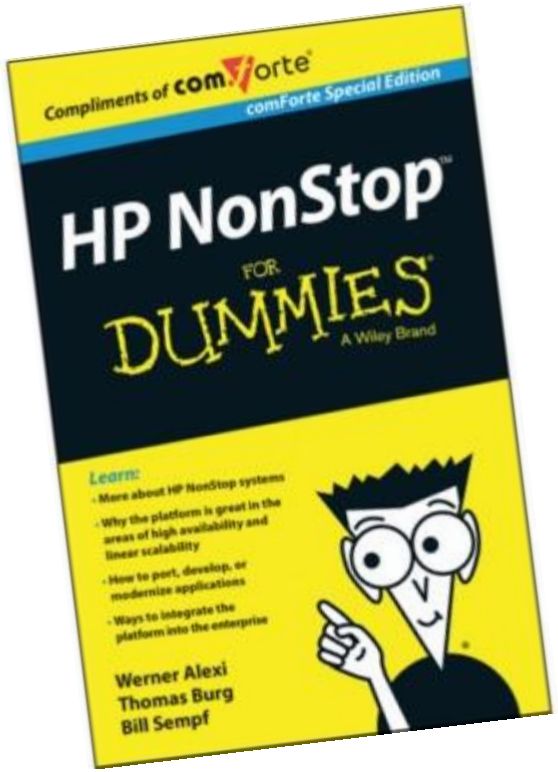
Redefining availability and scalability for x86

