Architecting Cloud Infrastructure for the Future

Jason Waxman
VP and General Manager
Cloud Platforms Group
Data Center and Connected Systems Group

July 22, 2013

Experiences Today and Tomorrow

Voice & Gestures

Personal assistant
Natural Interaction

'12-'17

20X
growth in speech driven mobile network traffic[1]

>22X
increase in smartphones with gesture recognition features[1]

Video/Media

Content Delivery
Video Search

'12-'17

16X
increase in mobile video traffic[2]

'13-'17

4X
increase in servers for media / graphics[3]

Predictive Analytics

Improve healthcare
Reduce car/aircraft parts failure

'11-'16

43% CAGR
for infrastructure supporting Big Data & Analytics[4]

1. ABI Research Aug 2012
2. Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012-2017
3. Intel internal analysis and forecast, 2013
4. IDC Storage Solutions, 2013, doc #241515, May 2013.

Sean Brown

Senior Manager, Innovation

An Inflection Point in Speech

Revolutionary shift from task-centric to user-centric

Speech Recognition

- Command & Control
- Dictation
- Search
- Natural Language

6 billion mobile handsets

70+ languages

65+ countries

Intelligent Systems

- Understand
- Inform
- Be Aware
- Ubiquitous

NUANCE

Delivering an Optimal UX Globally

Only the cloud can deliver the compute power required

Accuracy	Speed	New Features
Models	Users	Data
Languages	Transactions	Platforms

NUANCE

Intel & Nuance Collaboration

The Nuance Cloud, powered by Intel

Nuance Data Centers
Powered by Intel Xeon Processors

Balanced Computing
Device and cloud data centers leveraged for optimal performance

Joint Optimizations on Intel-based Platforms

Hardware + Software Accelerators

Scale Natural Language Processing

NUANCE

Delivering Great User Experiences

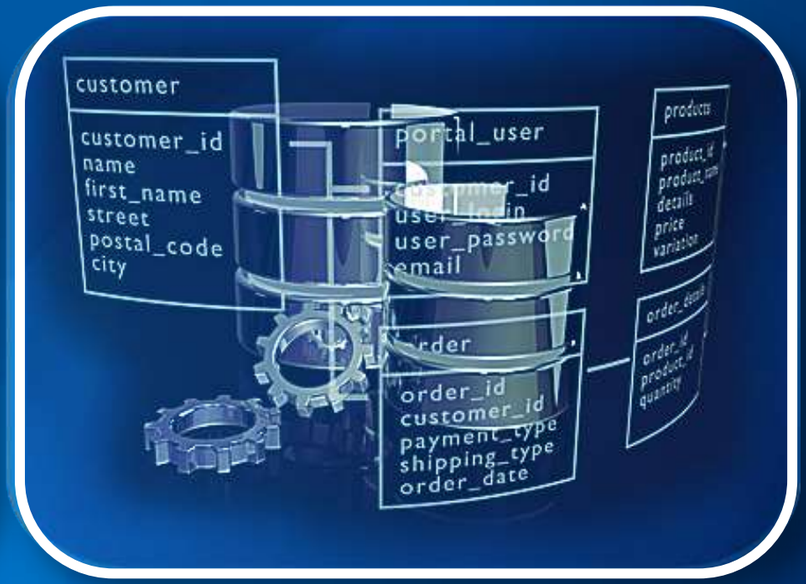
What's Needed?

Architecting Cloud Infrastructure for the Future

Addressing Requirements

Workload optimized technologies

Composable Resources



Software defined infrastructure

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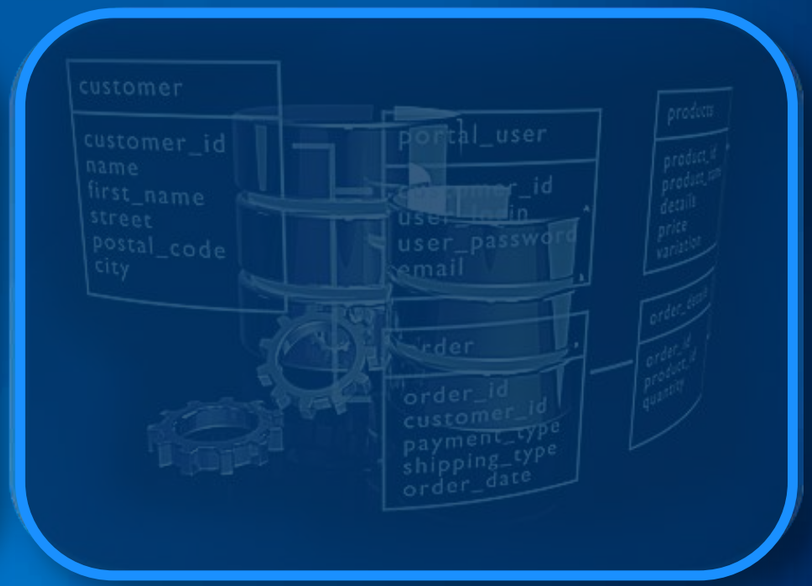
Architecting Cloud Infrastructure for the Future

Addressing Requirements

Workload optimized technologies

Composable Resources



Software defined infrastructure

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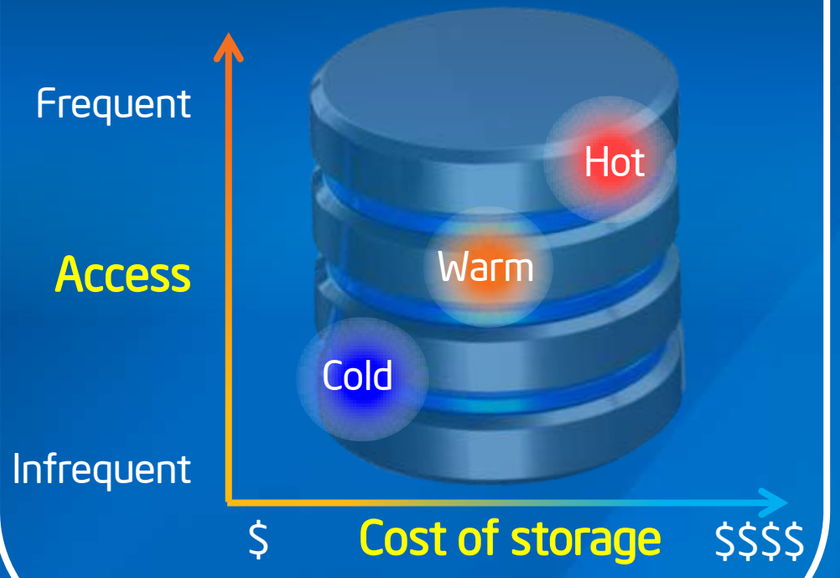
Workload Optimized Technologies

