The EPICS Brick development, application, status

EPICS Collaboration Meeting – Embedded Controllers
David Kline
June 12–16, 2006
Topics

- Hardware and supported modules
- Basic hardware solution
- Supported software
- Application development, IOC, boot environments
- Examples
- Status and future development
**Hardware and supported modules**

- Low-cost IOC, soft real-time, localized control
- PC104 bus based
- Fabricated for reliability, rugged, used in military, aerospace, sea and land vehicles, oilfields, and traffic control applications
- Diamond systems – Athena
  - 660Mhz (fan or fanless), 128MB (256MB)
  - Integrated DAQ
    - *16 ADC @ 16-bits (-10V..10V)*
    - *4 DAC @ 12-bits (-10V..10V)*
    - *24-bits TTL digital IO bits (programmable direction)*
    - *Watchdog timer, 4 USB, IDE, 4 serial ports, printer, VGA, mouse, keyboard, 10/100 Ethernet*
  - $850 (USD)
**Hardware and supported modules**

- **Diamond systems – Ruby-MM-416**
  - 4 channel 16-bits analog output
  - -10V..10V 330µV resolution
  - 24-bits TTL digital IO (programmable direction)
  - $395 (USD)

- **Diamond systems – Onyx-MM-DIO**
  - 48-bits TTL digital IO (programmable direction)
  - $90 (USD)
**Hardware and supported modules**

- **Sensoray Smart A/D model 518**
  - 8 channel sensor input @ 16-bits
  - Individually programmable sensors
  - Thermocouples (BCEJKNSTSR), RTD’s, strain gauges, voltage, thermistors, and resistors
  - 22mS or 13mS A/D conversion
  - $295 (USD)

- **Diamond systems – Pearl-MM**
  - 16-bits relay output
  - Screw terminals, pin headers
  - NO, NC, C contacts
  - AC / DC voltages
  - 30VDC / 2A, 125VAC / 0.5A
  - $175 (USD)
Hardware and supported modules

- Diamond systems – Emerald-MM-8P/4P
  - 8 and 4 serial ports
  - Configurable for RS232, RS485, RS422
  - Maximum baud rate 460.8kbps
  - /dev/ttySx
  - 8 port $250 (USD)
  - 4 port $130 (USD)

- Pro-dex (OMS) PC78 Multi-Axis Motion Controller
  - 2/4 axis stepper control
  - PC104 or RS232 communication
  - Encoder feedback
  - $1295 (USD)
Hardware and supported modules

- Pro-dex (OMS) PC68 Multi-Axis Motion Controller
  - 8 axis stepper control, no encoders
  - PC104 or RS232 communication
    (performance diff negligible)
  - $1565 (USD)

- Diamond systems – Panel IO
  - Provides industry standard I/O connectors
  - VGA, Ethernet, USB, Serial, Parallel, PS/2, and data acquisition, status LEDs.
  - Power input options:
    - *Circular jack for an AC wall adapter*
    - *DB 9 connector*
  - $85 (USD)
Hardware and supported modules

- Hard disk drive
  - Hard drive mount
  - 40GB hard drive
  - $110 (USD)

- Compact flash
  - Compact flash mount
  - 2GB compact flash
  - $110 (USD)

- Other hardware
  - AC adapter
  - $25 (USD)
Hardware and supported modules

- Diamond systems – Pandora
  - Compact, lightweight
  - Various depths, 1.7in, 3in, 5in, 7in, and 10in
  - Available only in black (no purple, sorry)
  - $80 (USD) 3in

- Rack mountable
  - Uses faceplate of Pandora enclosure
  - BNC connectors for Athena’s DAQ
  - Application specific connectors in back
Hardware and supported modules

- Generic Digital IO
  - Developed by Steve Ross
  - Altera FPGA-based (FLEX10K)
  - 16 32-bit Up / Down counters
  - Asyn-based serial link protocol

- Other supported hardware
  - Love controllers
  - MDrive
  - XIA Huber slits
  - Femto current amplifier
  - Kohzu monochromator
  - White beam slits
  - Peizo motors
**Basic hardware solution**

- **Hardware**,
  - Athena 660Mhz processor board with fan, DAQ
  - AC adapter
  - Pandora enclosure
  - Panel IO board
  - Mass media
    - 40GB hard drive
    - 2GB compact flash
    - Mounts
  - Total cost ~$1200 (USD)
**Supported software**