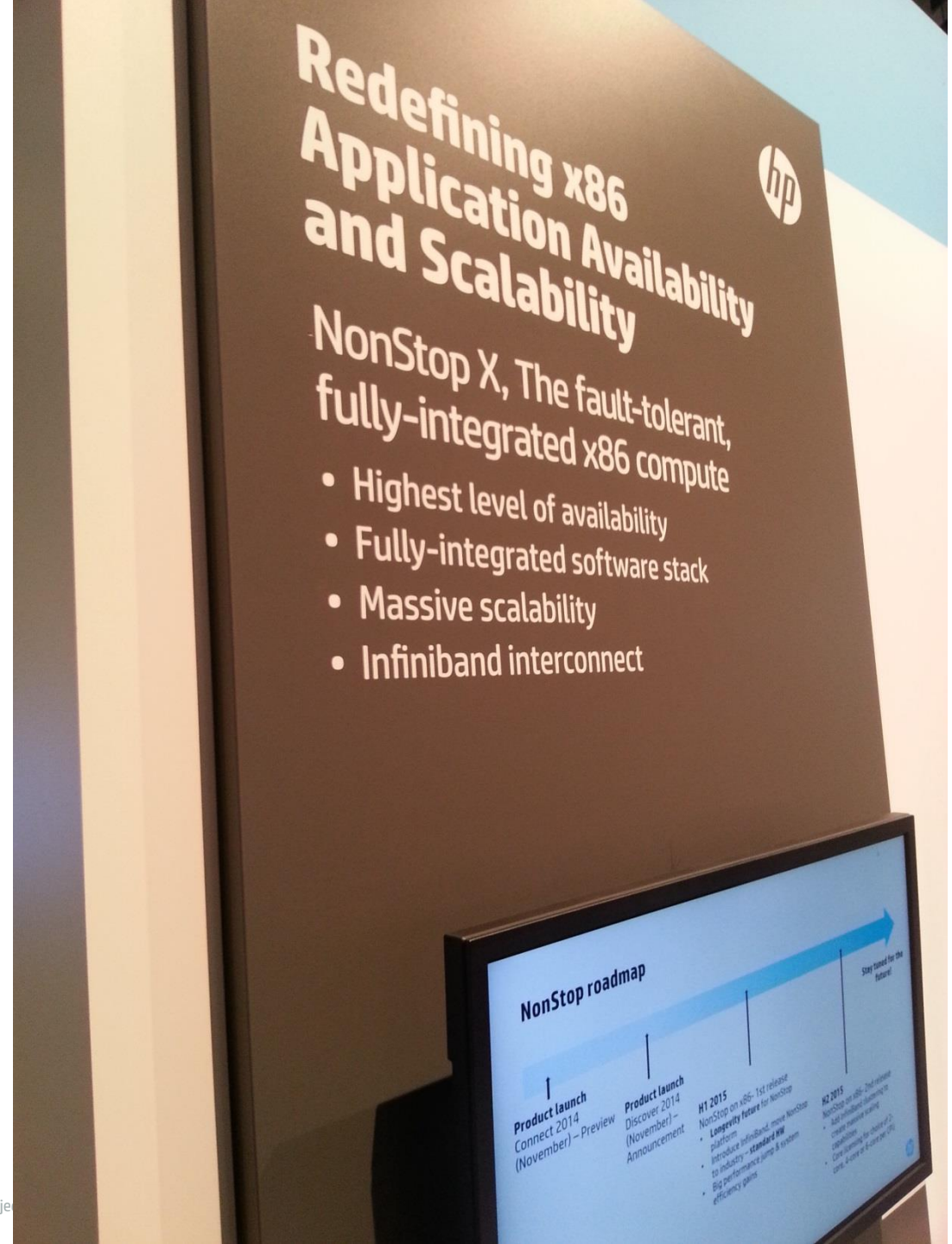
HP Integrity NonStop X

December 2014

TBC San Jose

HP Discover Barcelona





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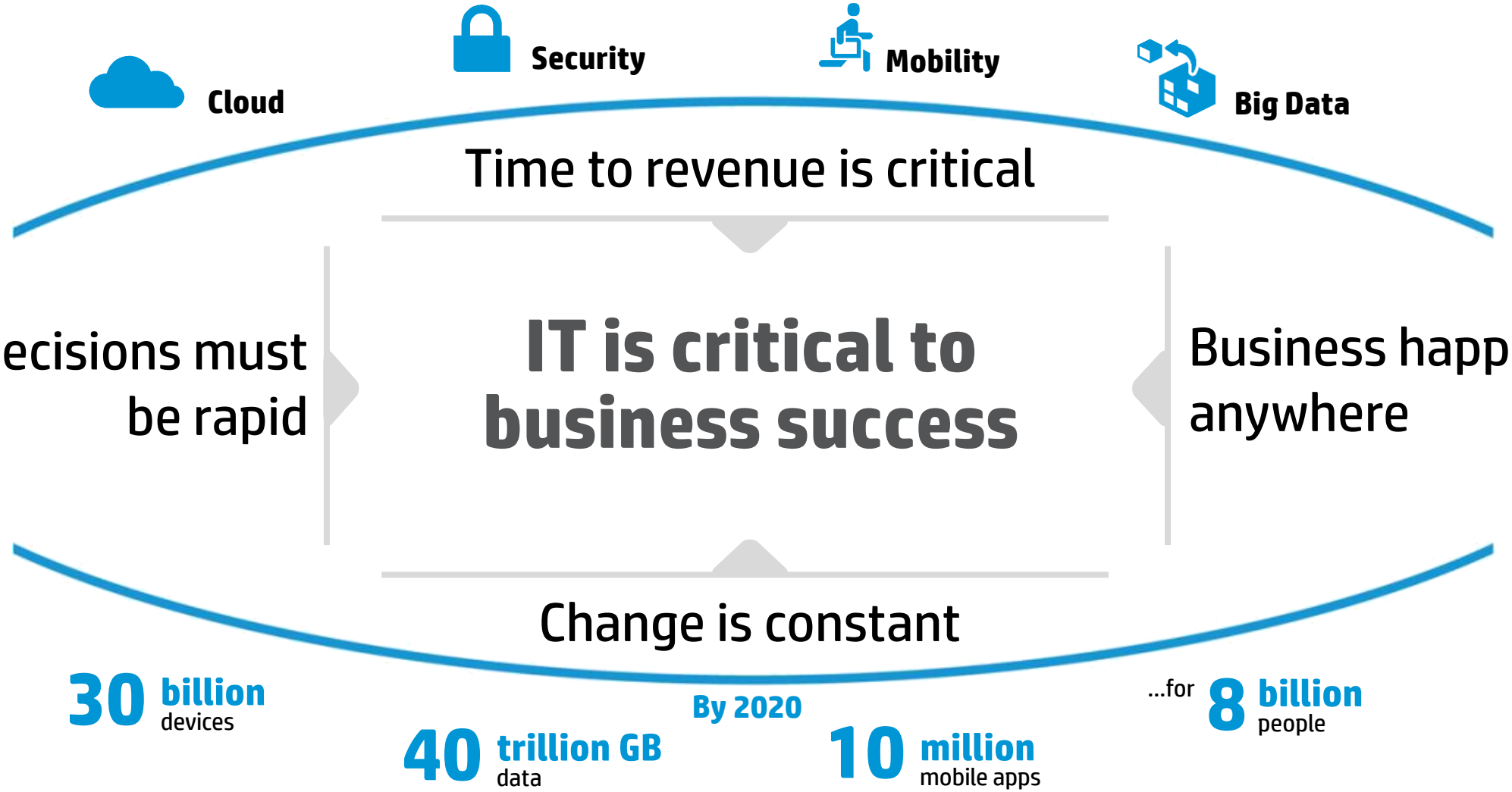
Forward-looking statements

