A Mainframe Guy Discovers Blades – as in zEnterprise “Blade” Extension

Glenn Anderson, IBM Technical Training

Session 9674
History of Blades.....

- 1999
  - Data center inefficiency
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  - Easier way to deploy large numbers of rack mount web servers in data centers
  - A new server form factor…lower power consumption without sacrificing performance
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• 2001
  – RLX Technologies
  – New term...“server blade”
  – First generation target market – large internet data centers

History of Blades.....

• 2002 – 2003
  – As service provider market collapsed, blade manufacturers attempted to take products to broader enterprise data center market
  – HP, Compaq, Dell, IBM, Sun

• 2006 - 2007
  – New blade designs further address needs of data centers....better I/O management and thermal management
“Interesting Quotes”…..

• “Blade servers arrived before the advent of virtualization…..”
  - Greg Shields, IT Consultant

What is a Blade Server?

• A stripped down server computer with a modular design optimized to minimize the use of physical space and energy
  - A standard rack-mount server can function with (at least) a power cord and network cable
  - Blade servers have many components removed to save space, minimize power consumption and other considerations
What is a Blade Server?

- Blade servers offer a standardized method of deploying multiple processors, memory and I/O resources by placing those resources on plug-in boards that slide into a standard chassis.
What is a blade server?

- A blade server contains the core components of a server
- Each blade server has:
  - Processor(s)
  - Memory
  - Internal storage (optional)
  - Network interface cards (NIC)
  - Optional plug-in components
- The blade server plugs into the midplane of a chassis that provides common functions:
  - Management console access (KVM)
  - Power
  - Cooling
  - Connectivity (LAN, SAN, NAS, HPC)
  - Shared media devices (DVD/ROM, USB)
  - Optional I/O modules to support additional function

Processor

- Processor architectures:
  - x86-64
  - IBM POWER
  - IBM PowerXCell 8i processor
- Single to four socket implementations
- Single to eight core processors
Storage

- Hard drives
  - SAS
- Hot-swap on selected blade servers
- RAID (0,1)
- Solid state disk (SSD)

Memory

- System board-mounted DIMMs
- Speed and capacity
  - Up to PC2-6400 memory speed
  - System board capacity to 128 GB
- Error correction and redundancy
  - ECC detection and correction
  - Chipkill technology
Top of the Rack Switch (TOR)

- A Top of the Rack or (TOR) switch is a small port count switch that sits on the very top or near the top of a Telco rack you see in Data Centers or Co-location facilities.
- Cisco and Brocade as well as other OEM (Original Equipment Manufacturers) describe their new FCoE (Fiber Channel over Ethernet) switches to be "Top of the Rack" thus differentiating them as being small low-cost low port count switches easy to deploy and manager etc.

Blades vs Racks: Industry Opinions

- Rack-mount servers have lower cost entry point than a blade-based installation
- Investment in blades carries a greater economic and technological risk
- Blade enclosure represents a single point of failure
Blades vs Racks: Industry Opinions

- Fill the chassis with blade servers, price per server comes way down
- Blades ease server management for administrator
- Blade infrastructure more efficient than racks with consolidated power and cooling
- Blades reduce cabling requirements

IBM Blade Servers
IBM BladeCenter Family

BladeCenter Chassis by model and type

IBM BladeCenter E
- High-density, power efficient
- 7U design
- Up to 14 blade bays
- Up to 4 switch fabrics
- Low cost
- Low power
- Support for 10 Gigabit Ethernet
- Support for 8 Gigabit Fiber Channel
- SAS Connectivity Module

IBM BladeCenter T
- Highly rugged, Telecom, AC/DC, N+1, or N+2
- 8U design
- Up to 8 blade bays
- Up to 4 switch fabrics
- AC or DC models
- N+1 compliant
- Copper
- Support 10 Gigabit Ethernet
- Support 8 Gigabit Fiber Channel
- SAS Connectivity Module

IBM BladeCenter H
- Ultra high performance and I/O flexibility
- 12U design
- Up to 14 blade bays
- Up to 10 Gigabit Ethernet
- I/O flexibility up to 8 switch bays
- Support 60 mm blades with up to 8 ports
- Support 10 Gigabit Ethernet
- Support 8 Gigabit Fiber Channel
- Support 480Gbps InfiniBand
- SAS Connectivity Module