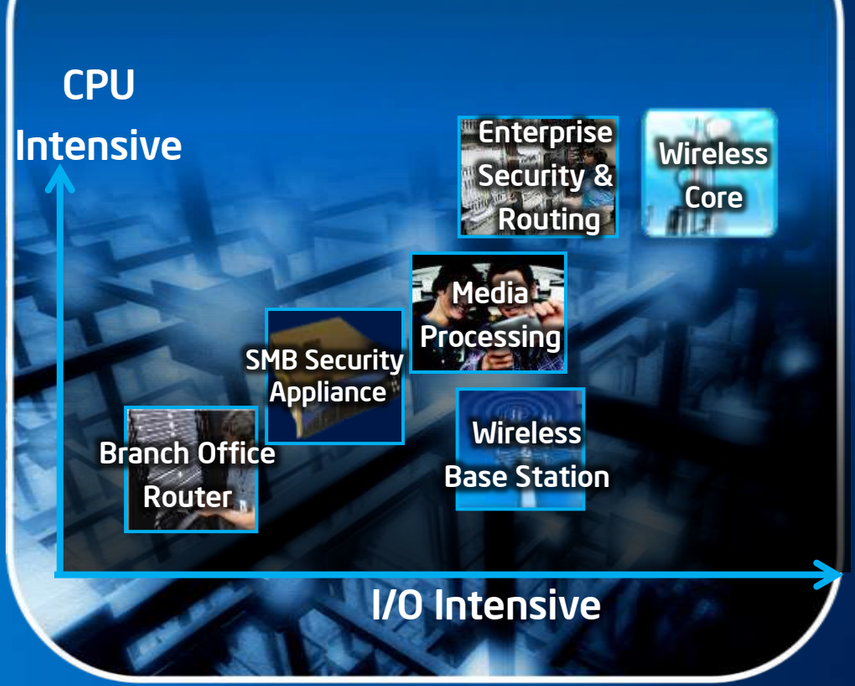
Diversity of Requirements

Servers

Storage



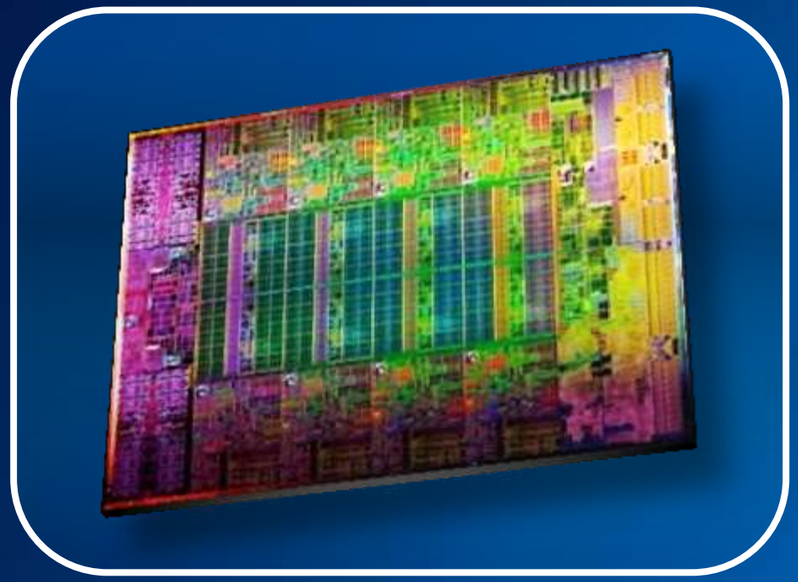
Network



Workload Optimized Technologies

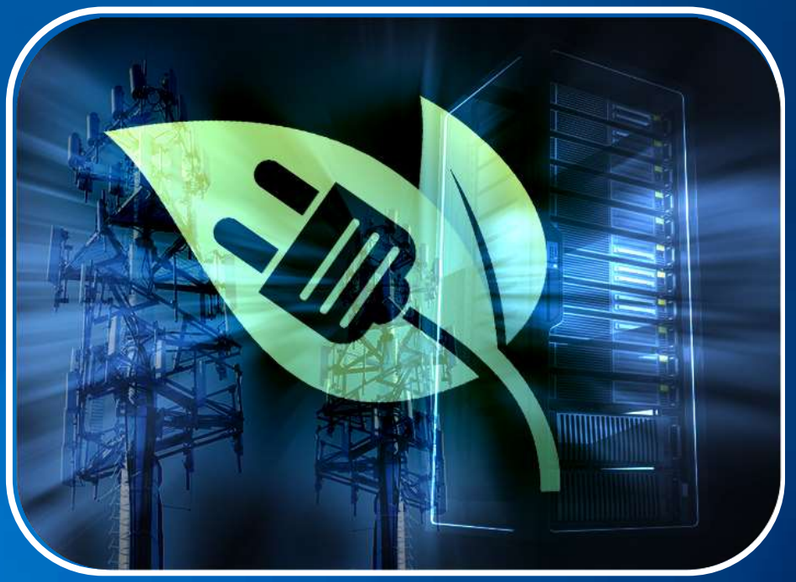
Intel Optimizations

CUSTOMIZED SILICON



ACCELERATORS

EXTREME LOW POWER



ebay

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vantrix

QuickFire NETWORKS

SAVVIS. A CenturyLink Company

OVH.COM

f5

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

Intel® Atom™ Processor C2000 Product Family

2nd Generation 64 bit Workload Optimized SoCs

Qual samples shipping

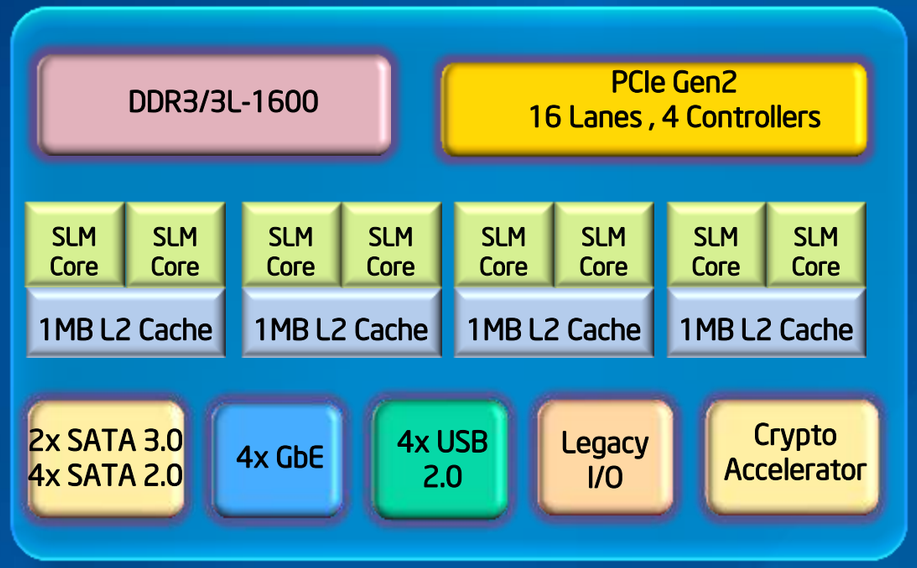
"Avoton" & "Rangeley"

Highly Scalable

Up to 8 cores with integrated I/O

Higher Performance

Up to 7x faster[1,2]



Higher Efficiency

Up to 4x higher performance per watt[1,3]

IA Software Compatibility