This is a rolling (up to three year) statement of direction and is subject to change without notice.

This document contains forward looking statements regarding future operations, product development, product capabilities and availability dates. This information is subject to substantial uncertainties and is subject to change at any time without prior notification. Statements contained in this document concerning these matters only reflect Hewlett Packard's predictions and/or expectations as of the date of this document and actual results and future plans of Hewlett-Packard may differ significantly as a result of, among other things, changes in product strategy resulting from technological, internal corporate, market and other changes. This is not a commitment to deliver any material, code or functionality and should not be relied upon in making purchasing decisions.

The most exciting shifts of our time are underway



Workload-optimized portfolio for better business outcomes

For virtualized and cloud workloads


HP BladeSystem


HP OneView

Convergence to accelerate IT service delivery

For mission-critical environments


HP ProLiant scale-up


"DragonHawk"


HP Integrity blades & Superdome


HP Integrity NonStop

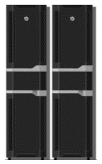
Availability to function in real-time

Common modular compute architecture

For Big Data, HPC, and web scalability


HP ProLiant SL and XL


HP Moonshot


HP Apollo

Density and efficiency to scale rapidly

For core business applications


HP MicroServer


HP ProLiant ML


HP ProLiant DL

Intelligence to increase productivity

Global support and services | Best-in-class partnerships | Converged solutions

Think what compute can do for your business

Hutchinson Drei Austria

20%
reduction in operating expenditures per year

BON-TON

Zero
unplanned downtime since 1998

Telefónica

50%
reduction in data center footprint

pulse

5x
transactional volume at 25% of former cost

FNB First National Bank

300%
performance increase with 30% YoY transaction volume growth

Software-defined and cloud-ready

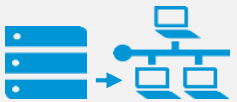
Workload-optimized

Converged

Basic processing to Integrated systems

Micro to **mission-critical computing**

Client to cloud



Storage to networking

The right compute for the right workload at the right economics … every time

Customer challenges

"Linux, Windows, and VMware cannot **deliver the fault-tolerance** my applications require."

"I want to leverage NonStop scalability and availability for my **Java applications.**"

"Our corporate direction is to **standardize** on architectures that use **x86 technology.**"

"We need a **really fast** system that can process a gigantic volume of **transactional data and scale as our business grows**."

