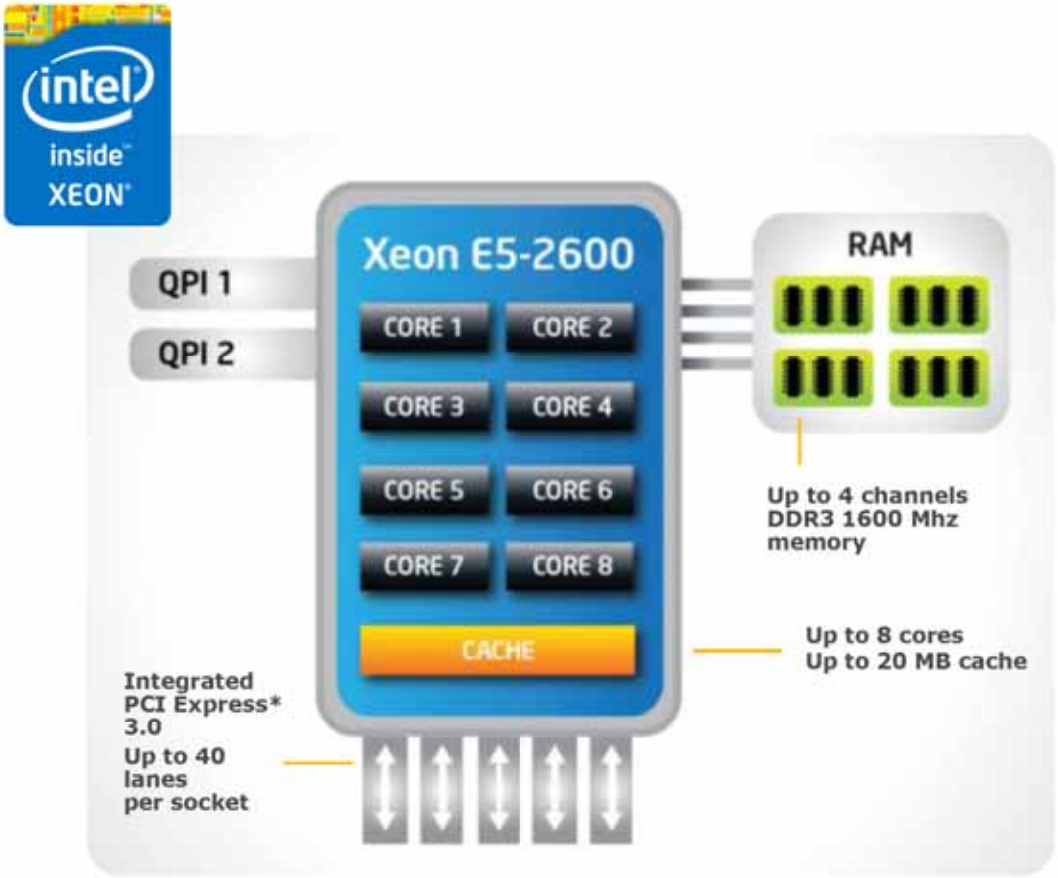
Intel® Data Center Manager

Sources: Server: 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

Intel in the Data Center

The Heart of a Next Generation Data Center

Intel® Xeon®: The data center's primary building block



Powerful

Efficient

Secure

up to **66% reduction in total cost of ownership**[1]

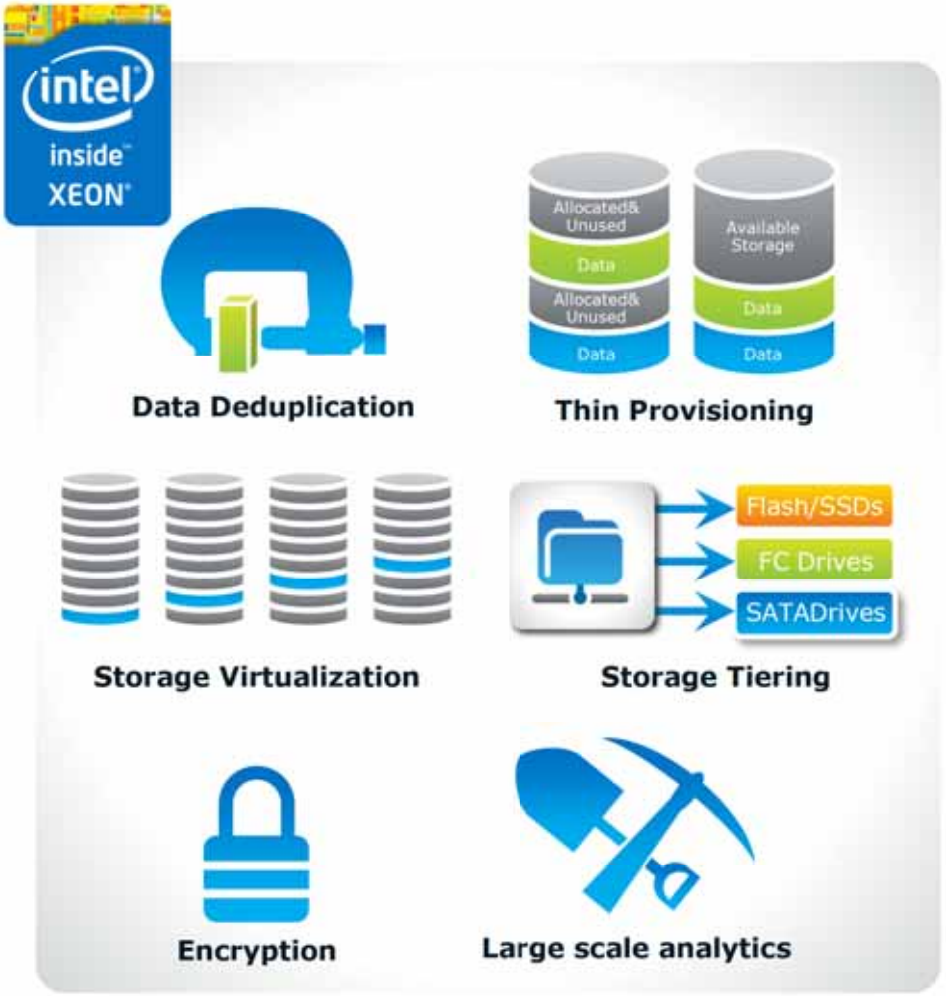
Est. your server refresh savings
www.intel.com/go/xeonestimator

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.

1. TCO reduction versus older generation Intel® processors. See slide speaker notes for details. Go to [illegible] to learn more.