Datacenter Class Features

64-bit, ECC memory, Intel® Virtualization Tech

Workload Optimized

8x (64GB) Memory capacity[1]

Intel® QuickAssist Technology

2.5X increase in system designs for microservers, network and storage

[1]vs Intel® Atom™ S2100. Intel Atom C2000 pre-production silicon measurements

SLM= Next Generation Atom® micro architecture "Silvermont"

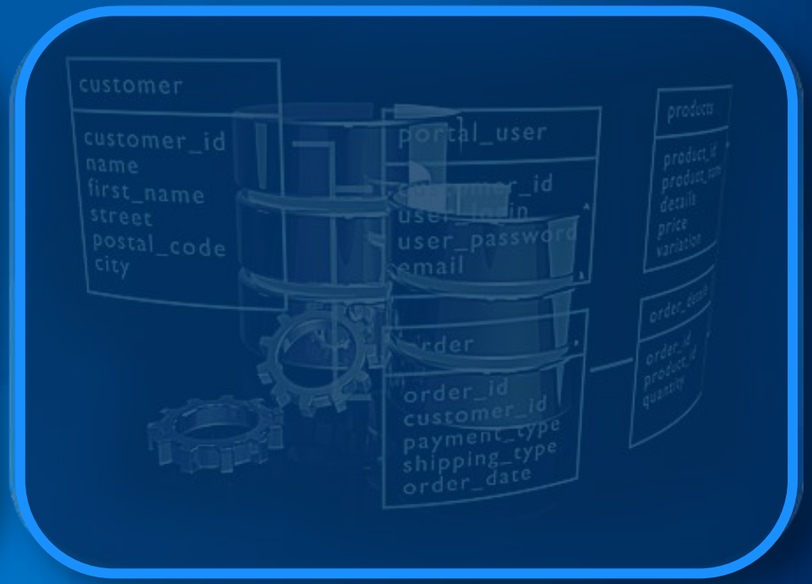
Configuration: [2]Dynamic Web Benchmark: Atom S1260(8GB,SSD,1GbE), Score=1522. Atom C2xxx(32GB, SSD,10GbE), score=11109. [3]Estimated SPECint*_rate_base2006 score for Atom S1260(8GB, HDD) 18.7, est. pwr=20W, Atom C2xxx(16GB, HDD), est. score=69, est. node pwr=19. Intel Internal measurements as of July 2013. Refer to backup for additional details. * Other names and brands may be claimed as the property of others.