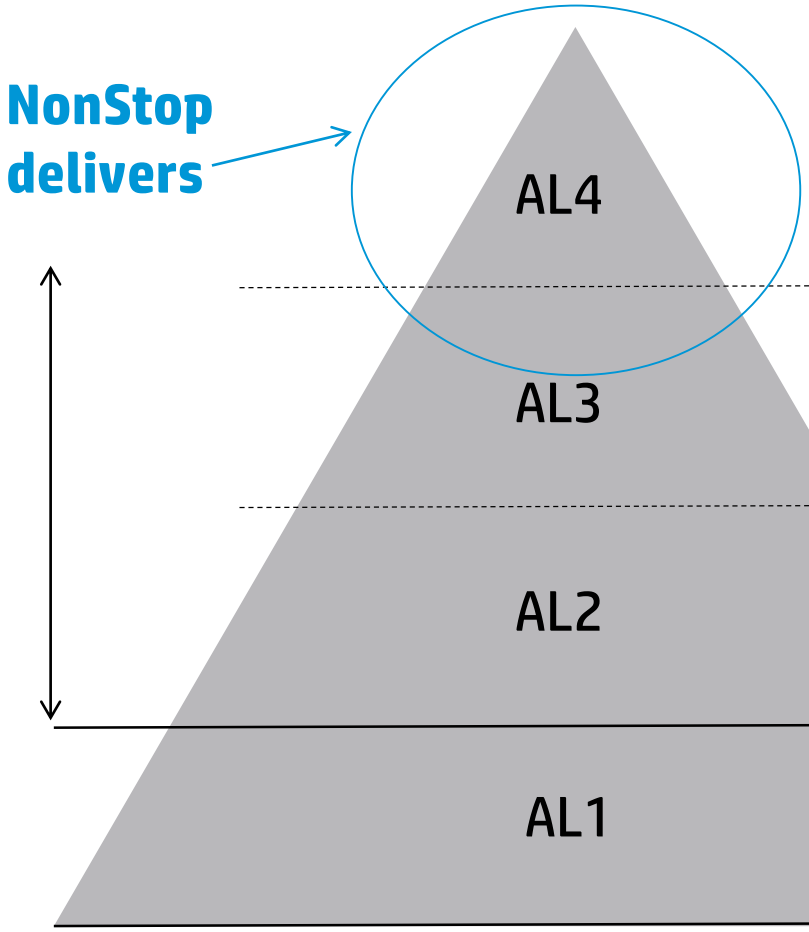
"Our application is very **critical to our business**. We just can't tolerate downtime ever**.**"

Is your IT mission-critical

Continuous Availability: to eliminate downtime

High Availability: to minimize downtime

HP NonStop systems are AL4



- Impact of component failure
  - **Availability Level 4**

Switch to alternate resources is not perceptible to end users

Availability Level 3
Short outage is needed for failover to take place

Availability Level 2
Balancing may not be perceptible to end-users because of retry

Availability Level 1
Need to switch to redundant resources before processing resumes.

Source: IDC, September 2012, Doc #236946 Worldwide and U.S. High-Availability Server 2012-2016 Forecast and Analysis

The beginning of a new family of NonStop products

Introducing HP Integrity NonStop X: redefining availability and scalability for x86

100% HP NonStop

NonStop Itanium

- Intel® Itanium® processor
- Proprietary interconnect
- Massive scalability
- Highest AL4 availability

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- Intel® Itanium® processor
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NonStop X

- Intel® Xeon® processor
- Industry-standard interconnect

NonStop X: The only fully-integrated, fault-tolerant compute for x86 solutions

The only fully-integrated, fault-tolerant compute for continuously-available x86 solutions

Making x86 compute continuous

HP Integrity NonStop X: the only fully-integrated, fault-tolerant compute for x86 solutions

Availability

100% fault-tolerant system architecture for the most-stringent uptime SLAs

Scalability

>25x increase in system interconnect capacity for responding to business growth needs

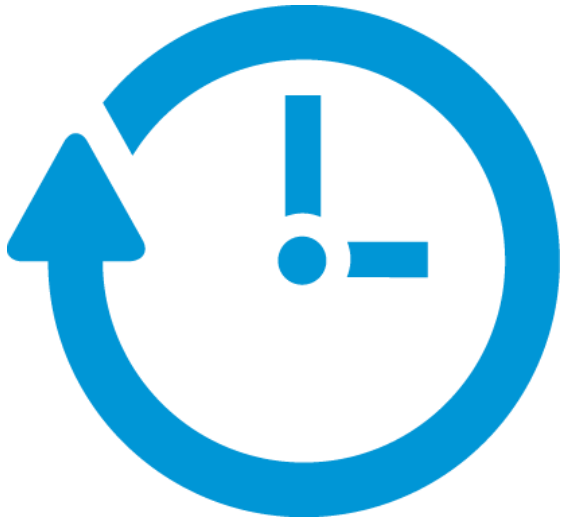
Efficiency

2x NonStop CPU density in a single enclosure for decreased data center footprint and costs