IBM BladeCenter HT
- Highly rugged, Telecom, AC/DC, N+1, or N+2
- 7U design
- Up to 12 blade bays
- AC or DC models
- I/O flexibility up to 8 switch bays
- N+1 compliant
- Copper
- Support 10 Gigabit Ethernet
- Support 8 Gigabit Fiber Channel
- Support 480Gbps InfiniBand
- Support SAS Connectivity Module

IBM BladeCenter S
- Integrated dual 10Gbps or 24Gbps power
- BladeCenter suitable for datacenter
- 7U design
- Up to 6 blade bays
- Integrated storage
- Up to 3 switch fabrics
- Power (103 - 240V)
- S40 with 1450 AC subsystem
- Support 10 Gigabit Ethernet
- Support 4 Gigabit Fiber Channel
- SAS RAID and Connectivity Modules

Common blades, common switches, common management

U = Rack Unit

(c) 2011 IBM Corporation
Chassis: IBM BladeCenter H

- 9U and 28 inches deep
- Supports up to 14 30mm blades
- Customer serviceable, hot swappable media tray
- 9.5mm combo drive (CD/DVD)
  - Two USB front inputs
  - Full light path diagnostics panel
- Rack mounted on rails
- Four front load 2900W power supplies
  - Each power supply includes a replaceable fan pack with three fans
IBM BladeCenter H Rear View

BladeCenter Midplane
BladeCenter H Power Modules

- Power module bays
  - Maximum of four per chassis
  - Two ship standard with the chassis
    - Power modules 1 and 2 standard pair
    - Power modules 3 and 4 optional pair

Power and Signal Paths

- Blade server to midplane connections
  - Redundant power
  - Signaling
Advanced Management Module

*Center point for IBM BladeCenter infrastructure intelligence*

- Hot-swappable module
- Powerful and robust systems management
- Proxy for expansion modules
- Controls all aspects of power, connectivity and communication
- Reliability, availability, and serviceability (RAS)

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The POWER7 Product Family

**Express**

- POWER 750 Express
  - 6, 8, 12, 16, 24, 32 cores
  - 8-512 GB Memory
  - Up to 8 I/O Drawers

- POWER 740 Express
  - 4, 6, 8, 12, 16 cores
  - 8-256 GB Memory
  - Up to 8 I/O Drawers

- POWER 720 Express
  - 4, 6, or 8 cores
  - 8-128 GB Memory
  - Up to 4 I/O Drawers

- POWER 730 Express
  - 8, 12, or 16 cores
  - 8-128 GB Memory

- POWER 710 Express
  - 4, 6, or 8 cores
  - 8-64 GB Memory

**Scalable Midrange**

- POWER 780
  - 8 or 16 Cores / Node
  - TurboCore Mode
  - 4-64 Cores at 3.8 GHz
  - 4-32 Cores at 4.1 GHz
  - 24x7 Warranty
  - PowerCare Service
  - Up to 2 TB memory

- POWER 770
  - 12 or 16 Cores / Node
  - 4-64 Cores at 3.1 GHz
  - 4-48 Cores at 3.5 GHz
  - Up to 2 TB memory

**Scalable High End**

- POWER 795
  - Up to 128 @ 4.20 GHz
  - Up to 192 @ 3.72 GHz
  - Up to 256 @ 4.00 GHz
  - Up to 8 TB memory
  - PowerCare Service
  - Capacity on Demand

**HPC**

- POWER 575
  - 32 Cores at 3.55 GHz
  - Up to 256 GB / Node

- POWER 755
  - 32 Cores at 3.55 GHz
  - Up to 256 GB / Node

**POWER Blades**

- PS700 – 4 core/64 GB max
- PS701 – 8 cores/128 GB max
- PS702 – 16 cores / 256 GB max

*Selected for zEnterprise zBX*
The PS701 blade server
The PS701 blade server (8406-71Y) is a single socket, single-wide 8-core 3.0 GHz POWER7 processor-based server. The POWER7 processor is a 64-bit, 8-core with 256 KB L2 cache per core and 4 MB L3 cache per core.

The PS701 blade server has 16 DDR3 memory DIMM slots. The industry standard VLP DDR3 memory DIMMs are either 4 GB or 8 GB running at 1066 MHz. The memory is supported in pairs, thus the minimum memory required for PS701 blade server is 8 GB (two 4 GB DIMMs). The maximum memory that can be supported is 128 GB (16x 8 GB DIMMs).