Architecting Cloud Infrastructure for the Future

Addressing Requirements

Workload optimized technologies

Composable Resources



Software defined infrastructure

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Composable Resources

Evolution of Rack Scale Infrastructure

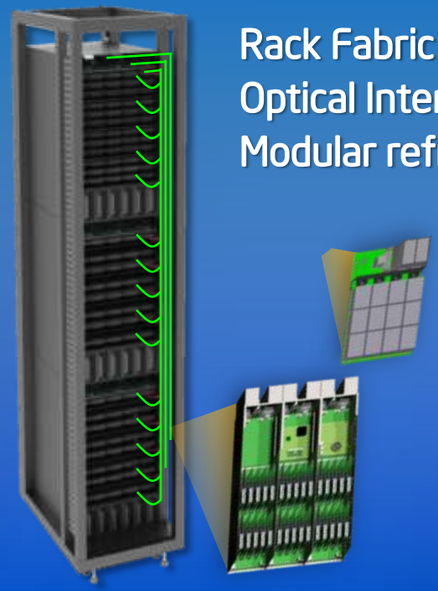
Today

Physical Aggregation

Shared Power
Shared Cooling
Rack Management

Next

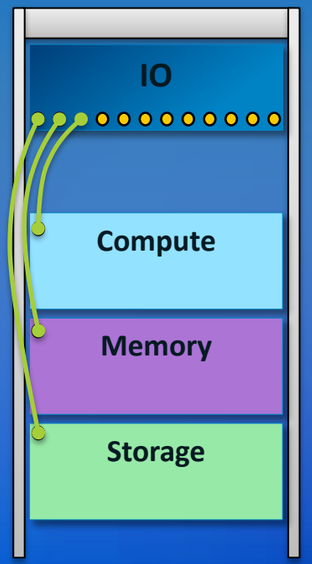
Fabric Integration



Rack Fabric
Optical Interconnects
Modular refresh

Future

Fully Modular Resources



Pooled compute
Pooled storage
Pooled memory
Shared boot

Enable flexible & efficient datacenters

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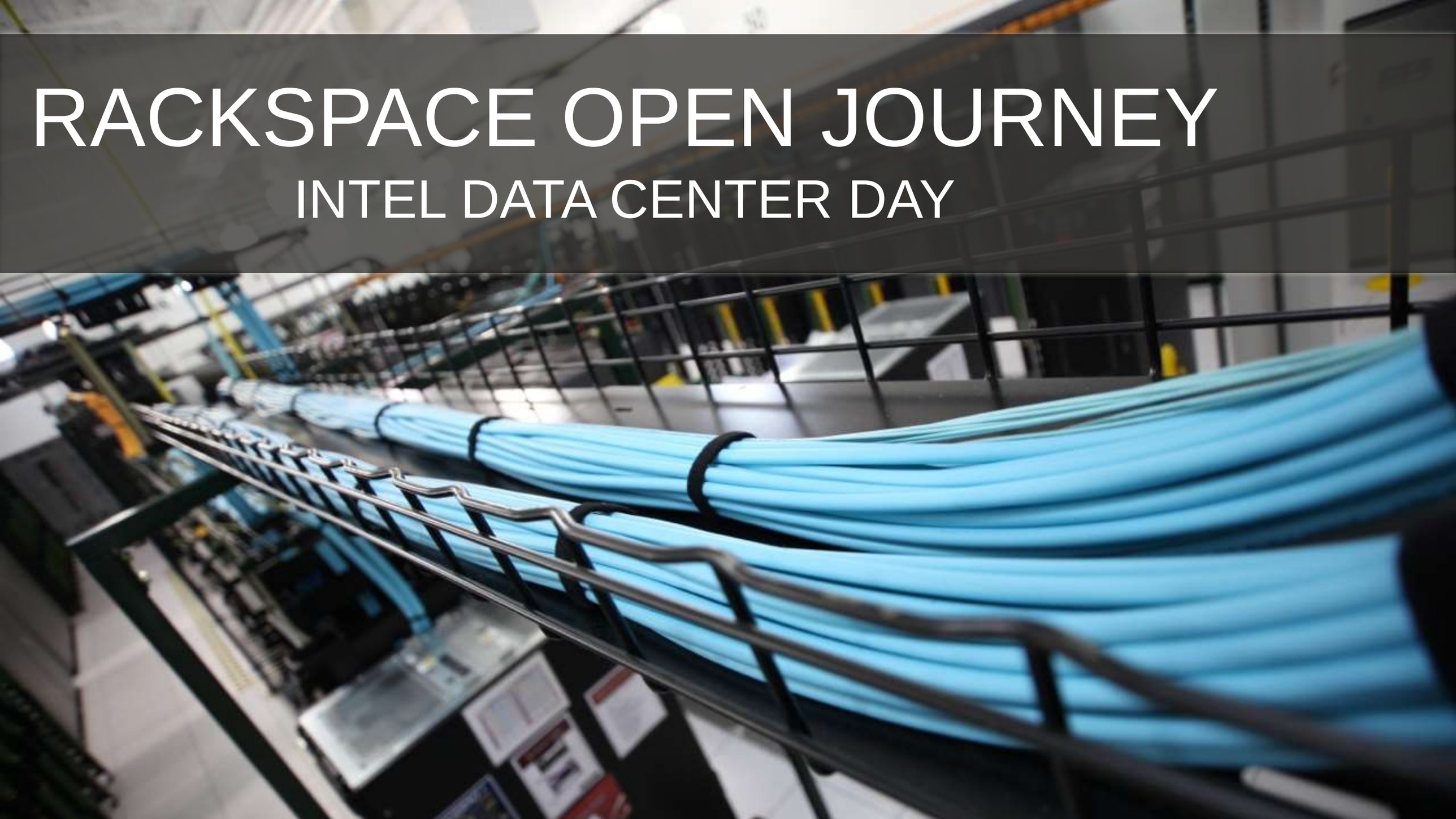
rackspace®
the open cloud company