Intelligent Scale-out Storage Simplifies and Saves

Intel® Xeon® powers today's compute intensive storage strategies[2]



Reduce storage footprint by up to 50% with storage refresh[1]

Reduce storage device capacity growth by 25% via thin provisioning[1]

Improve storage efficiency by up to 25% with data de-duplication[1]

Intel® High Performance SSDs[3]
Increased Performance
Data Center Endurance
New Safety Features
up to 2X TCO Savings[4]

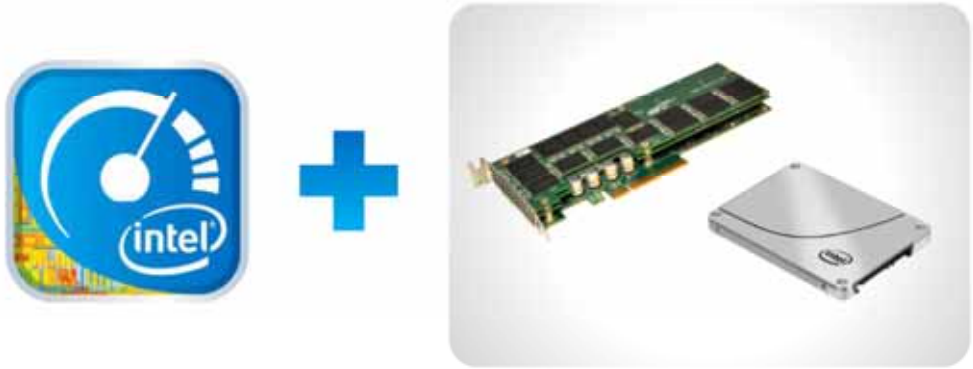
Estimate your SSD TCO savings
Intel(R) SSD TCO calculator

1. Sourced from IT@Intel Whitepaper "[illegible]". Published December 2011
2. Intel Xeon is the storage industry's processor of choice--Xeon MSS is 80% (2011); Source: : IDC Quarterly Storage Tracker Q4'11.
3. Intel enterprise SSDs. Intel® 710 series SSD--SATA; Intel® 910 series SSD--PCIe
4. SSD TCO generated from SNIA* (Storage Networking Industry Association). TCO model for Solid-State Storage. Calculations based on 4K random, 65/35 read writes. 3.5" SAS 15K HDD 48 drives, 73GB RAID 5. TCO model can be found at: [illegible].

Big Data – A Foundation For Delivering Big Value

Intel® CAS with Intel® SSD Solution

Added as cache layer accelerates Big Data workloads



50X IOPS

3X TPC-C

20X TPC-H

Performance near equal to replacing all hard drives with SSDs *at significantly lower cost*

http://www.intel.com/content/www/us/en/mission-critical/mission-critical-scalability-oracle-intel-brief.html

throughput performance

Intel in the Data Center

Simplify with Intel® 10GbE

The #1 selling Ethernet adapter[1]

Simplify[2]

10X 1GbE Server Connections → 2X 10GbE Server Connections

Up to	Up to	Up to	Up to
45% ↓	80% ↓	15% ↓	2x ↑
Reduction in Power per Rack	Reduction in Cables and Switch ports	Reduction in Infra-structure Costs	Improved Bandwidth per Server

Utilize Intel Advanced I/O Technologies: SR-IOV, VMDq, and Intelligent Data Path offload architecture

Unify

Unify your storage and data networks

>50% of IT shops have >2 storage networks[4]
27% have over five[4]

Fibre Channel Over Ethernet

Up to 20% ↓

Lower Total Infrastructure costs[3]

Better Together

Intel® Xeon® E5 2600 brings up to **3X more I/O bandwidth** vs. prior gen.[5]

Intel® Ethernet X540 Server 10GbE Adapter

Unleash the full I/O capabilities of Xeon® E5 with Intel® 10GbE

Intel® Xeon® E5 2600 Integrated I/O and Intel Data Direct I/O

Estimate your Intel® 10GbE ROI

Intel(R) 10GbE ROI calculator

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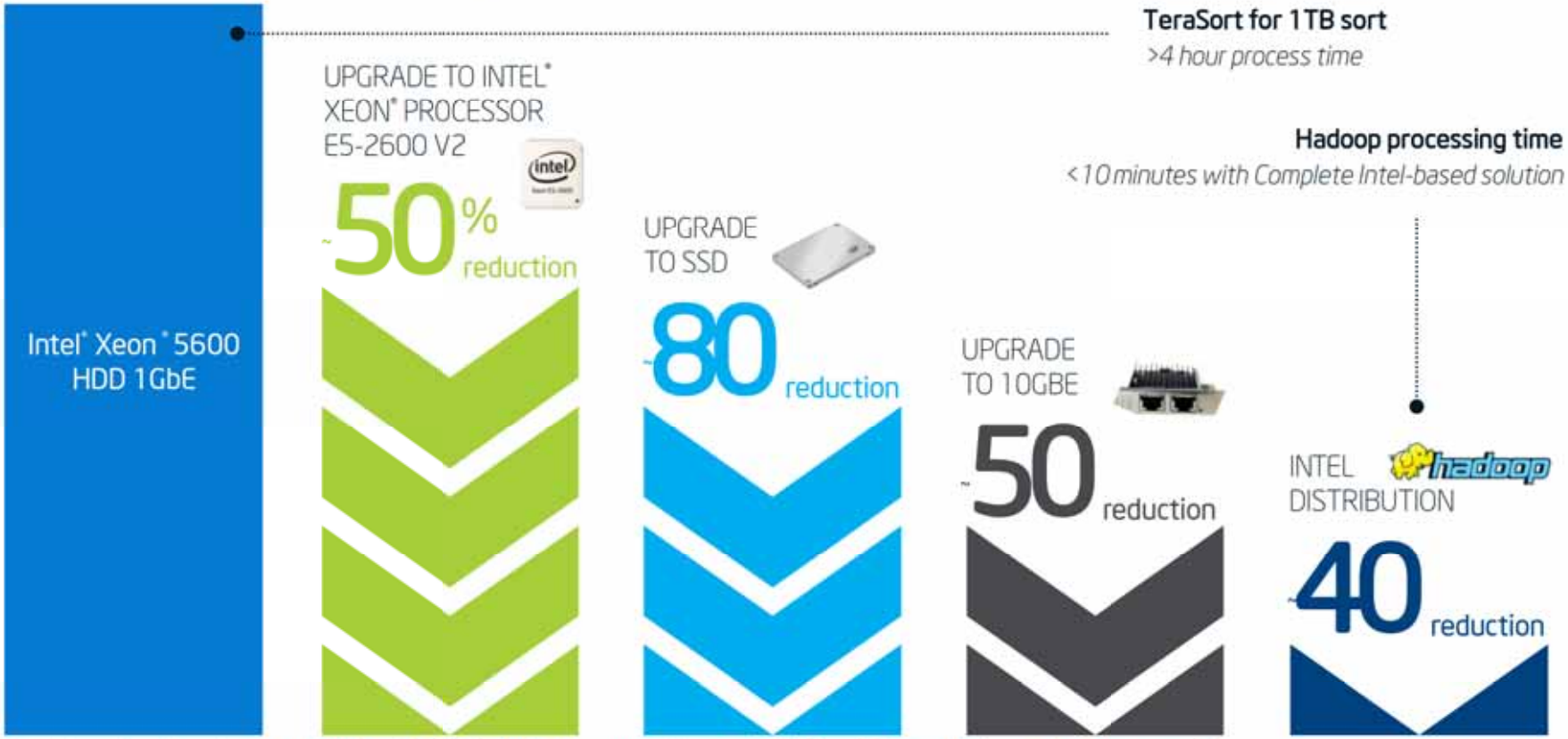
1. Intel® 82599 10 Gigabit Controller and Intel® Ethernet X520 Server Adapter; Intel® 10GbE Adapter: #1 MSS per Dell'Oro Group Q3'12 Ethernet Report
2. Intel 10GbE ROI Calculator. See back up foil "IT Savings with Unified Network" for more details.
3. Intel IT Proof of Concept with 10GbE and FCoE. See back up foil "IT Savings with Unified Network" for more details.
4. Storage Magazine Survey published Dec 11
5. Max. I/O R/W bandwidth Intel® Xeon® E5-2680 vs. Intel® Xeon® X5670. See backup slide *"Xeon® Processor Performance Leadership Claims"* for details

