VME-based MultiCore IOCs and EPICS: Road Map

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Outline

Controls

- Why multicore EPICS IOCs?
- VME-based Multicore Targets ... Outlook
- Operating System Awareness [vxWorks, RTEMS, Linux-RT]
- Multicore and EPICS
- Plan forward and the EPICS Codeathon
- Conclusion/Questions

Why multicore EPICS IOCs?

Controls

- Embedded Systems Hardware Virtualization: e.g. with Hypervisor
  - In a microTCA platform it would be nice to share one miroResearch EVR between LLRF and BPM subsystems via a hypervisor solution
- Application Scaling and Load Balancing (SMP)
  - Take advantage of extra compute power
  - In an ideal world we should be able to scale linearly with the number of cores.
- Run an OS on each core (AMP)
  - **Linux** on one core for supervisory and system management tasks
  - **VxWorks** or **RTEMS** on one core to handle real-time applications

VME-based Multicore Targets ... Outlook

Controls

- Emerson made a recent visit to SLAC to discuss their road map. Focus was on their multicore VME-based Single Board Computers.
- The VME market has traditionally been driven by military and aerospace sectors. This is still the case. Well this sector is hungry for **multicore**.
- For **higher bandwidth** the military has looked at VPX (VITA 46).
  - Plays well within the VME ECO system
- Military is also looking at xTCA as a new platform. There is some cPCI as well. ***So, how long will VME be here?***
- The military has a very large existing installed base of VME. Systems can be very costly to re-design everything based on a new platform. **So, smart upgrades is the existing approach.** New platforms for new systems, maybe?
- The idea is that ... accelerator control systems should follow the market/industry for commodity computing hardware.

Multicore Operating System Awareness

Controls

- **VxWorks**
  - Starting with vxWorks 6.8 support for multicore is very mature and well tested for both AMP and SMP.
- **RTEMS** *(scheduled for version 4.11)*
  - SMP support in progress (working but needs testing): very close
    - AMP support will start as well
  - Initial targets pc386 and sparc/leon3
  - PCs with compliant BIOS should work.
  - Development work is being done in a dedicated CVS Repo:
    - **:pserver:anonymous@www.rtems.org :2401/home/cvspserver/SMP_Repository**
    - **Joel Sherrill encourages the community to have a look at the code. (Testers and Reviewers wanted)**
- **LINUX (PREEMPT_RT)**
  - Also, very mature with SMP