Mark Roenigk

Chief Operating Officer

RACKSPACE OPEN JOURNEY

INTEL DATA CENTER DAY



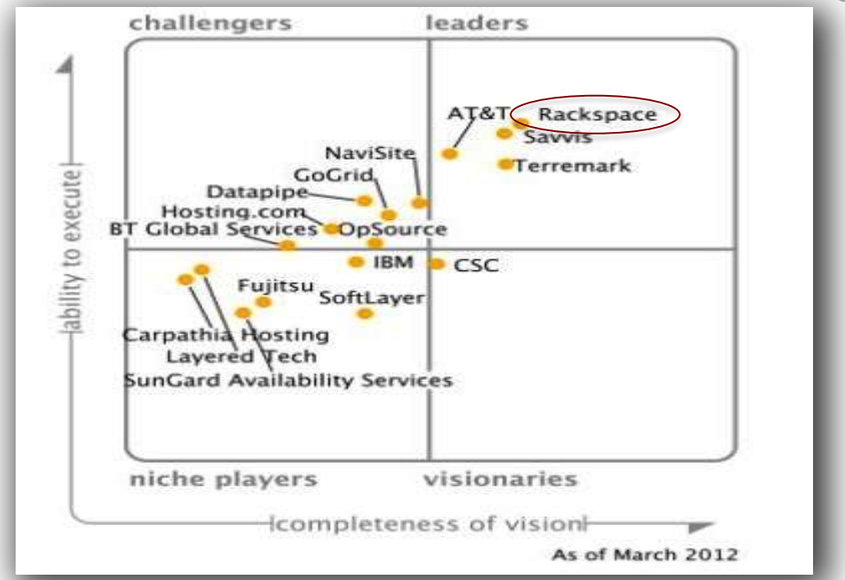
About Rackspace

205,000+ CUSTOMERS
100,000+ SERVERS
26,000+ VM
≅70 PB STORED

GLOBAL FOOTPRINT
CUSTOMERS IN
120+ COUNTRIES

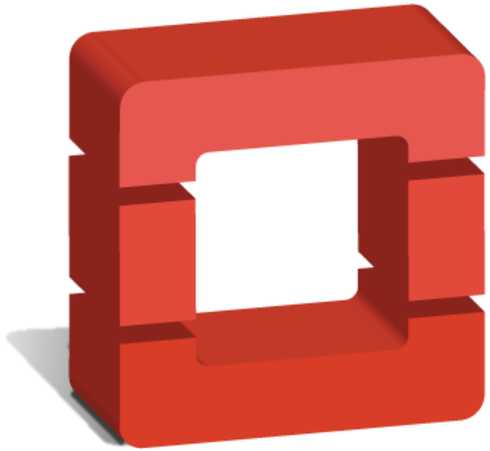
10 WORLDWIDE
DATA CENTERS

FORTUNE 100 BEST COMPANIES TO WORK FOR



rackspace
the open cloud company

We’re on the “Open Journey”



openstack™

CLOUD SOFTWARE

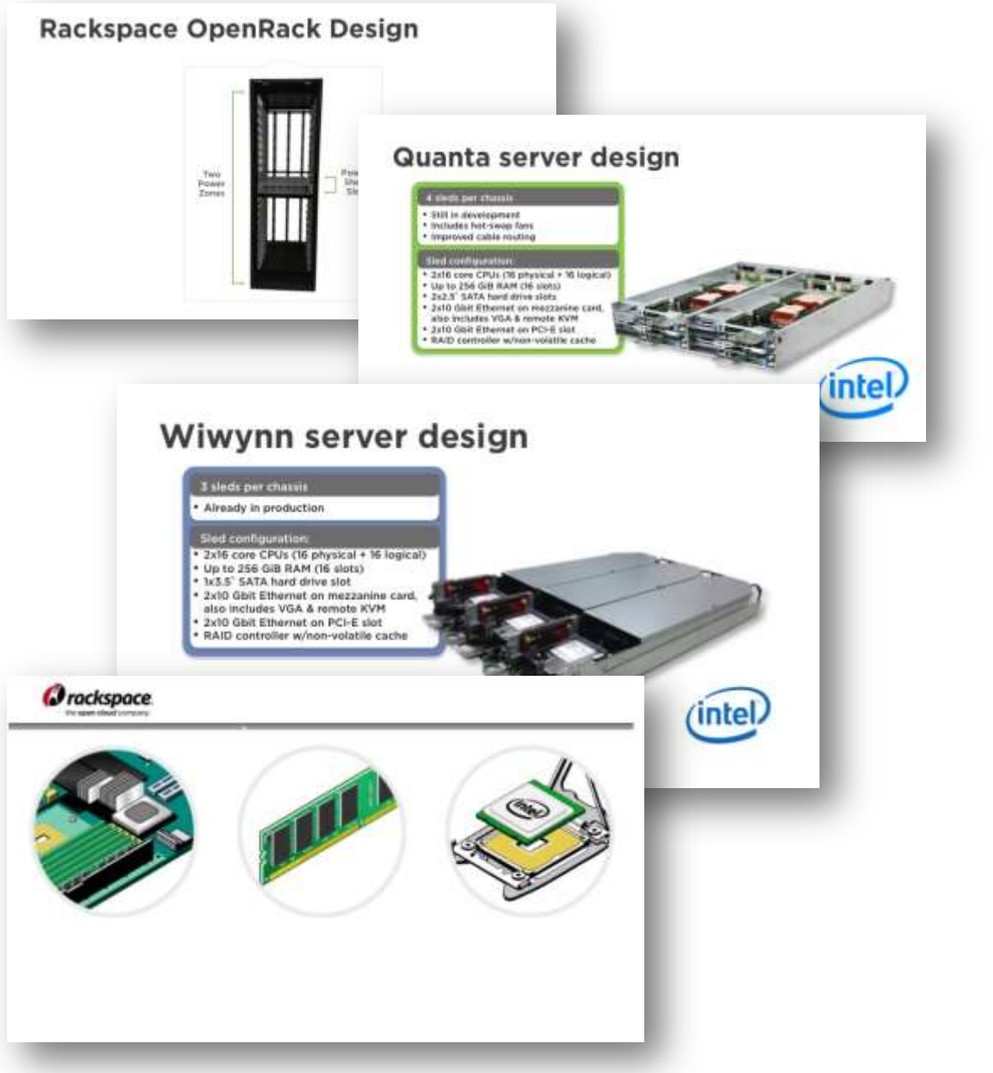
OPEN

Compute Project

The Rackspace OpenRack Server

Using Intel technologies for servers and networking

Rackspace Innovating Faster with Intel® Xeon® family



- Take advantage of greater VM density
- Improved revenue per WATT
- Great partnership
- Accelerated time to market
- A strong product roadmap
- OCP deployment will include Intel 10G implementation

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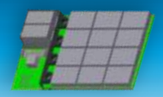
the open cloud company

Composable Resources

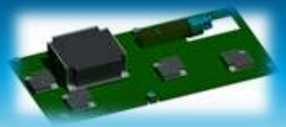
Intel Rack Scale Architecture Innovation

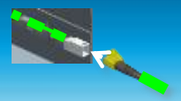
Open Network Platform

Storage-PCIe-SSD & Caching

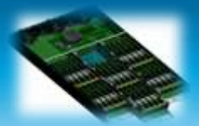


Photonics & Switch Fabric





Silicon: Intel® Atom™ & Xeon



CPU / Mem Modules

Up to **1.5X**[1]

Density servers/rack Improvement

Up to **6X**[2]

Power provisioning Reduction

Up to **2.5X**[1]

Network uplink Improvement

Up to **25X**[1]

Network downlink Improvement

Up to **3X**[1]

Cable 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. Results have been estimated based on internal Intel analysis and are provided for informational purposes only. Any difference in system hardware or software 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.