Putting It All Together: Big Data Example

Get big answers with a balanced system

Nearly 50x increase in your ability to discover insights



http://www.intel.com/content/dam/www/public/us/en/documents/white-papers/10gbe-10gbase-t-hadoop-clusters-paper.pdf

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Source: Intel internal measurement using a standard Hadoop benchmark, TeraSort, on a cluster of 10 top bin Xeon 5600 based servers sort 1TB of data Westmere 3HDD + 1GbE = 250 minutes; Romley 3HDD +1GbE = 125 Minutes; Romley 4SSD + 1GbE = 23 minutes; Romley 4SSD + 10GbE = 12 minutes; Romley 4SSD + 10GbE + Intel Hadoop Distribution = 7 minutes

Intel in the Data Center

Enterprise Data Center Modernization

Balance and scale considerations for today and tomorrow

		2013	
Server Performance & efficiency optimized	Intel® Xeon® processor E3 platforms Intel® Xeon® processor E5 platforms Intel® Xeon® processor E7 platforms Intel® Atom™(Server class) Intel® Xeon® Phi™	Increasing application performance, reliability, scale, serviceability	
Storage Scalable converged storage servers+ storage apps	Intel® Xeon® -based intelligent t storage Intel® SSD 910 series Intel® SSD S3700 series Intel® SSD 710 series Intel® Cache Acceleration Software	SSDs for low latency and high bandwidth needs	Enhancing large scale distributed storage and analytics
Network Programmable network equipment, open interfaces	Intel® Ethernet Controllers Intel® Ethernet Adapters Intel® Ethernet Switch Silicon Intel® True Scale Fabric	Unified networking	Programmable switch & management APIs
Security Automated controls, data protection, multi-tenant Data Center	Intel® Trusted Execution Technology Intel® Virtualization Tech; Intel® AES-NI Intel® Expressway Appliances McAfee ePO[1] ; McAfee MOVE-AV[1] McAfee NS Series Appliances McAfee Cloud Identity Manager[1] McAfee Application & Change Control	Hardware-based data and multi-tenant workload integrity	
Orchestration Automated density/ efficiency	Intel® Node Manager Intel® Datacenter Manager	DC efficiency and density tuning via deep power and resource usage instrumentation	

- McAfee ePO (ePolicy Orchestrator) unifies security management through an open platform
- McAfee MOVE-AV (Management for Optimized Virtual Environments-AntiVirus relieves the overhead of traditional AV in virtualized and cloud environments without sacrificing security
- McAfee Cloud Identity Manager provides user-to-cloud single sign on and strong authentication
- McAfee Application & Change Control: proactively enables a known good state; enforces change policies & alerts you to file integrity issues

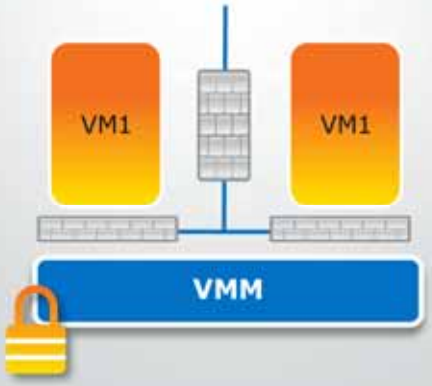
Secure Your Infrastructure at the Hardware Level

Intel® Technologies for server security

Isolate

Intel® VT & Intel® TXT

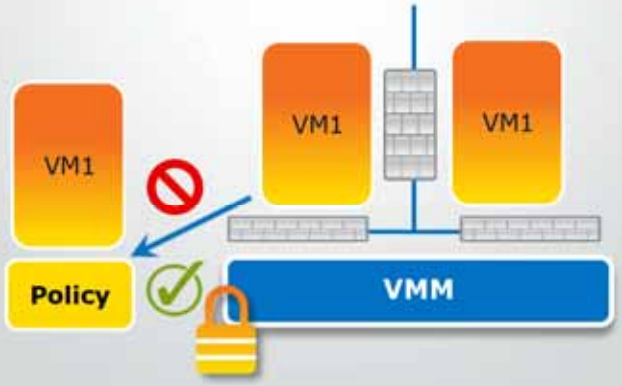
Protects VM isolation and provides a more secure platform launch



Enforce

Intel® TXT

Establishes "trusted" status foundation to control migration based on security policy