The PS701 blade server has two Host Ethernet Adapters (HEA) 1 GB integrated Ethernet ports that are connected to the BladeCenter chassis fabric (midplane). The PS701 also has an integrated SAS controller that supports local (on-board) storage, integrated USB controller and Serial over LAN console access through the service processor, and the BladeCenter Advance Management Module.

The PS701 has one on-board disk drive bay. The on-board storage can be one 2.5-inch SAS HDD or SSD drive. The PS701 also supports one PCIe C1Ov expansion card slot and one PCIe CFFh expansion card slot. See 1.5.8, “I/O features” on page 24 for supported I/O expansion cards.

AIX Version 7.1

- Latest generation of IBM’s well-proven, scalable, open standards-based UNIX operating system
- Built on IBM POWER technology and virtualization
- Celebrating 25th anniversary
  - Originally ran on RISC processor, engineering workstation
“Interesting Quotes”…..

• “AIX is the only operating system that leverages decades of IBM technology innovation designed to provide the highest level of performance and reliability of any UNIX operating system.”
  
  - IBM AIX Web Page

Power Hypervisor
Dedicated and Shared Processor Modes
### Sample Calculations for Configuring Virtual Servers

<table>
<thead>
<tr>
<th>Configuration step</th>
<th>Available physical processor cores</th>
<th>Available processing units (pu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start with one PS701 blade that has no virtual servers defined</td>
<td>8</td>
<td>8.00</td>
</tr>
<tr>
<td>Subtract amount reserved for the blade hypervisor (0.80 pu)</td>
<td>7</td>
<td>7.20</td>
</tr>
<tr>
<td>Add virtual server A, which requires 2 dedicated processors assigned to two virtual processors</td>
<td>5</td>
<td>5.20</td>
</tr>
<tr>
<td>Add virtual server B, which requires 1.20 processing units assigned to two virtual processors</td>
<td>4</td>
<td>4.00</td>
</tr>
<tr>
<td>Add virtual server C, which requires 2.10 processing units assigned to five virtual processors</td>
<td>1</td>
<td>1.90</td>
</tr>
<tr>
<td>Add virtual server D, which requires 1.50 processing units assigned to three virtual processors</td>
<td>0</td>
<td>0.40</td>
</tr>
</tbody>
</table>

![Diagram of zBX BladeCenter with virtual servers](image)
System x – HX5 Blade Server

- The HX5 Blade Server implements the IBM eX5 architecture
- Processor support for up to four Intel Xeon 7500 processors
  - Four-core, six-core or eight-core configurations
    - Hyper-threading
    - Turbo boost
    - Quick path interconnect (QPI)
System x Hypervisor

• Integrated KVM based Hypervisor supplied by Unified Resource Manager
• KVM: Kernel-based Virtual Machine
  – Open source virtualization solution for Linux on x86 hardware

• For System x blade on zBX, loaded as firmware
  – Linux Kernel + KVM + zManager components

Fibre Channel (FC) Terms

• Ports
  – connection point for Fibre-Channel cable
  – identified by World-Wide Unique Portname (WWPN)

• Logical Unit
  – virtual SCSI disk drive on Storage Controller
  – addressed by WWPN/Logical Unit Number (LUN)
  • multiple WWPN/LUN pairs

• Access Control
  – Zoning
    • logical grouping of host and storage controller ports in switches
    • only members within a group can see/talk to each other
    • WWPN (or port) based
  – LUN Masking
    • access control enforcement by storage controller
    • host port WWPN based
Zoning

Fabric

Zone1: WWPN3 + WWPN0 + WWPN6
Zone2: WWPN7 + WWPN5 + WWPN1
Zone3: WWPN5 + WWPN2

Zoning policy is kept in a switch and is valid for the entire fabric.

zEnterprise Hardware Components

zBX Infrastructure
- Rack
- Top-of-Rack Switch
- BladeCenter Chassis
- Ethernet & FC Cables
- BC Switches (ESM, FC)
- Power Dist. Units
- Opt: Heat Exchanger, Power cord types

Blades
- IBM Smart Analytics Optimizer
- DataPower Blade
- Power Blade
- Intel Blade
POWER7 Blade in the zBX