1. Improvement based on standard rack with 40 DP servers, 48 port ToR switch, 1GE downlink/server and 4 x10GE uplinks, Cables: 40 downlink and 4 uplink vs . rack with 42 DP servers, SiPh patch panel, 25Gb/s downlink, 100Gb/s uplink, , Cables: 14 optical downlink, and 1 optical uplink. Actual improvement will vary depending on configuration and actual implementation.
2. Improvement as compared to 20 Dell PowerEdge R720, N+1 redundant power, 705W PSU x2, peak power provisioned 30,000 Watts vs. same server, shared DC power using 1 power shelf of 7x 700W modules and 4200W (N+1) : power provisioned 4900 Watts http://www.opencompute.org/wp/wp-content/uploads/2013/01/Open_Compute_Project_Power_Shelf_v0.3.pdf, http://www.spec.org/power_ssj2008/results/res2012q4/power_ssj2008-20121030-00569.html ..

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Workload optimized technologies

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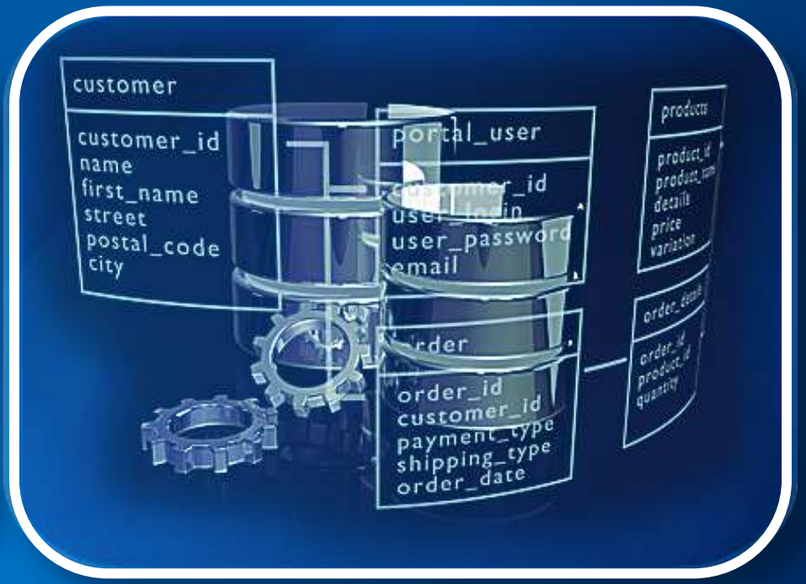

Software defined infrastructure

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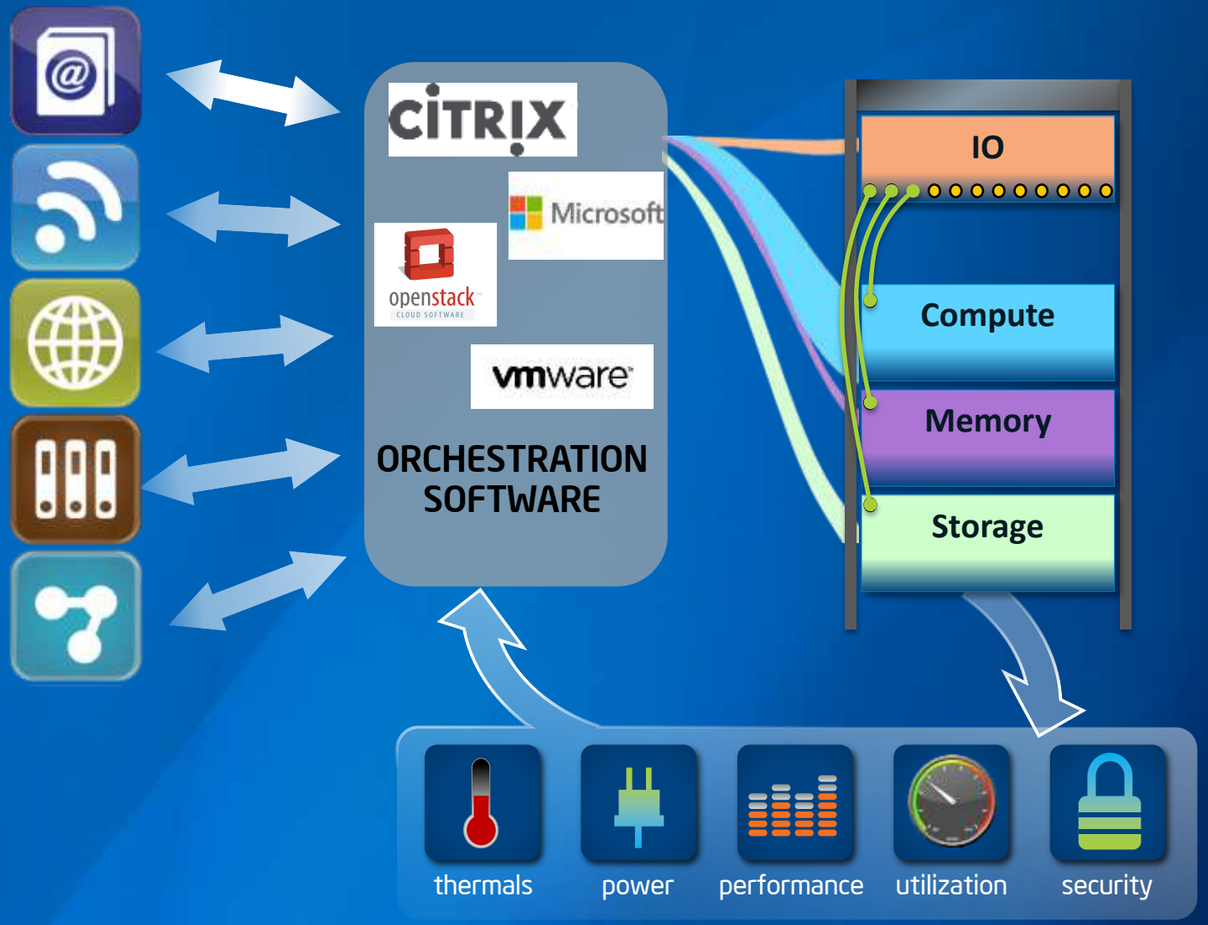
Software Defined Infrastructure
The Need for Better Workload Orchestration

TODAY'S CHALLENGES

- Pressure to meet SLAs
- Overprovisioning of resources
- Inefficient workload placement