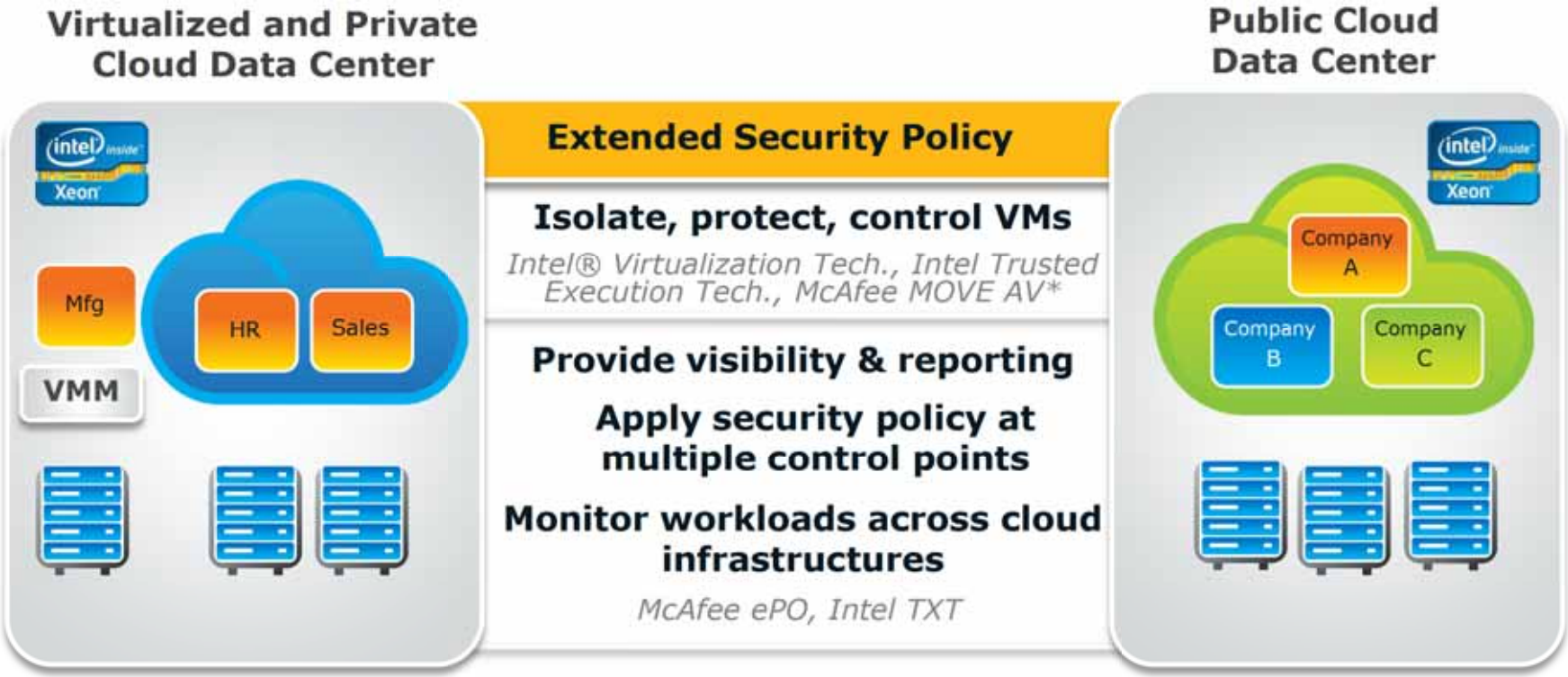
Encrypt

Intel® AES-NI

Delivers built-in encryption acceleration for better data protection

Enhancing End to End Cloud Security

Extending Security Approaches for a Virtual Cloud World



1 Integrating McAfee ePolicy Orchestrator (ePO) with Intel TXT requires custom integration work

*McAfee MOVE AV = McAfee Management of Optimized Virtualized Environments Anti-Virus

Intel® Xeon® Processor E5-2600 v2 Product Family

Solve Real Problems, Deliver Real Results

At the Heart of a Modern Data Center

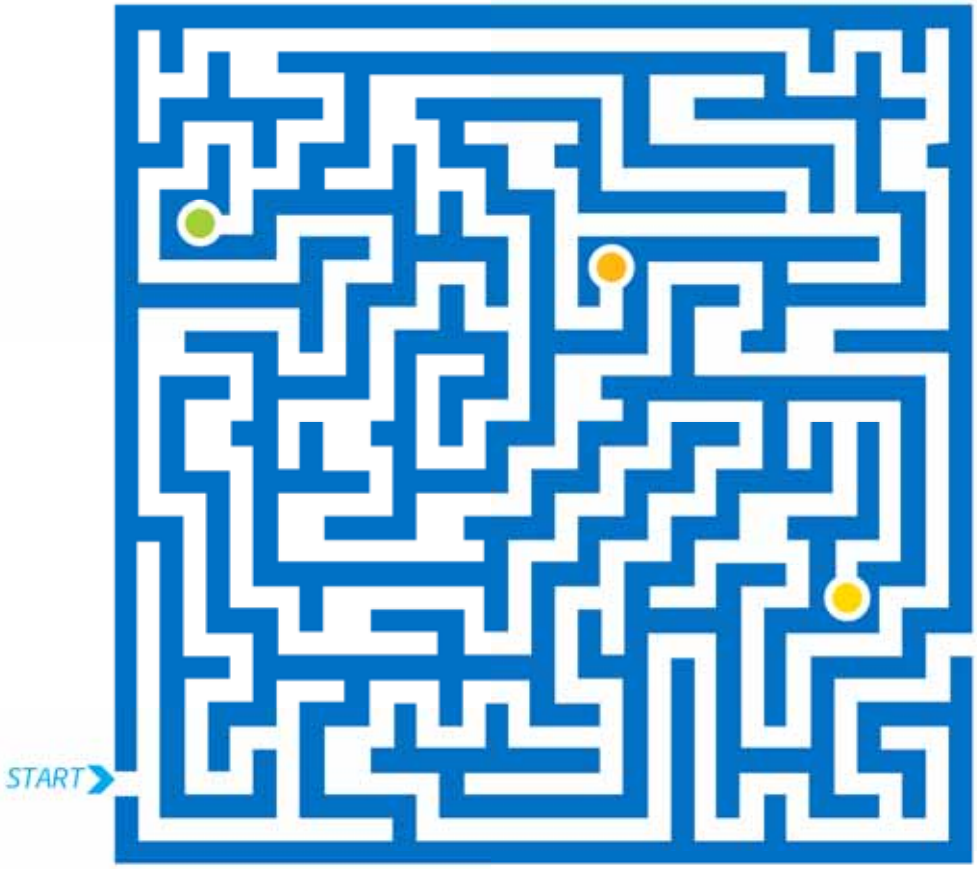
Intel® Xeon® E5-2600 v2 product family

intel inside XEON

- Operational Excellence
- Modernized Services Delivery
- NEW New Business Opportunities