Multicore and EPICS

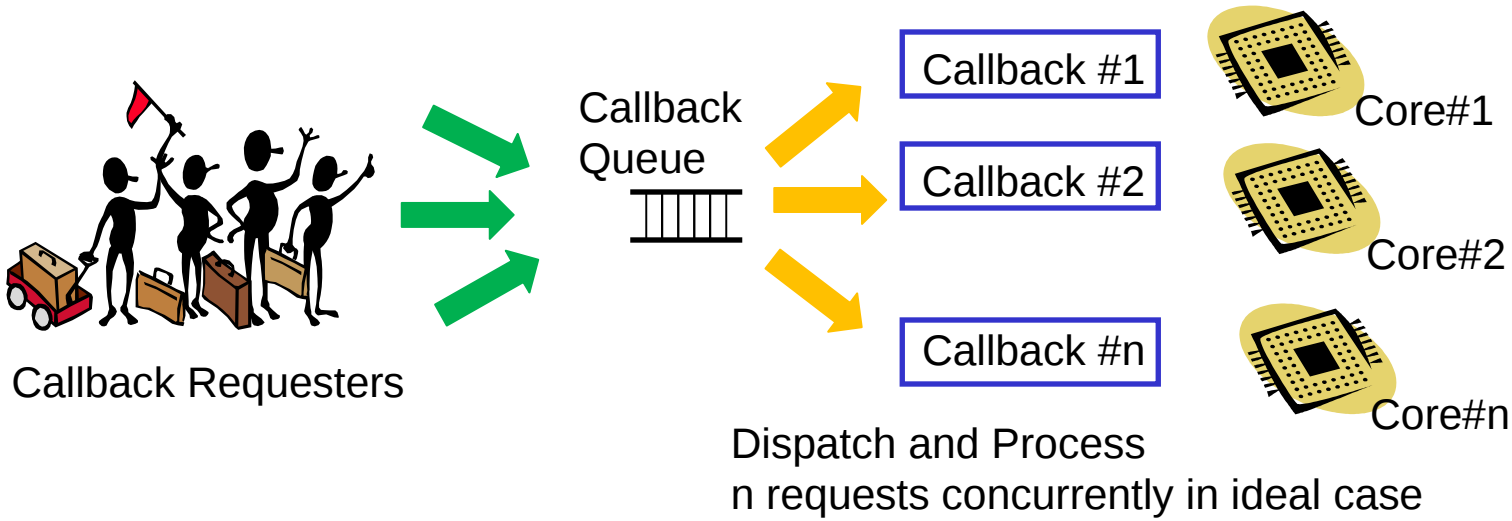
Controls

- Just run EPICS on an SMP-optimized vxWorks kernel?
- How about CPU Affinity?
  - EPICS I/O versus EPICS CA stuff
  - Let's partition EPICS into two areas.
    - [Core 1] [LAN1] : EPICS memory-mapped I/O and ethernet fieldbus I/O
    - [Core 2] [LAN2] : EPICS Channel Access for applications outside of the IOC
  - Use CA priority to distinguish between inter-IOC, Archiver, etc..
- There may be “use cases” for AMP as well.

Multicore and EPICS (2)

Controls

- Multi-threading for the built-in callbacks in EPICS **[Kukhee Kim]**
  - High/Medium/Low priority callbacks
  - Make multiple callbacks which shares a callback queue and bound with a core
  - Concurrent callback processing up to the number of cores
  - Expect some issues with the concurrent processing on the callback and need to solve it



Plan Forward: EPICS Codeathon

- SLAC will participate in the August 2011 EPICS Codeathon.
  - Hosted by LBNL:
  - Topic: VxWorks SMP Support Integration
  - Lead: Kukhee Kim
    - Please join: I will have multiple targets online and available for real tests --- see next slide.

Plan Forward: EPICS Codeathon (2)

- VME-based targets under study and test using vxWorks 6.8
  - IVME7210: Intel® Core™ i7 dual-core integrated processor.
    - VxWorks BSP: ivme7210
  - MVME2500-0173: 1.2G Hz Freescale QorIQ™ P2020 dual-core processor
    - VxWorks BSP: mv2500
- Prepare vxWorks Kernels for Uni-processor (UP) and SMP tests and comparison. We already have the IVME7210s in-house and setup is in progress. MVME2500s will arrive this month.
- Baseline EPICS Core will be R3-14-12-1:
- Complete modifications to EPICS for multicore awareness:
  - Modify EPICS regression tests code
  - Perform application profiling and performance tests.

Conclusions/Questions

Controls

- **VME-based** targets Road map considerations:
  - IVME7210: can succeed the MVME6100 for high performance Apps
  - MVME2500-0173: succeeds the MVME3100, MVME4100, MVME5100, and the MVME5110
- **Freescale** is not slowing down: Let's keep INTEL Honest ...
  - *QorIQ P4080 processor: Eight high-performance e500mc cores up to 1.5 GHz*
  - *Emerson provides: COMX-P4080*
  - *http://www.emersonnetworkpower.com/en-US/Products/EmbeddedComputing/Documents/DocumentationArchive/BrochuresDataSheets/01/comxp4080-DS.pdf*
- **Wind River** is serious about Multicore and recently 64-bit as well. VxWorks 6.9 has introduced a 64-bit RTOS.
- **RTEMS** will be catching up with Multicore: need embedded systems EPICS developers to volunteer effort.

Conclusions/Questions (2)

Controls

- At SLAC we are indeed working with new **platforms** and technology:
  - **MicroTCA-based Intel Core Duo: (Linux-PREEMP_RT)**
    - ***MicroTCA-based LLRF IOC Subsystem***
    - ***MicroTCA-based BPM IOC Subsystem***
- Some of our Accelerator upgrades and new facilities will use the newer platforms such as **microTCA**:
- Some systems may still use **VME**.
- The work we do with **multicore** and **EPICS** can apply to all platforms/OS(s)
- Hiring at SLAC, indeed.
- Questions?