A Linux Application Tool to Leverage the Full Capability of Hardware

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Agenda

- Linux and Open Source Software Trends
- POWER processor & Power Systems benefit to Linux
- Advanced Toolchain
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  - Components
  - How to use
  - Example Adaption for PostgreSQL 9
- SDK for PowerLinux
  - Overview
  - Features
  - How to use
- Conclusion
Linux and Open Source Software Trends

- Becomes more “enterprise”
  - This report says
    - 73% companies now place open source equal to or ahead of proprietary software
    - 68% companies use Linux, which is the most popular open source package than others

From Edge to Business Critical Workloads

- Adoption area of Linux and Open Source Software seem to expand from edge towards backend workloads

**Application and Data Serving**
- Characteristics:
  - Open Industry Driven
  - Open elements of IT industry join existing community
  - Linux adoption in the enterprise accelerates

**Business-Critical Workloads**
- Characteristics:
  - Competition driven
  - Accepted as mature, open, lower-cost platform for DB, BI, ERP, CRM
  - Cornerstone of datacenter strategies
  - Steady adoption through downturn

**Next Generation Workloads**
- Characteristics:
  - Innovation driven
  - Fully established for business-critical use
  - Workload allocation by platform capability
  - IT-led cloud adoption
  - Utility billing models
  - Accelerated adoption post-downturn

PPC and PPC64 architecture

- Embedded, Super Computers, Game Consoles, Appliance and Enterprise Servers

* Please refer to endor website

OpenBlocks Micro Server
http://openblocks.plathome.com/
POWER processor & Power Systems benefit to Linux

- POWER is
  - a RISC microprocessor architecture developed by IBM
  - a microprocessor implementation of the POWER ISA

- IBM Power Systems
  - uses IBM POWER processor
    - Now the latest processor generation is POWER7
  - supports running Linux
    - Red Hat Enterprise Linux, SUSE Linux Enterprise Server
    - Fedora, Debian…
    - IBM calls these Linux environments on Power Systems as “PowerLinux”

- POWER & Power Systems can provide to Linux users and market
  - additional choice of server hardware
  - more Scalability & Reliability
More Scalable

- More numbers of CPU Core are supported

**PPC64**

- 16~ Threads
- 4~8 / 1 sockets
- 8~16 / 2 sockets
- 32~64 / 4 Sockets
- ~ 256 / 32 Sockets

**X86_64**

- 2~8 Threads
- 2~4 / 1 sockets
- 2~8 / 2 sockets
- 8~20 / 2 sockets
- 24~40 / 4 Sockets
- 48~80 / 8 Sockets
- ~ 256 / 32 Sockets


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More Reliable

- Trying to run continuously when an error occurs

### Processor Recovery

**Transparent error recovery by Hardware**

- Check Point for Processor Status
- Error Check per Cycle
- Error
  - No Error
  - Resume from the Latest Check Point
  - No Error (Soft Error)
  - Move Other Processor and Resume (Hard Error)

### PCI Bus Error Recovery

**Capability to improve the reliability of PCI/PCI-E bus peripherals**

- **iv) GX+ Bus control**
- **iii) RIO-G Failover**
- **ii) PCI Bridge EEH**
- **i) PCI Bus EEH**

- **POWER CPU**
- **RIO Bridge**
- **PCI Bridge**
- **PCI to PCI**
- **PCI Adapter**

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**EEH is introduced in the competing session. Please follow-up after finish of conference.**
Application is much portable

- Linux Application is portable although between different architectures.
  - On commercial distribution of Linux, such as RHEL or SLES, although different architecture,
    - Linux kernel is built from same version of source code, so available almost completely same function on kernel
    - Bundling middleware and libraries are also same version, so available almost completely same API for middleware or libraries
      - ex) RDBMS, Language Runtime, Graphic Libraries…etc.
  - Recent application is coded by “portable” Language
    - Script Language, such as Perl, PHP, Ruby
    - Java
  - Web-App-RDB 3 Tier Application depends on only middleware layer

- Only C/C++ Applications or Libraries modification should be careful.
Two Major helpers for more easily C/C++ application development

- Advance Toolchain Linux on Power Systems
- Software Development Kit for PowerLinux
Advance Toolchain Overviews & Component

- Available from University of Illinois Web Site
  - A set of open source software development extensions and tools allowing users to take leading edge advantage of IBM latest hardware features:
    - POWER6 enablement
    - POWER6 Optimized scheduler
    - POWER6 Native DFP instruction support
    - POWER6 VMX enablement with auto-vector
    - POWER7 enablement
    - POWER7 Optimized scheduler
    - POWER7 Native DFP instruction support
    - POWER7 VMX/VSX enablement with auto-vector
    - ppc970, POWER4, POWER5, POWER5+, POWER6, POWER6x, POWER7 optimized system and math libraries
    - libhugetlbfs 2.0 support

http://www.ibm.com/developerworks/wikis/display/hpccentral/How+to+use+Advance+Toolchain+for+Linux+on+POWER
How to use AT

- The repository Information is available from following URL:

- Easy to install
  - Recent versions are available through online repository, such as yum and zypper.
  - Prior to install AT, install locally only 1 package
    - For example on RHEL
      ```bash
      # rpm -ivh ibm-power-repo-1.1.6-5.ppc.rpm
      ```
  - After that, Just execute online installation command
    - For example on RHEL
      ```bash
      # yum install advance-toolchain-at5.0-runtime
      or
      # yum install advance-toolchain-at5.0-devel
      ```

- Flexible, easily co-exist and switch the multiple versions of tool chains
  ```bash
  $ ls /opt
  at4.0  at5.0
  ```
AT5 Example Adaptation for PostgreSQL 9

- PostgreSQL is
  - a famous open source RDBMS
  - developed by PostgreSQL Development Community

- PostgreSQL contains a self benchmarking tool, pgbench
  - pgbench execute several types of workloads
    - Offline Batch Transaction (pgbench default, TPC-B)
    - Read Only Queries (pgbench -S)
    - Online Mix Transaction (pgbench -N)

- pgbench -S mainly depends on CPU and memory
Results of Adaption of AT5.0

\texttt{pgbench \textasciitilde S}, scale factor 100, 500 sec, 32-core POWER7 on Power 750 (128 threads), max_connections = 32, shared_buffer = 8GB
SMP scalability is not automatically realize

- AT5.0 also provides other functions:
  - Decimal Floating Point Library (libdfp)
  - GNU Binary Utilities (ld, ldd, objcopy, objdump, nm, and others)
  - GNU Debugger (gdb)
  - performance analysis tools (Oprofile, Valgrind, gprof, mtrace, xtrace, iTrace)
  - The AUXV Library (libauxv)

- But does not automatically covers
  - SMP scalability

http://www.ibm.com/developerworks/wikis/display/hpccentral/How+to+use+Advance+Toolchain+for+Linux+on+POWER
Example: PostgreSQL 9.2dev Modification on POWER

```
pgbench -S, scale factor 100, 500 sec,
32-core POWER7 on Power 750 (128 threads)
max_connections = 128, shared_buffer = 8GB
```

![Graph showing performance scale with various connection counts and hardware configurations](image-url)
To Leverage the Full Capability

- SMP scalability improvement is important
- Analytics and Suggestion may help your development
  - System Analytics
  - Code Suggestion

More Scalable

- More numbers of CPU Core are supported


* please refer to slide #7 in this presentation
SDK for PowerLinux

- New released in 2012
- Eclipse-based IDE
  - CDT
  - Code Analytics Tool
  - GFE
  - PTP

- All-in-one solution for developing softwares on PowerLinux (Linux running on Power Systems)

How to use

- Available from following URL:

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    - For example on RHEL
      
      # rpm -ivh ibm-power-repo-1.1.6-5.ppc.rpm

    - After that, Just execute online installation command
      - For example on RHEL

      # yum install ibm-sdk-lop
SDK sample screen shots
SDK for PowerLinux extends value-add plugins

- C/C++ project support of IBM Advance Toolchain
  - Power optimization wizard

- Linux Tools OProfile plugin
  - Launch and analysis integrated with code development
  - Configurable for HW specific event profiling
  - POWER6/7 PMU events

- Linux Tools Valgrind plugin
  - Launch and analysis integrated with code development
  - Open framework for dynamic analysis
    - Memcheck, detects memory leaks and malloc/free errors
    - Cachegrind, cache and branch miss analysis
    - Helgrind, thread and data race analysis
  - PowerISA features for POWER6/7

- Linux Tools RPM plugin
  - Build RPM packages from source code
SDK for PowerLinux includes additional Power-unique features

- **FDPR (Feedback Directed Program Restructuring)**
  - Integrated with Eclipse/CDT for ease of use
  - Works on both executable programs and shared libraries
  - Provides post-link global code optimization step
  - Tunes program to a representative workload

- **Source Code Advisor**
  - Leverages the FDPR dynamic inter procedural analysis capabilities
  - Provides interactive feedback to the developer
  - Identifies hot spots in source code that need rework
  - Specific suggestions for
    - Source code structure improvements
    - Compiler/linker options to use

- **Code Migration Assist plugin**
  - Integrated with Eclipse context sensitive source tooling
  - Scan/Analyze application source for common migration issues
    - Data Endian dependent unions and structures
    - Cast with potential endian issues
    - Non-portable data types
    - Non-portable inline assembler code
    - Non-portable or arch dependent compiler builtins
    - Proprietary/Arch specific APIs
    - Performance degradation
Sample Screenshot: Profile application performance with ease
Sample Screenshot : Source Code Advisor
Sample Screenshot: Analyze thread using the Trace Analyzer

Thread events color map
Sample Screenshot: Execute Migration Advisor (1/2)
Sample Screenshot : Execute Migration Advisor (2/2)
Conclusion

- Linux and Open Source Software becomes
  - to be adopted deeply inside of enterprises.

- POWER processor & Power Systems can provide
  - More scalability and reliability for Linux
  - Another hardware choice for Enterprise Linux Server Market

- PPC64 Linux can use Free Application development tools
  - Advanced Toolchain
    - Easy to improve application running performance
  - SDK for PowerLinux
    - Help your system analysis and C/C++ application development

If you are interested in PowerLinux, please feel free to contact to IBM.
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