

# EPICS

## Future Plans

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The EPICS Collaboration (world wide)

# Agenda

- EPICS Status
- Developments:
  - IOC
  - Network Protocols
  - Applications
- What's Missing (wish-list)
- Summary
- Outlook

# Status

- Even though – or just because the EPICS core software has reached a mature state, it is time to think about the long term future plans for EPICS.
- The core software is running in several thousand IOCs around the world and has proven to be at least as reliable as commercial products. IOCs are running in several instances for several years continuously.
- The collaboration is growing continuously and every year new installations and institutions decide to choose EPICS as their ‘control work horse’.

# EPICS Future

## What's up?

## IOC: Core Developments - Base

- EPICS Base
  - \* Development continues, but at a slower pace
  - \* Mature, widely used code base
  - \* Need to maintain an upward migration path
  - \* Fewer core developers
    - \* Development emphasis has moved to
      - \* More and better device support
      - \* Client applications, CSS etc.
  - \* Added support for more Operating Systems
  - \* Added more CPU families

**EPICS core has reached a very mature state.**

**Support for more operating systems has been added**

# IOC: Core Developments - Base Enhancements

- Enhancements to EPICS Base
  - \* CVS repository contains several minor changes
  - \* NTP Time synchronization for RTEMS IOCs
  - \* VAL keyword in CALC expressions
  - \* Better error messages from dbLoadRecords
  - \* EPICS Codeathon planned for April 2008
  - \* Meeting of core developers
  - \* Work on items from our To Do list
  - \* Plan to automate our regression test suite

**Many small changes continuously improve EPICS.  
Code changes are managed by Argonne (Andrew Johnson)**

# IOC: Core Developments - Driver

- Asyn Driver
  - \* Many updates from Mark Rivers
  - \* Portable to all EPICS Operating Systems
  - \* Provides cross-platform interfaces to RS232/423/485, TCP/IP, UDP/IP, GPIB and VXI-11
  - \* For moderately complex message-based protocols, use with Streams from SLS/PSI
  - \* Supports older devCommonGpib device support
  - \* Can communicate with most PLCs using MODbus

## Behind the scene: Enhancements for drivers

# IOC: New Timing Support

The main design goals for the new time service are:

- Provide a robust time service that has a well-defined behaviour
- The design should allow adding user's preferred time services (modularity)
- The system should have fallbacks in case some service has problems (reliability)
- Switching between the different time services should be as smooth as possible (monotonously progressing time)

**Robust time services (hard – and soft (NTP)) are key for IOC operations.**

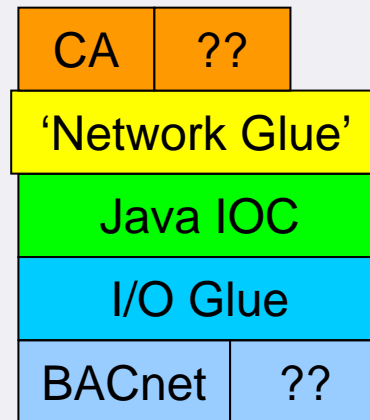
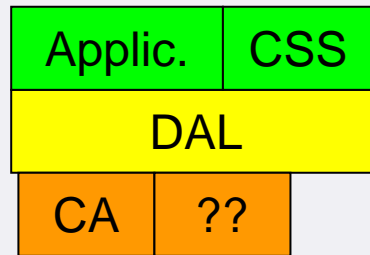


# IOC: Java-IOC

- Hierarchical database definition
- Implementation the notion of 'Device/ Property/ Characteristics and Commands'
- Decoupling of data processing from the control system protocol
- Decoupling of data processing from data acquisition.
- Complex data structures can be configured in a Java IOC database

**The Java IOC brings flexibility to the front end controller**

# IOC: Java-IOC – decoupling the Network Layer



**The Java IOC opens the chance to integrate other network protocols.**

# IOC: Redundancy

- Redundancy support for EPICS opens a new regime of applications for the EPICS toolkit.
- Automatic failover is a mandatory functionality for High Availability (HA) systems.
- The modular design for redundant EPICS IOCs implementation adds the chance to apply the Redundancy Monitor Task also to applications outside the EPICS world.
- Note: Redundant communication is socket based (no CA)

**Redundancy adds High Availability to the reliable EPICS IOCs.**

# IOC: Redundancy - Management

- Out of band management of redundant IOCs is based on XML data exchange.
- Analysis of processes down to the driver adds a new level of flexibility to diagnose IOC processing.
- XML diagnostics are also applied to the State Notation Language processing on the IOC. This opens a new level of flexibility to SNL processing on the IOC.

**Out of band XML diagnostics on the IOC add a new level of flexibility.**

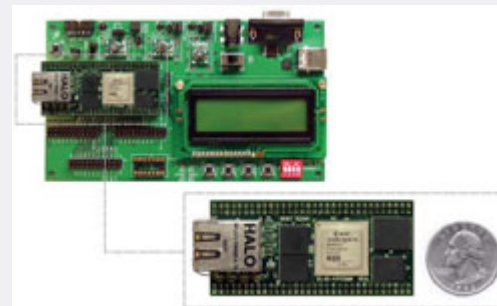
## IOC: Channel Access Gateway

- The CA gateway is an essential part of the EPICS architecture to separate controls networks from office or WAN networks.
- Continuous improvements keep the gateway up to date.
- Redundancy support has been added recently by using the RMT from the redundant IOC development.
- Load balancing is a spin off from the redundant gateway implementation.

