IBM POWER7 a benefity spojené s DB2
Introductions

- Pavel Sýkora
- Sales Specialist – Power Systems
- Přehled systémů Power Systems a jejich výhody ve spojení s DB2
Basic architecture terminology

- **“Socket”**
  The place a chip is placed on a processor card. For POWER7 servers today there is one chip per socket.

- **“Chip”**
  A POWER7 chip is the **hardware processor chip** which consists of over a billion transistors and other circuitry. It has cores, cache, memory controllers, connections to other elements, etc.

- **“Core”**
  A subunit of a chip consisting of multiple execution units. **A core could be considered “the brain” of the chip.** Years ago the processor chip and processor core were the same thing, but as technology advanced it became possible to shrink multiple chips onto one chip and share some resources. The POWER6 chip had two cores. The POWER7 chip has four, six or eight cores.

- **“Thread”**
  A unit of work which can be done by the core. **POWER7 introduces the ability to have up to four threads being worked on concurrently per core.** POWER6 had a max of 2. The ability to run multiple threads allows the cores to work more productively (less waiting) and thus allows more work to be accomplished over a set span of time.
IBM ... has a proven track record

100 Years of scientific discovery!
Power Systems is helping deliver higher quality services
— by impacting the way humans communicate with computers

- **IBM Watson** represents the latest in a long line of groundbreaking innovations from IBM

- Watson can understand the meaning and context of human language, and rapidly process information to find precise answers to complex questions

**What’s next for Watson…**

**Healthcare and life sciences:**
- Diagnostic Assistance
- Evidence-based
- Collaborative Medicine

**Technical support:** help-desk, call centers

**Enterprise knowledge management and business intelligence**

**Government citizen services**

“In healthcare, we talk about turning data into knowledge. That’s really what Watson does.”

Joe Jasinski, Program Director
IBM Healthcare and Life Sciences Research

To learn more about IBM Watson:
http://www.ibm.com/watson/
Why Power?

Workload-Optimizing Systems

Virtualization without Limits
- Drive over 90% utilization
- Dynamically scale per demand

Resiliency without Downtime
- Roadmap to continuous availability
- High availability systems & scaling

Dynamic Energy Optimization
- 70-90% energy cost reduction
- EnergyScale™ technologies

Management with Automation
- VMControl to manage virtualization
- Automation to reduce task time
Workloads moving to Power Systems

New capabilities make POWER7 systems the right choice for a wide range of workloads

- CRM
- ERP
- SCM
- HR
- Finance
- Telco
- Government
- Healthcare
- Retail / Distribution

- Web application serving
- Network Infrastructure
- Security Infrastructure
- E-mail & Collaboration
- Remote Access
- Data Center Networks

Analytics/HPC
- "Real-time" analytics
- Business Intelligence / Data Mining
- Departmental High Performance Computing
- High Capability HPC

Transaction Processing
- Database & OLTP
  - Small to Very Large
- Data Warehousing
- ERP/CRM Backends

Web / Application Serving & Collaboration

Business Processing

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IBM … Power leading market growth …

Only UNIX growth in the market today

UNIX Server Rolling Four Quarter Average Revenue Share

Sun/Oracle and HP customers moving to Power in the last 5 years!

Source: IDC Server Tracker, Feb 2011
POWER7 System technology value …

- **Balance System Design**
  - Cache, Memory, and IO

- **POWER7 Processor Technology**
  - 6th Implementation of multi-core design
  - On chip L2 & L3 caches

- **Common POWER7 System Architecture**
  - Blades to High End offerings
  - Enhanced memory implementation
  - PCIe, SAS / SATA

- **Built in Virtualization**
  - Memory Sharing and Expansion
  - VM Control and Mobility
  - Virtualized IO and Ethernet

- **Green Technologies**
  - Processor Nap & Sleep Mode
  - Memory Power Down support
  - Aggressive Power Save / Capping Modes

- **Availability**
  - Processor Instruction Retry
  - Alternate Process Recovery
  - Concurrent Add & Services
POWER7 architecture

**Physical Design:**
- IBM 45nm Silicon-On-Insulator (SIO) technology
  - 567 mm² with 1.2 billion components
  - 8 cores with integrated cache and memory controllers, 4 threads per core
  - 4 / 6 / 8 Core options
  - 256kb L2 cache, with 32MB shared L3
  - Aggressive Out-of-Order (OoO) execution
  - *Intelligent Threads* in SMT 1, 2, or 4 modes