NonStop X: Delivering more availability and scalability than any x86 server

NonStop X delivers the very highest availability

For continuous business



More availability than any x86 server

100% fault-tolerant architecture for the most-stringent uptime SLAs

IDC AL4 server availability ranking where business processing continues without interruption

Intelligent **self-healing** capabilities to protect from application outages

NonStop X delivers massive scalability

For growing business performance

More scalability than <u>any</u> x86 server

>25x increase in system interconnect capacity for responding to business growth needs

Up to **50%** performance capacity increase to handle higher transaction volumes

Near-linear scalability, online without application outage, for handling transaction volume

NonStop X delivers operational efficiency

For greater business value

2x NonStop CPU density

50% reduction in data center footprint using a single enclosure

Up to **2x** memory capacity for improved application performance

Standard **InfiniBand** for increased system interconnect capacity

What we're announcing

Standard hardware with x86 architecture

Provides flexibility and choice

- **Half-height HP server blade with Intel® Xeon® processors**
  - Up to 16 NonStop CPUs in a single c7000 enclosure
  - Up to 2x NonStop CPU density
  - Up to 2X memory capacity
- **Fixed 4-core license**
  - 4-core NonStop X system with up to 50% more performance capacity
  - Compared to 4-core NonStop BladeSystem NB56000c
- **Scale-up in a single NonStop on x86 system** online without application outage
  - Scale-out with up to 255 networked nodes via Expand over IP clustering

New system interconnect for NonStop X

Industry-standard InfiniBand

- **Shares many of the same features as ServerNet**, including:
  - Remote Direct Memory Access (RDMA)
  - Guaranteed packet delivery
  - Fault tolerance
  - Scalability
- **Increases the NonStop X system interconnect capacity** by more than 25 times
- **Improves packet latency** (significant reduction)
- **Delivers higher per port bandwidth to CLIMs**
- **Increases maximum CLIM connectivity**
- **Supports storage, IP, and Telco CLIMS**

The NonStop X software stack

All layers of the software stack have been optimized for HP Integrity NonStop X

APPLICATIONS

Modern application development tools	NSDEE (Eclipse) + compilers are modified for x86.
Middleware	Middleware products work as they did on Intel® Itanium®.
Database and transaction management	HP NonStop SQL/MX and SQL/MP are ported to x86.
System management and control	All management products offered on Itanium are expected to run on x86.
Security	Security is included with the OS, modified to run in x86 Native mode.
NonStop Operating System	The NonStop OS is optimized for x86 and InfiniBand.

HARDWARE

Some more technical details…

Deploying existing applications on NonStop X

NonStop has successfully transitioned to new processor technologies in the past

NonStop processor technology introductions

Applications moving to NonStop X will have the same options as they had with prior technology introductions

- Some code runs ‘as is’ on the new platform without any change
- Some code may need to be accelerated—adding a new x86 binary to the existing object file
- Native code will need to be recompiled—to run on the new platform

Software Release version is L-series

And it has a new naming convention

- Format: **Lyy-mm**: **yy** last two digits of release year, **mm** month of release
- For example, **L14.09** is the customer Beta RVU name, i.e. September 2014 release
- TOSVERSION is L06 and will remain so for all L-series RVUs
  - Just like the TOSVERSION for H-series was H06 and J-series was J06
    - Note that the above is in the human readable form, the internal version is “V06”
- A function available on all H, J, and L-series releases that returns the release name is being externalized in the Guardian Procedure Calls Manual (since the release name can no longer be constructed using TOSVERSION)
  - SUTVER_GET_()

Big Endian, how does it work?

The x86 is little endian, right?

- The compilers byte swap data items before placing them into memory for program variables
  - Does not apply to non-program variables such as return addresses pushed onto the memory stack
- The OS along with the debuggers make the view complete
  - But if you just scroll through memory you can see a mix of Big and Little endian datums
- Allows for binary data to be exchanged between Itanium and x86 systems without any special handling
  - In particular, messages sent via Expand between a NonStop x86 based system and a NonStop Itanium system require no extra handling.