FUTURE: INTELLIGENT ORCHESTRATION



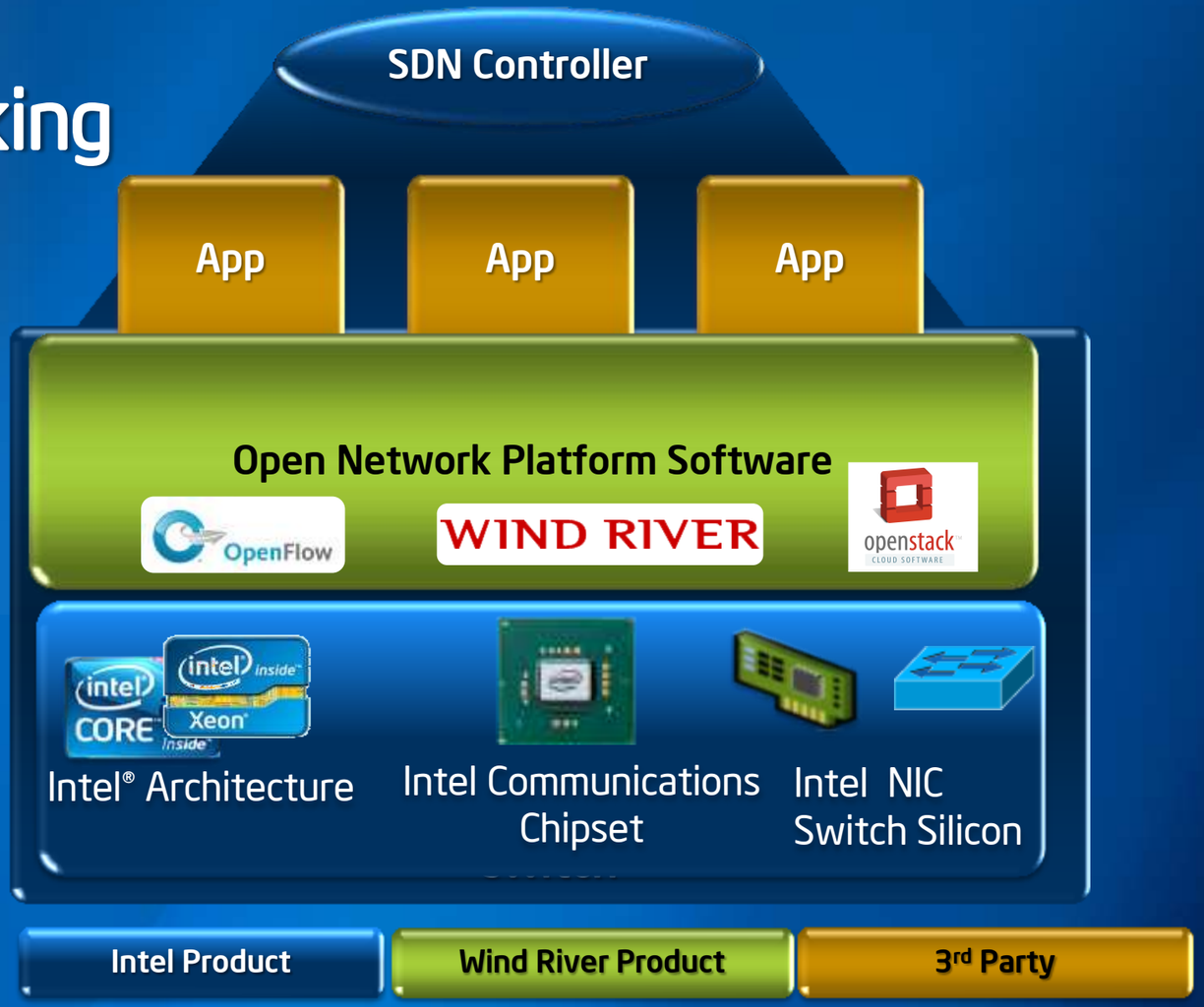
Software Defined Infrastructure

Intel: Accelerating Software Defined Networks

Building blocks for Open Networking

Programmable platform

Enable SDN with Open APIs



Architecting Cloud Infrastructure for the Future

Opportunities in Cloud Systems by 2016

	CAGR	'16 Revenues
Public Cloud Servers	25%	$15B[1]
Distributed Storage	50%	$21B[2]
SW-Defined Networking	175%	$5.5B[3]

1. Intel forecast, 2013
2. IDC Storage Solutions, 2013, doc #241515, May 2013
3. SDN Market Sizing Plexxi, Lightspeed Venture Partners, SDN Central April 2013; Markets & Markets - 2013

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Delivering Great User Experiences

McAfee An Intel Company

WIND RIVER

intel Data Center Manager

Cache Acceleration Software

Rack Scale Architecture

Software Defined Networking

Server

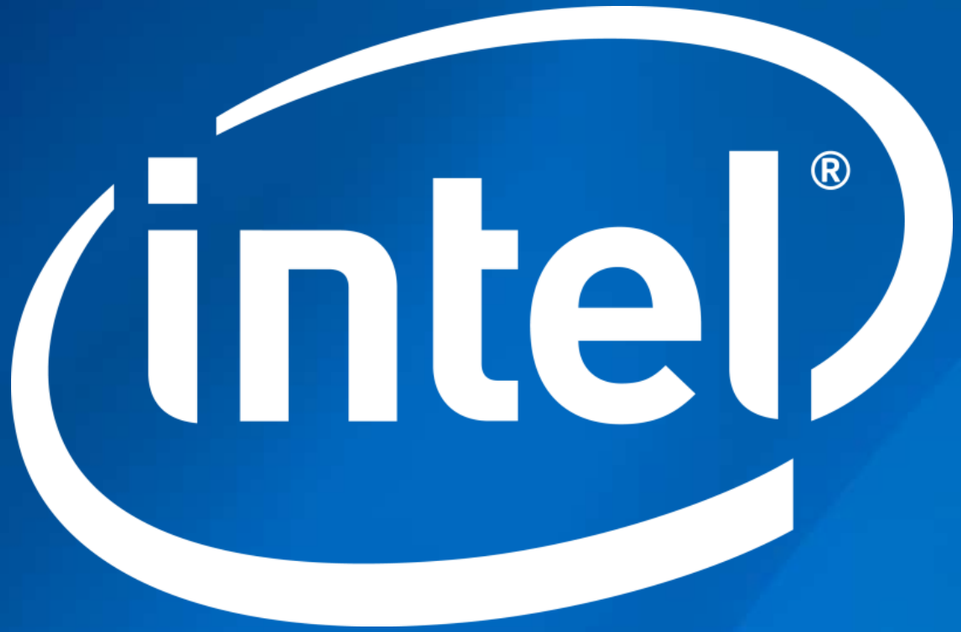
Intel® CPUs & Chipsets
SOCs & Accelerators