**Features:**
- 4th Generation SMP Fabric Bus
- 3rd Generation Multi-Threading
- New Power Bus
- Energy Optimized Design
- Multiple Memory Controllers
- DDR3 memory support
- Enhanced GX System Buses
- On-Chip L2/L3 Cache
- eDRAM L3 Cache
- Industry Standard IO

**POWER7 Core**
64-bit PowerPC architecture v2.07
**Execution Units**
- 2 Fixed Point, 2 Load Store Units
- 4 Double Precision Floating Point Units
- 1 Branch, 1 Vector Unit
- 1 Condition Register
- 1 Decimal Floating Point Unit
- 6 Wide Dispatch
- Units include distributed Recovery Function

**Modes:** POWER6, POWER6+ and POWER7
### Solid reliable processor roadmap

<table>
<thead>
<tr>
<th></th>
<th>POWER4</th>
<th>POWER5</th>
<th>POWER6</th>
<th>POWER7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>180 nm</td>
<td>130 nm</td>
<td>60 nm</td>
<td>45 nm</td>
</tr>
<tr>
<td>Size</td>
<td>389 mm²</td>
<td>389 mm²</td>
<td>341 mm²</td>
<td>567 mm²</td>
</tr>
<tr>
<td>Transistors</td>
<td>174 M</td>
<td>276 M</td>
<td>790 M</td>
<td>1.2 B</td>
</tr>
<tr>
<td>Cores</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4 / 6 / 8</td>
</tr>
<tr>
<td>Frequencies</td>
<td>1.3 GHz</td>
<td>1.65 GHz</td>
<td>3-5 GHz</td>
<td>3-4 GHz</td>
</tr>
<tr>
<td>L2 Cache</td>
<td>1.41 MB Shared</td>
<td>1.9 MB Shared</td>
<td>4 MB / Core</td>
<td>256 KB / Core</td>
</tr>
<tr>
<td>L3 Cache</td>
<td>32 MB</td>
<td>36 MB</td>
<td>32 MB</td>
<td>4 MB / Core</td>
</tr>
<tr>
<td>Memory Cntrl</td>
<td>1</td>
<td>1</td>
<td>2 / 1</td>
<td>2</td>
</tr>
<tr>
<td>LPAR</td>
<td>10 / Core</td>
<td>10 / Core</td>
<td>10 / Core</td>
<td>10 / Core</td>
</tr>
</tbody>
</table>

IBM invested over $3.2B in POWER7 systems over the last 3.5 years.
POWER7 multi-threading options

- Dynamic Runtime SMT scheduling
  - Spread work among cores to execute in appropriate threaded mode
  - Can *dynamically* shift between modes as required: SMT1/SMT2/SMT4 … i.e. *Intelligent Threads*
  - Power 7 supports all modes, Power 6 supports SMT1/SMT2

- Operating System Support
  - AIX 6.1, AIX 7.1 and Linux

- LPAR-wide SMT Controls
  - ST, SMT2, SMT4 modes
  - `smtctl/mpstat` commands

- Mixed SMT modes supported within same LPAR
  - Requires use of “Resource Groups”

SMT1: single instruction execution thread per core
SMT2: two instruction execution threads per core
SMT4: four instruction execution threads per core
POWER7  MaxCore and TurboCore™ mode

- MaxCore: 8 available cores
- TurboCore: 4 available cores
- Aggregation of L3 Caches of unused cores.
- TurboCore chips have a 2X the L3 Cache per Chip available
  - 4 TurboCore Chips \( L3 = 32 \text{ MB} \)
- Performance gain over POWER6.
  - Provides up to 1.5X per core to core
- Chips run at higher frequency:
  - Power reduction of unused cores.
- The mode setting is read and implemented only during a “power recycle/reboot” of the System.
  - Set via ASMI or HMC.
- Power 795 8 core chips
  - 4.0GHz (MaxCore) vs. 4.25GHz (TurboCore)
- Power 780 8 core chips
  - 3.86GHz (MaxCore) vs. 4.14GHz (TurboCore)
Power family portrait

Select from the broadest system portfolio in the industry

- The highest performance, most scalable UNIX system ever
- Modular footprints enable seamless growth
- The best selection of Entry servers and Blades for UNIX, Linux and IBM i
IBM’s history of virtualization leadership

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>IBM invents Hypervisor that would become VM on the mainframe.</td>
</tr>
<tr>
<td>1974</td>
<td>First machines with Physical Partitioning.</td>
</tr>
<tr>
<td>1988</td>
<td>IBM delivers LPARs on the mainframe.</td>
</tr>
<tr>
<td>2001</td>
<td>LPARs on POWER4.</td>
</tr>
<tr>
<td>2004</td>
<td>POWER Hypervisor on POWER5.</td>
</tr>
<tr>
<td>2007</td>
<td>Partition Mobility on POWER6.</td>
</tr>
<tr>
<td>2009</td>
<td>Active Memory Sharing on POWER7.</td>
</tr>
</tbody>
</table>