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

IT Challenges



Do more with less

Improve performance

Reduce operational costs

Increase agility

Offer agile peak capacity

Protect Intellectual Property,

Offer new services

Deliver deeper insights & competitive advantage

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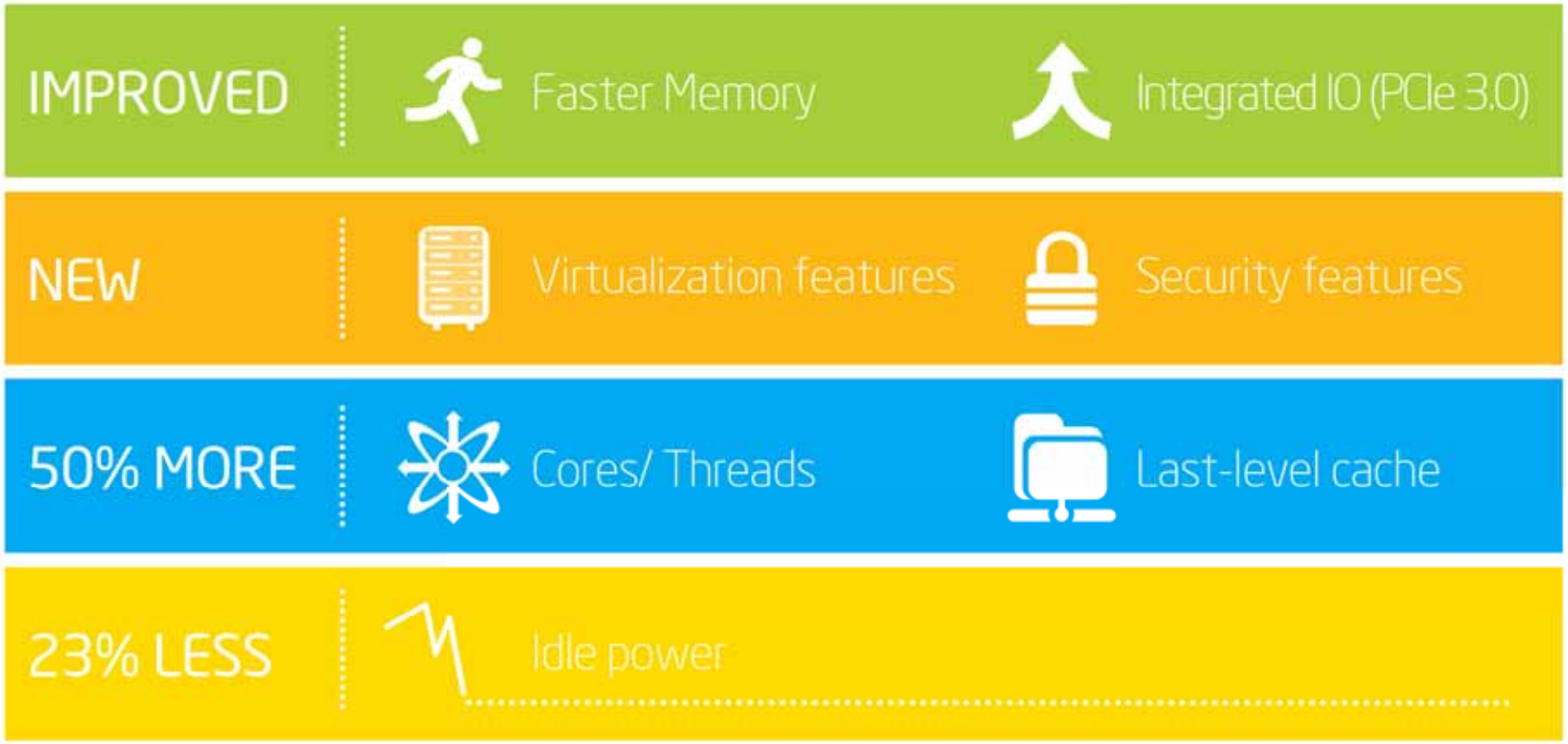
Real Enhancements Where it Counts

Intel® Xeon® Processor E5-2600 v2 Product Family



1 Source: Intel internal measurements. [Idle power, Intel® Xeon® processor E5-26xx v2 (12C, 2.5GHz, 95w), 28 March 2013]. Results have been simulated and are provided for informational purposes only. Results were derived using simulations run on an architecture simulator or model. Any difference in system hardware or software design or configuration may affect actual performance. Intel product plans in this presentation do not constitute Intel plan of record product roadmaps. Please contact your Intel representative to obtain Intel's current plan of record product roadmaps. For more information go to http://www.intel.com/performance

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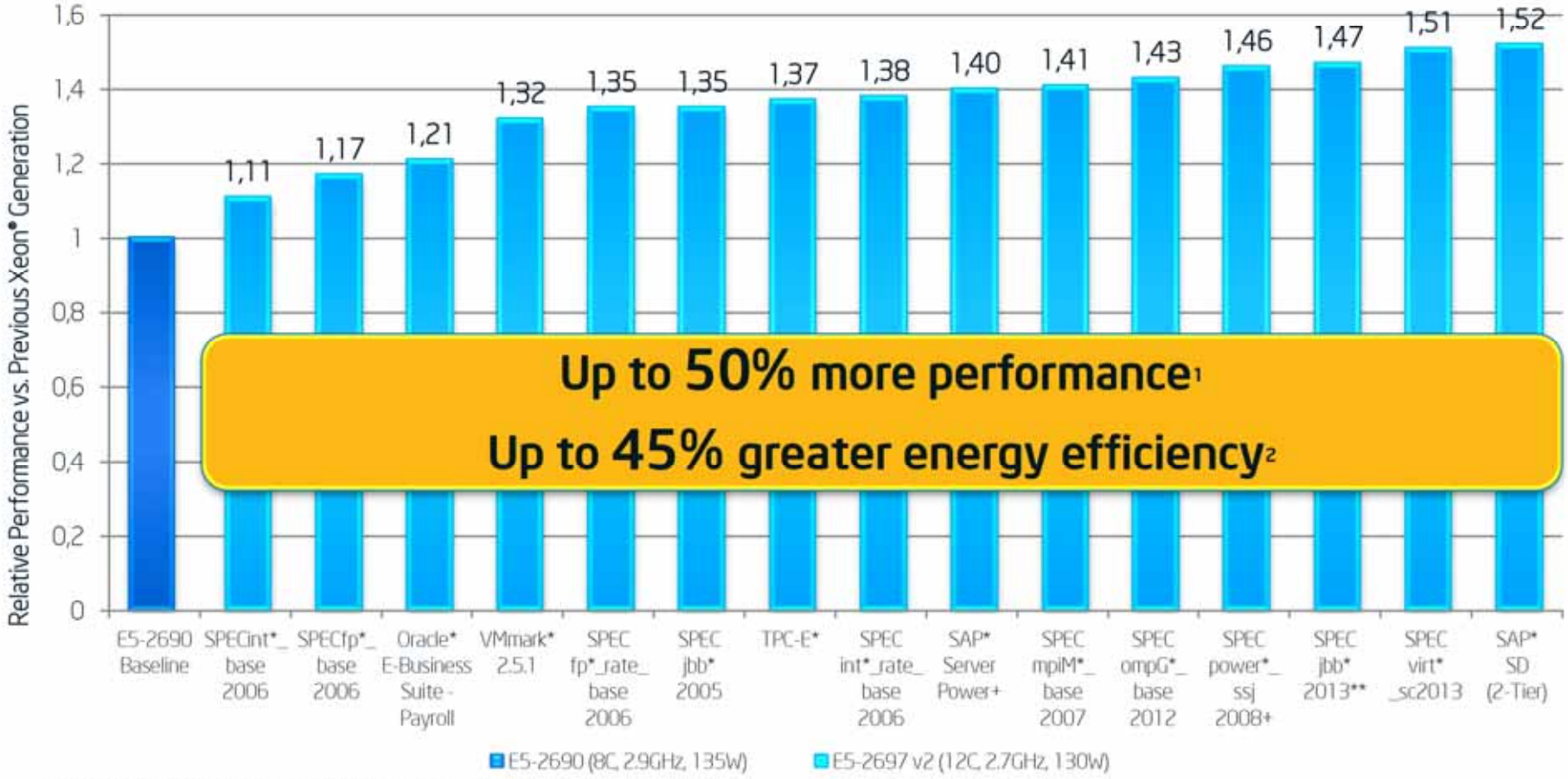
New 2S Performance World Records

Across a diverse set of benchmarks

- ✓ Enterprise Computing
- ✓ Virtualization
- ✓ Energy Efficiency
- ✓ Web+
- ✓ Technical Computing
- ✓ Database

+World Record x86 2-socket result

2S World Record Performance on Intel® Xeon® Processor E5-2697 v2



+E5-2660 v2 (10C, 2.2GHz, 95W) vs. E5-2660 (8C, 2.2GHz, 95W)

**World Record x86 2-socket result

[1]SPECvirt_sc2013*: E5-2690 platform, 256GB, score: 624.9@37VMs, baseline source. IBM* System x3650 M4, E5-2697 v2, 512GB, score 947.9@53 VMs.