Network

Intel 10GbE
Intel Switch Silicon
Intel Silicon Photonics

Storage

Flexible building blocks
Intel NVM & SSD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The gross margin percentage could vary significantly from expectations based on capacity utilization; variations in inventory valuation, including variations related to the timing of qualifying products for sale; changes in revenue levels; segment product mix; the timing and execution of the manufacturing ramp and associated costs; start-up costs; excess or obsolete inventory; changes in unit costs; defects or disruptions in the supply of materials or resources; product manufacturing quality/yields; and impairments of long-lived assets, including manufacturing, assembly/test and intangible assets. The tax rate expectation is based on current tax law and current expected income. The tax rate may be affected by the jurisdictions in which profits are determined to be earned and taxed; changes in the estimates of credits, benefits and deductions; the resolution of issues arising from tax audits with various tax authorities, including payment of interest and penalties; and the ability to realize deferred tax assets. Gains or losses from equity securities and interest and other could vary from expectations depending on gains or losses on the sale, exchange, change in the fair value or impairments of debt and equity investments; interest rates; cash balances; and changes in fair value of derivative instruments. Intel's results could be affected by adverse economic, social, political and physical/infrastructure conditions in countries where Intel, its customers or its suppliers operate, including military conflict and other security risks, natural disasters, infrastructure disruptions, health concerns and fluctuations in currency exchange rates. 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Intel® Atom™: Performance Configuration Details

Dynamic Web Perfomance:

Atom S1260: DBC SDP w/Intel® Atom™ S1260 (2.0GHz, 2C), Hyper-Threading Enabled, 1x8GB DDR3-1333 MHz UDIMM ECC, BIOS version D134.4, Fedora* 17, Linux Kernel 3.3.4-5fc.x86_64, Apache 2.2.22, PHP 5.4.7, Boot Drive 1x 150GB SSD, Addl Drive 2x 150GB SSD, 2xGbE, Score: 1522

Atom C2xxx: MPK SDP w/Intel® Atom™ C2xxx (8C), Turbo Disabled, 4x8GB DDR3-1600 MHz UDIMM ECC, BIOS version 18D05, Fedora* 17, Linux Kernel 3.3.4-5fc.x86_64, Apache 2.2.22, PHP 5.4.7, Boot Drive 1x150GB SSD, Addl Drive 1x 800GB SSD, 1x10GbE, Score: 11109

Perfomance Per Watt:

Atom S1260: FOR.INTEL.cpu2006.1.2.ic13.1.linux64.01june2013
Supermicro* 5017A-EF with one Intel® S1260 processor (2-core 2.0GHz), EIST Enabled, Hyper-Threading Enabled, 8GB memory (1x 8GB DDR3-1333 UDIMM ECC), 250GB SATA 7200RPM HDD, Red Hat Enterprise Linux 6.4 . Estimated score:int_rate_base2006=18.7. Est. Power=20W

Atom C2xxx: FOR.INTEL.cpu2006.1.2.ic13.1.linux64.01june2013
Intel® Mohon Peak Alpha platform with one Intel® Avoton processor (8-core), Turbo Boost Disabled, 16GB memory (2x 8GB DDR3-1600 UDIMM ECC), 250GB SATA 7200RPM HDD, Red Hat Enterprise Linux 6.4. Estimated score:int_rate_base2006=69, Est. Power=19W

Estimated Xeon® E3-1285L v3 vs. nVidia* GTX 680 Comparison

		nVidia* GTX 680	Xeon E3-1285L v3	Xeon E3 Advantage
				
Per Node	No. of Transcodes	8	10	up to 25% more
	Power (1 CPU + 1 GPU)	290W	65W	
Per Rack	No. of Transcodes	336 (42 GPUs)	1,560 (156 GPUs)	up to 4.6x better
	Power	14,524W	10,865W	
	3yr TCO per Transcode	$353.52	$127.42	up to 64% lower

Platform configurations: Discrete graphics: 1U server with two Intel® Xeon® processor E5-2650, 2.0 GHz, 20MB cache, 8GT/s QPI, 8x1GB DDR3-1333 memory, 1 hard drive, 1 power supply, 2 nVidia* GTX680 graphics cards; Xeon E3v3: 3U microserver with twelve Intel® Xeon® processor E3-1285Lv3, 3.1 GHz, 8MB cache, 4x1GB DDR3-1333, 1 hard drive, 1 power supply. Concurrent transcode per GPU: 8 (Discrete graphics), 10 (E3v3). GTX680 transcode performance from nVidia* whitepaper at http://international.download.nVidia*.com/webassets/en_US/pdf/GeForce-GTX-680-Whitepaper-FINAL.pdf. Intel E3 transcode performance came from Intel whitepaper: Intel Quick Sync Video Technology on Intel® Iris™/Iris Pro Graphics (5100+ Series and Intel HD Graphics (4200+ Series)—Flexible Transcode Performance and Quality Explained.

* Results, which are provided for informational purposes only, were estimated as of March 2013 by Intel based on a comparison of performance (number of 1080p 30fps HD concurrent transcode per GPU) and related results utilizing Intel's product data and data published by nVidia* Kepler*. Any difference in system hardware or software design or configuration may affect actual performance. Intel does not control or audit the design or implementation of third party data referenced in this document. Intel encourages all of its customers to visit the websites of the referenced third parties or other sources to confirm whether the referenced data is accurate and reflects performance of systems available for purchase.