PowerVM™ Builds on Over 40 Years of IBM Innovation:
- Extreme scalability and robustness
- Fine-grained dynamic sharing of processors, memory, and I/O
- Virtual or direct resources
- Integrated firmware hypervisor
- Virtual I/O Server
- Hardware-enforced isolation
- Integrates LPARs and WPARs
- Lx86 cross-platform virtualization
- Capacity on Demand
- Live Partition Mobility
Logical partitions (LPARs)

What is it?

- Firmware-based hypervisor derived from mainframes
- Virtualized operating system instances within a single chassis
- Guest operating system can be AIX, IBM i, or Linux
- I/O devices can be directly attached to the guest OS or virtualized through a (possibly redundant) Virtual I/O Server
- Guest operating systems can add and remove CPU, memory, and I/O resources without rebooting
- LPARs are managed through a Hardware Management Console (HMC)
What is it?

- Each partition still needs a boot disk and Ethernet network connection, but now they can be virtual instead of physical.
- Allows partitions to share Fibre Channel, disk and Ethernet network adapters, with max of 254 partitions (P5 or P6) and 1,000 partitions (P7).
- VIOS 1.2 (AIX 5.3) or VIOS 2.1 (AIX 6.1 & Higher) required with POWER6™ and higher hardware.
- Installed as a special purpose AIX based LPAR, which uses AIX LVM and attaches to traditional storage subsystems.
- Inter-partition communication (client-server model) provided via Hypervisor.
- Provides hosting facilities for virtualized resources for clients and has a restricted shell with unique virtualization command set.

**PowerVM: Virtual I/O server (VIOS)**
What is it?

- Pools of processor cores under scheduling control of the PowerVM™ hypervisor
- Requires POWER6™ or better
- Most useful when guests experience peak loads at different times
- Multiple processor pools per chassis are allowed
- Guest operating systems can be assigned weighted scheduling priorities and processor caps to remain compliant with software licensing requirements
PowerVM: Live Partition Mobility

**What is it?**

- Relocate an entire LPAR between physical chassis
- Requires POWER6™ or better
- LPARs continue to run and provide services to clients, who are completely unaware of the migration
- Final suspension and resumption of LPAR is guaranteed to be **less than 2 seconds**

PowerVM: Live Application Mobility

What is it?

- The capability to relocate a running workload partition from one system to another without restarting the application
- Requires AIX 6.1 or better
- The application running inside the WPAR resumes running after the relocation is complete
- Works with systems based on POWER4™, POWER5™, POWER6™ and POWER7™ processors
- Requires the IBM Workload Partitions Manager for AIX
- Manual or automatic, policy-based relocation

IBM Systems Director with VMControl: Management with Automation

*Integrated service management for simplified IT operations*

Automated management, provisioning and optimization of physical/virtual servers and system pools ensure that your cloud resources are automatically provisioned for optimal utilization

✓ Combines management functions into a single virtualization management tool

✓ Automated provisioning of standardized virtual images enable you to reduce deployment times from days to hours and reduces deployment errors

✓ Improved manageability by combining multiple virtual resources into one manageable entity

✓ Automated virtual image mobility within the system pool for optimal utilization and resilience

✓ Optimizes virtual assets within a system pool for performance, availability and energy use
IBM Systems Director Active Energy Manager

- **Settings**
- **Status**
  - Highest power and temperatures
- **Monitor**
  - Active Energy Managed Resources
  - Candidate Energy Managed Resources
  - Energy Managed Resources by Type
  - Externally Metered Energy Managed Devices
- **Manage**
  - Power caps and power savings
  - Power savings policies
  - Configuration
- **Automation plans and thresholds**
- **License**
Power and Tivoli – Starting a Cloud foundation

Cloud Computing: IBM CloudBurst 2.1

Rapidly deploy a private cloud on POWER7

An integrated service management platform with network, servers, storage, quickstart services that enables the fastest Private Cloud Deployment Today

Customer Benefits

- **Improved time to value** - Quickly deliver a private cloud using a preloaded and integrated system
- **Improved innovation** - Dramatically improve business value and IT’s effect on time-to-market by delivering services faster
- **Decrease capital expenses** – Maximize capital usage and reduce added capital expense.
- **Reduce complexity and risk** - With automation and standardization the human error factor is minimized.
- **Scales to the enterprise** – Able to scale and manage additional Platforms and Workloads