Supported Features

Most features move forward from J-series to L-series, but with the most current version

- SQL/MP
- SQL/MX, version 3.3
- TS/MP, version 2.5
- JAVA™, version 7 in both 32b and 64b flavors
- LTO6 tape drives

Products not being brought forward to L-series

- All non-CLIM based Comm protocols
  - SNAX and SWAN based I/O
- OSI subsystem
- Tuxedo
- TNS/R (MIPS, G-series) cross development tools
- Enterprise ToolKit (Visual Studio with integrated compilers)
  - replaced by NSDEE (aka eclipse)
- Visual Inspect (VI)
  - replaced by NSDEE

InfiniBand Overview - Technology

HP NonStop on X86

InfiniBand Overview Technology

- Switched Fabric Architecture
  - Point to Point connections, not a bus. Worm hole routing
  - Scalability to more end nodes with additional switches.
  - Redundant paths between end node.
- Media characteristics
  - High speed link rate/ theoretical bandwidth (56 Gb/sec)
  - Low latency
    - The application perceived latency values have a direct relationship to the underlying software driver.
    - InfiniBand HCAs and switches have low latency in terms of port arbitration.
  - Copper or Optical links
  - Long distance capability using optical and DWDMs
- RDMA Semantics
  - Provides Remote RDMA into/out of CPU memory.
  - Provides “interrupt” packets. These packets can be of variable size.
  - Provides memory region access protections

HP NonStop on X86

InfiniBand Overview Technology

- Connection Types
  - Reliable Connections
    - Standard mode for NonStop.
    - Provides guaranteed delivery and error detection
    - Provides connection validation and access rights.
  - Unreliable Datagram
    - Used for Multicast
- Quality of Service
  - Virtual Lanes are separate logical links shared over a given physical link
  - Virtual Lanes have an associated Service Level that defines priority
    - The priority defines order that packets are processed and how much of the bandwidth can be consumed.
  - Credit based flow control
- Data integrity
  - Two CRCs per packet.

InfiniBand Overview – NonStop Usage

HP NonStop on X86

InfiniBand NonStop Usage

- Data Integrity
  - InfiniBand enables the highest levels of data integrity by performing cyclic redundancy checks (CRCs) at each fabric hop and end to end across the fabric to ensure the data is correctly transferred. Data integrity is one of the cornerstones of the NonStop platform architecture.
- Fault Tolerance
  - InfiniBand enables the creation of multiple separate fabrics. Failover between fabrics is provided by the NSK OS and is transparent to customer applications.
- Bandwidth/Latency
  - InfiniBand provides increased bandwidth and low latency required for demanding IO centric applications on the x86 platform.
- RDMA
  - The ability to remote DMA data into/out of CPU memory without kernel intervention enhances efficiency of customer workload processing
  - NonStop software, in terms of the system interconnect, will require a high bandwidth and low latency architecture provided by InfiniBand. This interconnect architecture will minimize CPU cycles consumed solely for task context switches, protocol processing and data movement from/into the network