- CorelXwin, Fedora, DSC Slackware, VectorLinux distributions
- VectorLinux STD 5.1
  - Slackware based
  - Easy package, configuration management
  - Active forum
  - Small foot print (~1.2GB)
  - Fast boot ~50s
- Development tools
  - GNU compiler/linker
  - Editors (nano, nedit, vi)
  - CVS and TkCVS
  - X11, XDMCP, ssh, scp, IceWM
  - NFS client
  - Mozilla Firefox web browser
**Supported software**

- **EPICS support**
  - Base 3.14.7 (3.14.8.2 summer)
  - synApps 5.1 modules
  - Extensions, Probe, MEDM
  - Asyn-based driver support
    - *Athena integrated DAQ*
    - *Supported hardware modules*
    - *Motor controller support (BT,RS)*
  - IOC examples
  - MEDM screens, diagnostics, commissioning, operations

- **Screen application**
  - Remotely connect to an IOC, attach to iocsh, detach
  - IOC application runs under screen, started in rc.local
  - Logging
Supported software

- “launch” application
  - Taken from Eric Norum
  - Wrapper app
  - Opens IO ports
  - IOC app passed to launch

- Logrotate application
  - Daily cron job
  - Compress, manage screen log files
Application development, IOC, boot environments

- Development environment
  - Uses the 40GB HDD
  - Development tools
  - EPICS base 3.14.7, synApps 5.1 modules
  - epics application (xxx) or specific IOC application
  - Accounts root, epics, epicsioc

- epics account hierarchy
  - EPICS Base tree
  - synApps support tree
  - IOC tree
    - epics application (xxx)
    - Specific IOC applications (makeBaseApp)
**Application development, IOC, boot environments**

- epicsioc account hierarchy
  - epics directory
  - IOC application

- IOC environment
  - Uses the 40GB HDD or 2GB compact flash
  - Application only, uses standard directory structure
  - Accounts root, epicsioc

- Distribution
  - Local copy (mounted mass media)
  - USB-based Pendrive
  - tar / gzip scp
Application development, IOC, boot environments

- Boot environment
  - Controlled by run-levels
  - RL2 – IOC iocsh prompt @ serial, no X
  - RL3 – IOC iocsh prompt @ VGA, no X
  - RL5 – Development @ VGA, X, no IOC
  - RL7 – IOC iocsh prompt available after login, X,
  - Screen application
Example: 26ID Beamline Kohzu Monochromator

- Basic configuration/w 40GB

- Motor control, serial to OMS Motion Controllers /wo encoders

- Standard EPICS support
  - Motor record
  - Kohzu sequencer
  - MEDM displays

- Extra capacity
  - ADC, DAC, digital IO, 2 serial ports…
**Example: 26ID Beamline White Beam Slits**

- Basic configuration/w 40GB
- Motor control, serial to OMS Motion Controllers /w encoders
- Standard EPICS support
  - Motor record
  - MEDM screens
- Extra capacity
  - ADC, DAC, digital IO, 1 serial port
Example: 33ID USAXS Instrument

- Basic configuration/w 40GB
- 19” rack mounted
- 2 DSC Ruby-MM-416
  - DACs for PZT positioners
- Digital IO for Femto DLPCA current amplifiers
- Standard EPICS support
  - Femto sequencer
  - MEDM screens
- Extra capacity
  - ADC, DAC, digital IO, 4 serial ports…
- Future:
  - Digital IO for XIA PF4 filters
  - DSC PMM-S module for shutter control
Example: 33ID USAXS Instrument
Status and future development

- Status
  - Ready for prime time
  - Nano’s Kohzu, White-beam slits
  - USAXS instrument
  - Other sectors are interested, detector pool

- Future
  - USAXS mirrors
  - GPIB support, PC104-based IP carrier
  - NFS or flash boot
  - Installation CD
  - Love controller replacement
  - USB-to-VME bridge
  - DSC Athena II, 800MHz, 256MB; Poseidon, 2GHz, 512MB
Beamline application demonstration

Demonstration @ 15:00
Acknowledgements

- Kurt Götze
- Pete Jemian
- John Maclean
- Nanoprobe (sector 26)
- Steve Ross
- Brian Tieman

Thank You