90%

Private cloud implementations built around new Power 7 based servers can be up to 90% less expensive than public cloud options over a three year period *

* “Building a Dynamic Infrastructure with IBM Power Systems” IBM SWG Competitive Project Office, March 2010;
DB2 and IBM POWER Innovative Synergy

Deep Integration for superior performance and management

- Enabled and optimized for IBM Virtualization
- Deep exploitation of Simultaneous Multi Threading (SMT)
- Autonomic exploitation of POWER5/6/7 features such as larger page sizes
- NUMAtization of DB2 resource objects to better align with system architecture
- Enablement for POWER6 features (Decimal Floating Point, Storage Keys)

- Deep integration with AIX APIs
- Exploits Asynchronous I/O and Scatter / Gather I/O
- Exploits AIX CIO and DIO interfaces for efficient handling of database I/O
- Support for AIX multi page support that includes 64KB, 16MB and 16GB AIX page sizes
- Support for AIX “On Demand” dynamic reconfiguration
- Exploits full xIC capabilities for optimal PowerPC performance using Profile Directed Feedback (PDF)
- Deep integration with AIX Workload Load Management

- End-to-End I/O Priorities
- Co-operative Caching
- Atomic Logical Volumes
- End-to-End Checksums
- Automated Storage Topology Discovery and DB2 Setup
- And many, many more …
DB2 Architecture Maps to Power7 Capabilities

- Power7 – massive number of threads per server
  - Requires sophisticated software to exploit
    - DB2 threaded engine built to scale on large multi core servers
  - Requires sophisticated virtualization to consolidate
    - DB2 autonomies “play nice” and “react quickly” in virtualized, dynamic environments
  - Requires advanced workload management to meet SLAs
    - DB2 and AIX tightly integrated WLM to deliver the resources where they are needed most
  - Requires advanced diagnostics to help lower administration costs for customers with massive levels of concurrency
    - The blue stack helps resolve problems faster with integrated diagnostics
  - Requires integrated high availability
    - If any part of the solution fails, DB2 and PowerHA respond more rapidly to provide business continuity
How much of a boost can I expect with Power7?

- Power7 reduces individual thread clock speed but significantly increases thread density per socket
- For well-parallelized DB2 workloads, Power7 can give up to around 30% improved per-core performance over Power6  
  - Naturally, this amount is affected by the Power6 & Power7 clock speeds in question, and the degree to which the workload is CPU bound …

Visit [http://www-03.ibm.com/systems/power/hardware/reports/system_perf.html](http://www-03.ibm.com/systems/power/hardware/reports/system_perf.html) for up-to-date rperf
Proven Workload Optimization

- Unlimited capacity
- Continuous availability
- High Performance
- Energy savings
- Centralized management
- Optimize storage

Source: IBM-maintained records of performance benchmark leadership. TPC-C and SAP 3-Tier SD leadership days are up to and including 22 Feb 2010. SPECjEnterprise2010 up to 05 Mar 2010.

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DB2 and Power 795 top all others in SAP benchmark

DB2 on Power System again proves to be the most powerful SAP server

70,032 SAP users on SAP SD 2 Tier

Power 795 with DB2®

Configuration and results of the IBM Power System 795 on the two-tier SAP SD standard application benchmark running SAP enhancement package 4 for SAP ERP 6.0 (Unicode): 16-p / 128–c / 512–t, POWER7, 4.0 GHz, 2048 GB memory, 70,032 SAP SD benchmark users, dialog resp: 0.93s, line item/s/hour: 7,686.670, Dialog steps/hour: 23,060,000, SAPS: 384,330, DB resp. time (dialog/update): 0.015s / 0.028s, CPU utilization: 99%, OS: AIX 7.1, DB2 9.7; Cert# 2010042. All results as of 10/7/2010; Source: [http://www.sap.com/solutions/benchmark/sd2tier.epx](http://www.sap.com/solutions/benchmark/sd2tier.epx) - See Power 795 benchmark details for more information
Summary and Conclusion

• Very strong collaboration between DB2 and AIX/POWER/Storage
  – Expect more and more deeper integration

• POWER7 adds significant more capability which DB2 exploits to the fullest
  – Many benchmark proof points already available

• Ongoing exploitation by DB2 of new hardware capabilities

• Performance is a critical and integral part of DB2!
  – Maintaining excellent performance
    • On current hardware
    • Over the course of DB2 maintenance
  – Preparing for future hardware/OS technology
Thank You!

ibm.com/smartersystems

Simply put, IBM is making systems smarter.