HP NonStop on X86

InfiniBand NonStop Usage

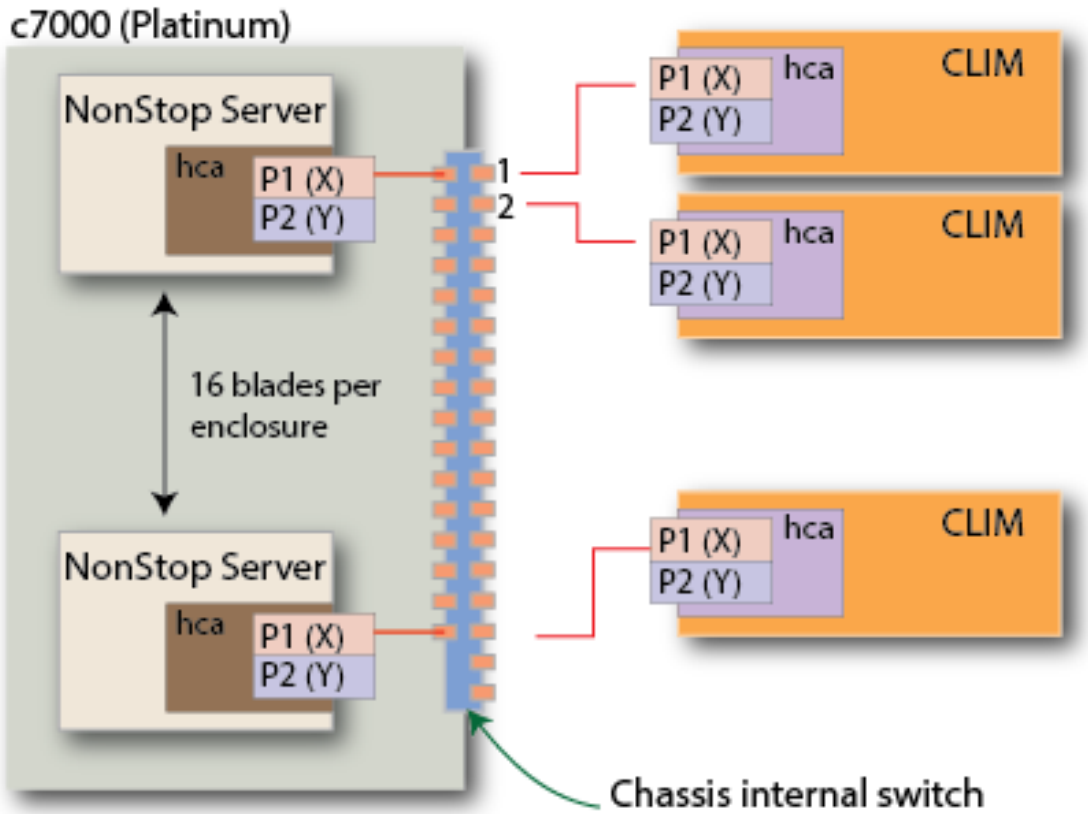
- Multiple Vendor Support
  - The NSK OS kernel infrastructure can support multiple hardware vendors
- Clustering / Long Distance
  - InfiniBand provides solutions for clustering NonStop systems together
  - Geographically remote systems can be clustered over InfiniBand
- Continuity of NSK OS infrastructure
  - InfiniBand technology is based on ServerNet
  - Existing NSK OS relies on the ServerNet fundamentals that are still present within InfiniBand