[2]SPECpower_ssj2008*: E5-2660 platform, 16GB, score 5,544, baseline source. Fujitsu* PRIMERGY RX300 S8, E5-2660 v2, 48GB, score 8,097.

Achieving Operational Excellence

Dial up efficiency at every level

Maximize software investments with latest Intel hardware

Enhance infrastructure with optimized networking

Unrelenting Focus on Power Efficiency

Active Power

Delivering up to **45%[1] power efficiency improvements** through enhanced fine grain power controls and 22nm tri-gate process

Dynamic Power

Efficient Turbo that **intelligently adapts** to peak workloads conditions and disengages when Memory and I/O are the bottlenecks

Idle Power

Low leakage process technology and power gating technology contribute to Idle Power of up to **23%[2] lower** than previous generation

1. Source: Baseline Configuration and Score on SPECpower_ssj2008® benchmark: Platform with two Intel® Xeon® Processor E5-2660, 16GB memory, Microsoft Windows Server 2008 Enterprise x64 Edition Baseline scores as of November 2012. Score: 5,544 overall ssj_ops/watt. New Configuration: Platform with two Intel® Xeon® Processor E5-2660 v2, 48GB, Microsoft Windows Server 2012 Standard Edition. Source: Submitted to SPEC for review/publication as of Sept. 10, 2013. Score: 8,097 overall ssj_ops/watt.
2. Idle power based on ; Intel® Xeon ® processor E5- 26xx v2 (12C, 2.5GHz, 95W), 28 March 2013)For more information go to http://www.intel.com/performance
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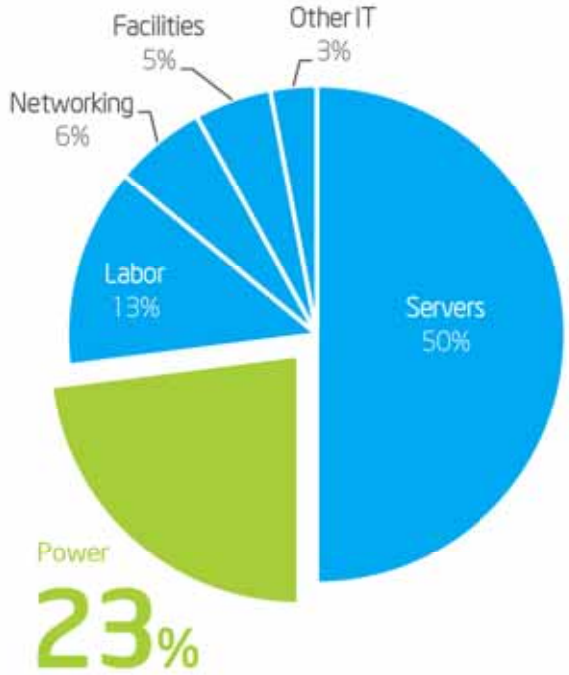
Decrease Data Center Power Costs

...without Compromise

Operational Costs of a Typical Large Cloud Service Provider



Power Management at the Server, Rack & Data Center Level

Intel® Xeon®
Greater Workload Consolidation. Up to **66% TCO reduction**[3]

Intel® Node Manager
Up to **30% power reduction** at similar performance.[1] Up to **40% more** servers and performance per rack.[2]

Intel® Data Center Manager
Up to **30% power reduction** at similar performance.[1] Up to **40% more** servers and performance per rack.[2]

1.30% savings: Oracle: http://www.intel.com/content/www/us/en/data-center-efficiency/data-center-efficiency-xeon-oracle-changing-the-game-study.html
2.Baidu: http://www.intel.com/content/www/us/en/data-center-efficiency/data-center-efficiency-xeon-baidu-case-study.html China Telecom: http://www.intel.com/content/www/us/en/enterprise-security/enterprise-security-xeon-5600-china-telecom-business-advantage-study.html?wapkw=china+telecom
3. Over previous generation Intel® processors. Intel internal estimate. For more legal information on performance forecasts go to http://www.intel.com/performance
*Other names and brands may be claimed as the property of others.

Gain REAL Optimization

+ Windows Server 2012

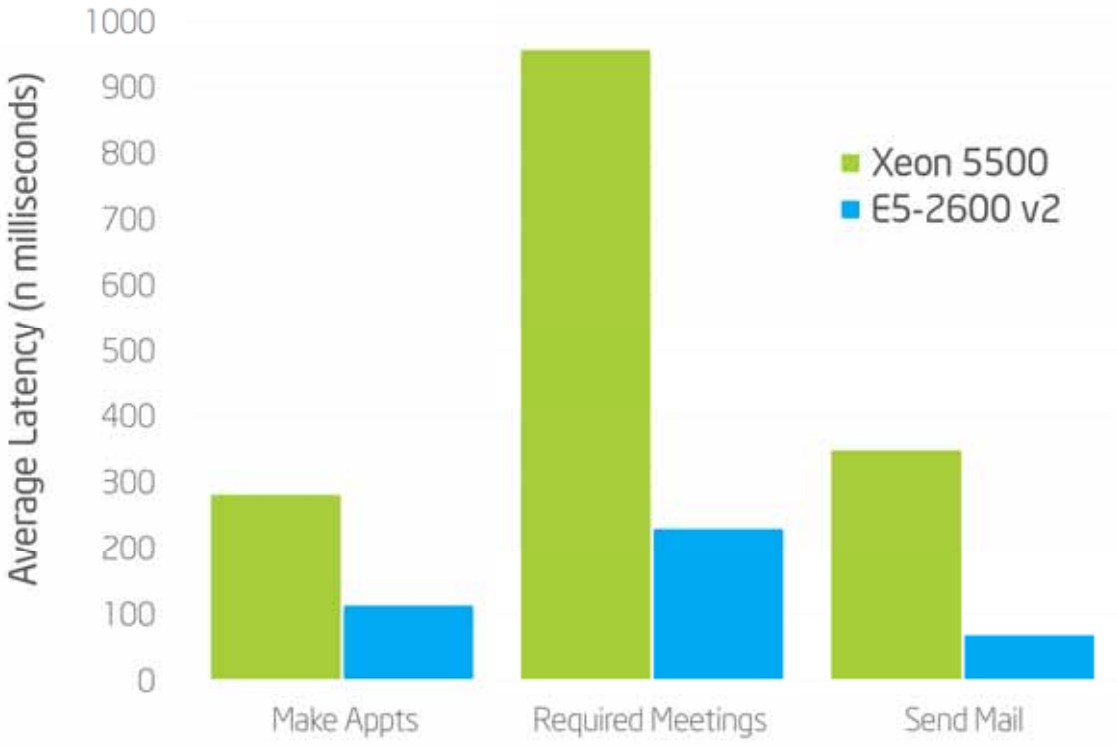
Deliver up to **15%**[1] **power reduction** by upgrading to WS2012 from WS2008

Hyper-V offers **uncompromised live migration** with IO virtualization improvements

HW enhanced security with **fast, low overhead encryption** (AES-NI) and the addition of high quality keys.