- General-purpose computing platform
  - Housed in standard BladeCenter H chassis inside IBM® zEnterprise™ BladeCenter® Extension enclosure
  - Up to 112 blades
    - 14 blades per BladeCenter
    - 2 BladeCenters per rack
    - 4 racks per zBX Model 2
- Managed by the IBM zEnterprise Unified Resource Manager
- Virtualized with firmware-supplied hypervisor
- Entitled through System z firmware

System x Blade in the zBX

- Intel 8 core processor
- HX5 7873
  - Single wide two socket blade
- 64GB or 128GB memory
- Blades acquired by the customer through existing channels or through IBM
- Red Hat RHEL 5.5 or Novell SLES 11 SP1 Linux
zEnterprise Firmware

- PowerVM Enterprise Edition is hypervisor
  - pHyp 2.1
  - VIOS 2.1.3
  - Extensions for configuration systems management
    - Hardware setup, FFDC, Heartbeat, PPM Daemon
- System x KVM-based hypervisor
- Packaged and managed as firmware on Support Element
  - Loaded automatically at power on
  - Serviced via System z MCL process
  - Full set of operational controls
- Managed as a closed system from the Hardware Management Console (HMC)
  - No AMM access
  - No VIOS access, so no VIOS add-ons supported. (e.g., ITM hypervisor agent, or PCM drivers)
  - Enables creation and management of virtual servers via the Unified Resource Manager

PowerVM Hypervisor

- CPU (8-core PS701)
  - Each CPU has capacity of 1.0 processing units (PUs)
    - VIOS default capacity is 0.1 PUs per CPU (8 shared virtual CPUs on PS701)
    - Each dedicated CPU requires 1.0 PUs
  - Each shared virtual CPU requires at least 0.1 PUs
  - Up to 7.2 PUs across 8 shared CPUs or up to 7 dedicated CPUs (one for VIOS)
  - No over-commitment of PUs
- Memory
  - No over-commitment.
  - VIOS requires at least 4GB
Provision Virtual Server

- Required Planning
  - Processors (virtual CPUs and capacity in PUs)
  - Memory
  - Storage (i.e., zones)
  - Network (i.e., VLANs)
  - Possible static migration targets (i.e., SAN zones, VLANs)

- To provision a virtual server
  - Create it
  - Install an operating system

zEnterprise Storage Resources
zBX Storage Topology

Similarities to Current POWER7 Blades

- **zEnterprise POWER7 Blade offerings, PS701**
  - 8 core, 3.0 GHz processors, 32G/64G/128G memory options
  - 2 1Gb Ethernet, 2 10 Gb Ethernet, 2 8Gbps fibre channel ports

- **AIX 5.3 or higher**
  - Installed via virtual media or NIM

- **Virtualization via PowerVM Enterprise Edition**
  - Built on POWER7 Hypervisor
  - Shared or dedicated processors
  - Capped / Uncapped LPARs

- **Acquired through normal sales channels**
Differences from Current POWER7 Blades

- Only the 8 core, PS701 POWER7 blade is supported,
  - Memory, adapters, and disk options are pre-determined
- The POWER EE Hypervisor and VIOS are packaged, distributed, and installed from the System z196 Support Element using the zManager UI (Ensemble HMC)
  - The VIOS is required for all PS701 blades in zBX.
  - There is no need for AMM access.
  - There is no need for VIOS command line access.
- All LPAR lifecycle management is provided via zManager
- End to End Performance Management from the Hypervisor down is provided via zManager
  - Adjusts entitled CPU capacity to meet installation-specified objectives
  - Requires the Automate Feature Code (FC0020)
- SAN access via a pair of Qlogic 8Gbit ports which connect to the SAN via 8Gbit QLogic switches operating in Passthru Mode (NPIV). NAS support is also available.
- No Active Memory Sharing / Active Memory Expansion
- No Live Partition Mobility (at GA1)
- No Linux (PowerVM Lx86) or IBM i (formerly i5/OS)
Blade.org

About Blade.org
Blade.org is a collaborative organization and developer community focused on accelerating the development and adoption of open blade server platforms. The organization was established in February 2006 to increase the number of blade platform solutions available for customers and to accelerate the process of bringing them to market. From eight founding companies, Blade.org has grown to nearly 100 members including leading blade hardware and software providers, developers, distribution partners and end users from around the globe.

For more information, please visit: http://www.blade.org.