NonStop InfiniBand Hardware

HP NonStop on X86

NonStop Hardware

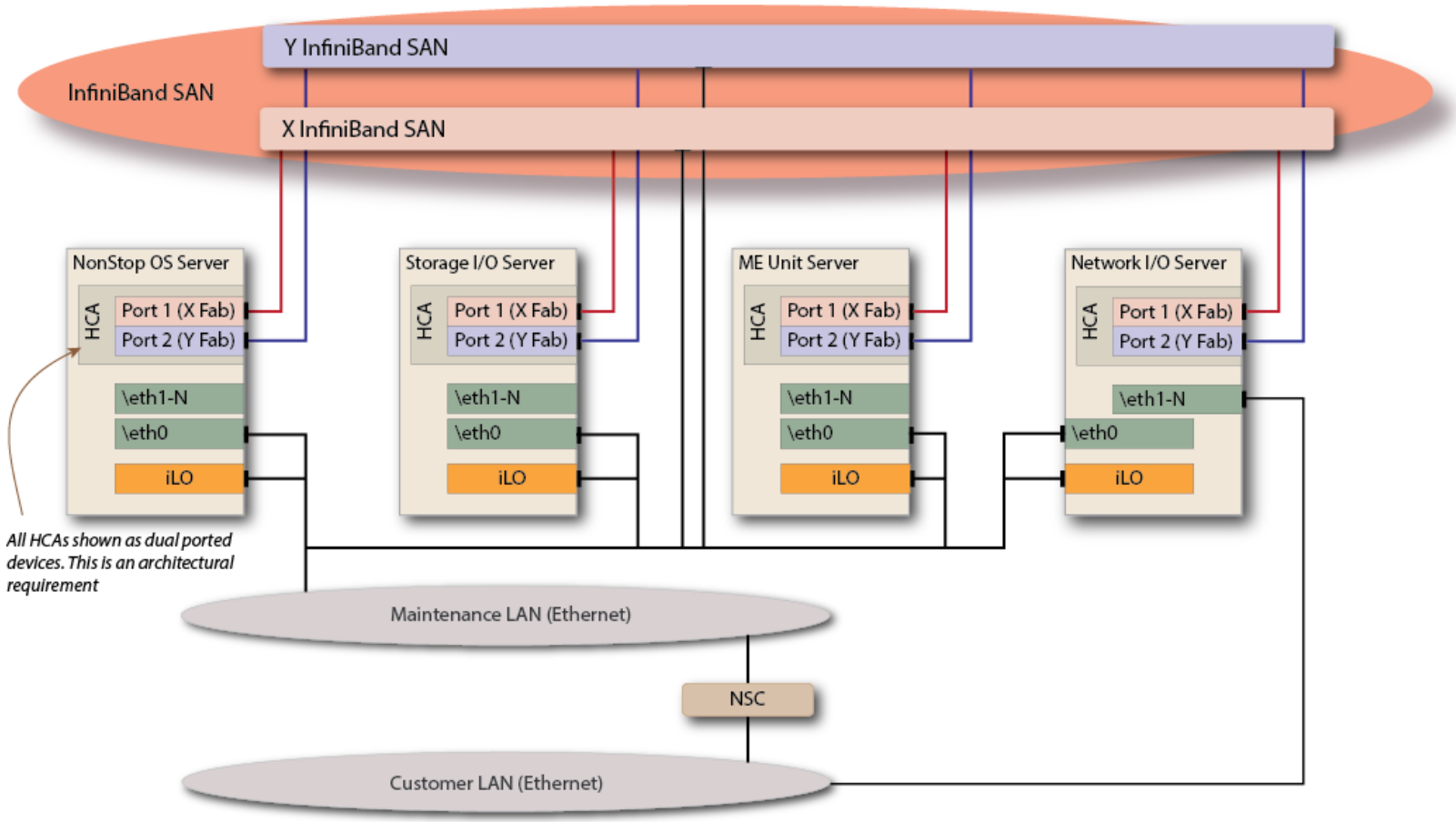
- NonStop systems are c7000 enclosure based
  - Each enclosure can house 16 NonStop CPUs.
  - Blades are of the half-height variety.
- NonStop CPUs are housed in x86 Blades
  - Each Blade contains one InfiniBand HCA (Host Communications Adapter)
  - Each HCA is dual ported (X and Y fabrics)
  - Each c7000 contains two InfiniBand switches (X and Y)
- NonStop CLIMs (storage and networking)
  - Each CLIM contains one InfiniBand HCA
  - Dual ported.
- Topology
  - All NonStop resources (CPUs and CLIMS) attach to a switch modules
  - Separate fabrics for X and Y. Fabrics converge at the given HCAs



HP NonStop on X86

NonStop Hardware

- Infiniband replaces legacy ServerNet
  - Dual Fabrics
  - Point to Point wormhole routing
- Ethernet Maintenance LAN
- NonStop CPUs boot HSS over Ethernet
  - HSS image can be on NSC or CLIM
- NonStop CPUs boot NSK over Infiniband
  - HSS loads system image from Storage CLIM using InfiniBand



This is just the beginning

HP Integrity NonStop X futures

New product family of x86 systems that run the NonStop OS

- Significant improvements in capacity, throughput, and general performance
- Easier to move new applications from other platforms to the NonStop platform
- More software product offerings for this NonStop X system family

Intel® Xeon®
- 4-core fixed configuration
- InfiniBand interconnect
- Expand over IP clustering

Intel Xeon
- 2, 4 and 6-core license configuration
- InfiniBand clustering
- Transaction Management Facility (TMF) audit trail increase

Intel Xeon
- New software offerings
- Entry-class platforms
- Carrier-grade offering
- CPU refresh
- I/O refresh

What NonStop X means for x86 Compute

Growing partner ecosystem for a changing world

Solution partners

Infrastructure partners

Redefining availability and scalability for x86

HP Integrity NonStop X: the only fault-tolerant, fully-integrated compute for x86 solutions

“No matter what HP NonStop hardware architecture you choose, you will continue to get 100% NonStop value that makes what you do truly matter.”

- Meg Whitman, CEO, Hewlett-Packard

Making IT critical to success because…

Availability matters

Scalability matters

Interactions matter

Thank you