1. Source: Intel internal measurements running Windows Server 2003 vs Windows Server 2008 R2 on Intel® Xeon® E5-2600 product family. And considering Typical Operating Power range estimated on a Performance of ssj*_OPS of approximately 1M. See backup slide for configuration details. For more information go to http://www.intel.com/performance

Make a REAL Difference



Xeon 5500 vs E5-2600 v2 with S3700 Series SSDs

intel inside XEON + Exchange

Support more users and enhance productivity by reducing latency and accelerating the completion of tasks up to 5x in the same server foot print

Improve uptime and data protection with advanced error recovery and HW enhanced security

Unleash performance with S3700 SSDs that offer 50x throughput compared to 15k HDDs

1. Source: Intel internal measurements. Conguration: 2S Romley platform with E5-2670 @ 2.6GHz vs. 2S Westmere-based server with Xeon 5670 both running Windows 2008 R2 and Exchange 2007 sp3. See backup slide for configuration details. For more information go to http://www.intel.com/performance

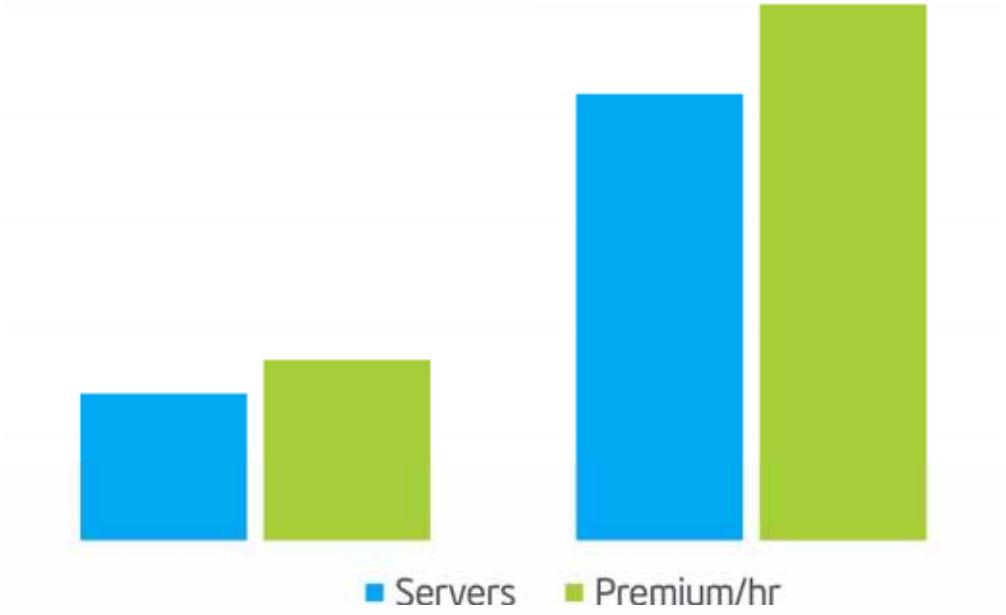
Scale REAL results

+ Microsoft SQL Server

Significant performance gains of >25%[1] on a variety of DB related benchmarks

Grow your infrastructure with your business and get nearly linear scalability of performance to workload demand

Enhanced data protection and compliance with Intel® Advanced Encryption Standard New Instructions (AES-NI)



3X the servers delivers **>3X** throughput when scaling SQL Server on E5[2]

1. Source: Intel internal measurements. [TPC-E*, based on E5-2600 (12C, 2.5GHz, 130w), 28 March 2013]. See configuration details in back up.
2. Source: Accenture Duck Creek and Microsoft SQL white paper – 2013Based on Intel and partner measurements. Configuration based on E5-2600 product family running Windows Server 2008 and SQL Server DB.

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

Modernized Service Delivery

Provision efficiently to support peak capacity

Leadership performance for virtualized data center

Cultivate trust by deploying a secure private cloud

Intel® Xeon® Processor E5-2600 v2 Product Family

Private Cloud with Agility & Velocity

As markets move more quickly, the ability to respond rapidly to customer demands and unexpected opportunities is critical to business success.

> *"Intel's Xeon based private cloud enables us to deliver **80% of new servers in less than 3 hours and most within 45 minutes**. In contrast just 2 years ago, server provisioning in the traditional IT environment typically took as long as 90 days."*
>
> Intel

90 DAYS

45 MIN

APPLICATION PROVISIONING

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

Intel® Xeon® Processor E5-2600 v2 Product Family

Produce REAL Business Results with vmware vSphere 5.1

Top Reasons to Virtualize business critical applications[2]

- Dynamic scalability and rapid provisioning
- Enable availability without cost, complexity
- Optimize business continuity
- Automate disaster recovery
- Utilize cloning for faster time to service
- Enhanced management
- Consolidation for lower TCO

Automating the Enterprise

Continue performance improvements for virtualized environments of up to 50%[1] providing headroom needed to support even transcoding with vCloud Hybrid Services

Virtualize your most complex workloads with large virtual machines that scale up to 48 virtual CPUs and ~.7 TB of vRAM per VM

Reduce network complexity by unifiying (FCoE and ISCSI) and virtualizing networking with Intel® 10GbE Converged Network Adapters and optimized Vmware® vSphere

1- Baseline Configuration: 2x[illegible] on SPECvirt_sc2010 3rd generation Platform with two Intel® Xeon® Processor E5-2690, 256GB memory, RHEL 6.4/KVM, [illegible] as of July 2013. Score: 6249 @ 37 VMs. New Configuration: Platform with two Intel® Xeon® Processor E5-2697 v2, 512 GB memory, RHEL 6.4/KVM, Source: Submitted to [illegible] for review/publication as of Sept. 10, 2013. Score: 9478 @ 57 VMs

2- Source: Virtualizing Business Critical Applications on vSphere – white paper. More information at: [illegible]

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

Establish a Foundation

for More Secure Computing

Enabling Security & Compliance Solutions

Driving industry standards

Enabling Trusted Compute Pools

ENCRYPT

Intel® AES-NI
Intel® Secure Key
Delivers built-in encryption acceleration for better data protection

ANALYZE

Intel® distribution Apache Hadoop*
Hardware-enhanced analytics platform to achieve insights faster

ISOLATE

Intel® Virtualization (VT)
Intel® Trusted Execution Technology (TXT)
Protects VM isolation and provides a more secure platform launch

ENFORCE

Intel® TXT
Establishes "trusted" status foundation for security policy-based workload control

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Enable New Business Opportunities

Accelerate results with scale-out storage

Enable intelligent, real-time analytics with Intel Hadoop distribution

Scale-out Storage Simplifies & Saves

Intel® Xeon® powers today's compute-intensive storage strategies[2]

Better Together

Reduce storage footprint by >50% with storage refresh

Reduce storage device capacity growth by 25% via thin provisioning

Improve storage efficiency by up to 25% with data de-duplication

ENCRYPTION

DATA DEDUPLICATION

LARGE SCALE ANALYTICS

Increased performance

Data center endurance

New safety features

Up to 2X TCO savings[4]

STORAGE VIRTUALIZATION

THIN PROVISIONING

STORAGE TIERING

1 Source for savings claims: IT@Intel Whitepaper "Solving Intel IT's Data Storage Challenges". December 2011

2 Intel Xeon is the storage industry's processor of choice—Xeon MSS is 80% (2011); Source: IDC Quarterly Storage Tracker Q4'11

3 Intel enterprise SSDs: Intel® 710 series SSD—SATA; Intel® 910 series SSD—PCIe

4 SSD TCO generated from SNIA* (Storage Networking Industry Association) TCO model for Solid-State Storage. Calculations based on 4K random, 65/35 read/writes. 3.5" SAS 15K HDDs can be found at: www.snia.org

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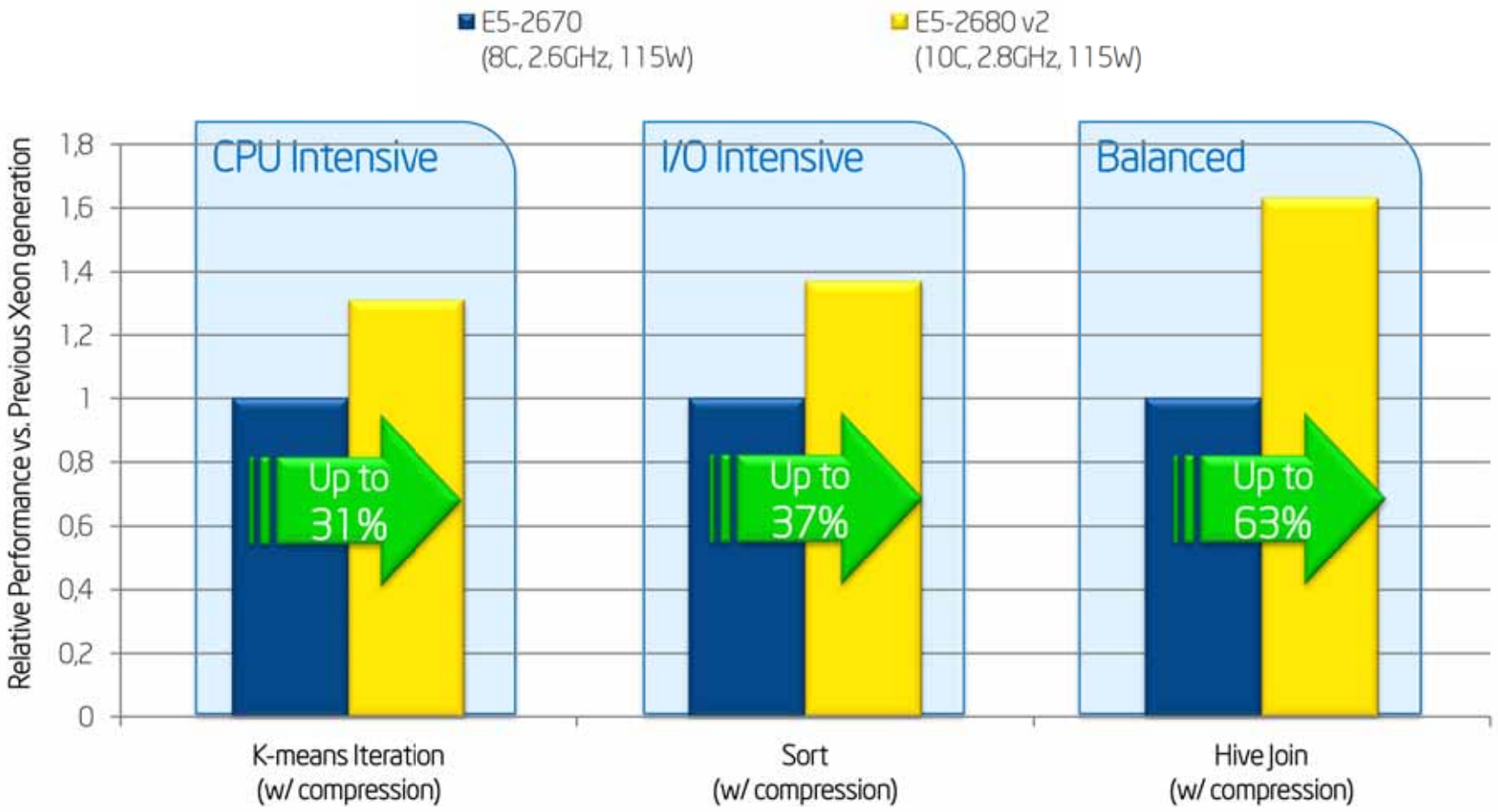
Big Data

Discover Business Insights - Faster

HiBench Benchmark		
Workload	**Pattern**	**Rationale**
K-means Iteration	CPU intensive	Large-scale machine learning is one of the most significant uses of Hadoop
Sort	I/O intensive	Sorting program has been pervasively accepted as an important performance indicator of MapReduce
Hive Join	Both CPU and IO intensive	Complex OLAP-style analytics is one of the most significant uses of Hadoop

http://www.intel.com/performance *Other names and brands may be claimed as the property of others.
1. E5-2670 platform, 64GB memory, 12x2T HDD, 1GBE, 8-node cluster, Ubuntu11.04, Java SE build 1.6.0_30-b12, IDH-1.0.3.7600. Performance/node (MB/s): K-means 12.42, Sort 76.2, Hive Join 83.3. Source: Intel TR#3007 as of Aug 2013. E5-2680 v2 platform, 64GB memory, 8x1T HDD, 10GBE, 4-node cluster, Ubuntu11.04, Java SE build 1.6.0_30-b12, IDH-1.0.3.7600 Performance/node (MB/s): K-means 16.28, Sort 104.8, Hive Join 136.59. Source: Intel TR#3007 as of Aug 2013.

Real-Time Analytics using Hadoop*



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At the Heart of a Modern Data Center

Intel® Xeon® E5-2600 v2 product family

Operational Excellence

Power efficiency to significantly drive down operational expenses and increase compute density.

Modernized Services Delivery

Security and virtualization features that you need to modernize your Data Center on a foundation of trust

New Business Opportunities

The horsepower and optimizations to successfully launch new services like real time data analytics


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