**The important function of the CA gateway is supported by continuous improvements. Adding redundancy improves the availability.**

# IOC: EPICS goes Embedded

- Since EPICS 3.14 it is possible to run EPICS core (IOC) software on a wide range of operating systems.
- As a result IOC software has been ported to a variety of micro controllers and even PLC hardware.
- The next level of embedded controls is bringing the IOC core software to PPC CPUs on FPGA cores.
- Example: 'EPOCH'  
EPics On a CHip



**EPICS on embedded (FPGA) cores add a direct interface to fast (feedback) control logic.**

## Network Protocol: Channel Access - Enhancements

- EPICS Channel Access (CA) clients need to dynamically specify the LANSCE macro pulse beam gate combinatorial (LANSCE Flavored Data), and the window in time (LANSCE Timed Data), to be sampled when they subscribe.
- Support for new (complex) data types for the waveform record.
- These upgrades will greatly improve the versatility of the original EPICS system expanding its intersection into the domain of data acquisition systems.

**CA support for flavored data as well as more data types improves versatility.**

# Network Protocol: new protocols!?

- Current developments on the IOC-side and on the applications-side (DAL) open the chance to discuss other protocols than CA within the EPICS framework.
- The obvious limitation of CA for bulk data transfers and the missing support for device oriented front ends (like commands) are triggering the discussion to integrate other protocols.
- While performance, compatibility and reliability speak for CA; functionality opens the discussion for other protocols.

**CA is the workhorse for EPICS systems. New protocols might find their way into the EPICS framework.**



## Basic Applications: Archiving

- Archiving control systems data into files is the most efficient way. Managing these files can become a nightmare.
- Archiving to Relational Databases eases management and data retrieval.
- New approaches at TJNAF and ORNL now re-evaluate the more conventional use of relational databases.
- New archive displays are available for CSS based on Eclipse.

**New approaches are under test to evaluate relational databases for archiving.**

# Basic Applications: Alarming

- Alarm processing is part of the basic functionality of record processing for any EPICS record.
- Current implementations only register those alarms which are configured on the client side.
- The 'Catch-All Alarms' approach – by pushing alarm messages from the IOC – is in operation at D0 for several years.
- A generic implementation based on JMS is following these lines.
- A dedicated process is writing all alarms into an (Oracle) database.
- New Alarm Displays have been developed and integrated into the CSS operator cockpit.

**A new set of alarm applications is in place to optimally use the built in alarm processing on the IOC.**

# Operator Cockpit: Control System Studio (CSS)

- CSS is a set of convenience plugins for Eclipse. They can be used inside the Eclipse IDE, as a runtime started from Eclipse IDE, or as a standalone runtime which includes the required Eclipse core. (only these)
- Any Eclipse plugin can be started inside of CSS. CSS services can be used when called from/ implemented in the plugin.
- A growing set of applications is already available for CSS. ( Alarm-Config./Display, Archive Browser, Name Browser, Probe, PV-Table, ... Save/ Restore)

**CSS is a set of convenience plugins written for a new generation of RCP based operator applications.**

# Operator Cockpit: CSS- Synoptic Display Studio

- YADM (Yet Another Display Manager) ??
- Designed to be as versatile as possible
  - Easy to add new widgets
  - Any property can be dynamic
  - Connects through DAL to ‘any’ supported control system
  - Converter for dm2k config files exist
- Is there a chance to build collaboration on CSS-SDS?

**Can SDS play the role of ‘the’ display manager?**

# Operator Cockpit: Web based Applications

- Web based applications are under development.
- A first application with a channel access plugin for the most common browsers will be available soon.

**Web based displays will play a role at least for remote operations. The usability in the control room can be checked soon.**

## Tool Kits: MMLT

- Matlab Middle Layer Toolkit is a set of Matlab applications for the commissioning and beam studies of 3rd generation light sources.
- Developed at LBL and in use at SPEAR, DIAMOND, CLS, and ASP, this toolkit provides an extensible platform for physics applications.

**Matlab plays an important role for machine commissioning and operations. MMLT integrates Matlab into the EPICS controls world.**

## Tool Kits: XAL

- *XAL* is a Java framework for developing accelerator physics applications for the commissioning and operation of the Spallation Neutron Source at Oak Ridge
- *XAL* has a growing user community.
- The integration of *XAL* applications into Eclipse (CSS) is underway.

***XAL* is a leading accelerator physics framework for EPICS based control systems.**

## Tool Kits: SEAL

- The SLAC Eclipse Accelerator Lab (SEAL) is a new development for the LCLS at SLAC. As already documented in the name, SEAL is based on Eclipse.
- Several XAL applications will be integrated as plugins into SEAL.
- General purpose (EPICS) tools will be integrated by CSS.
- SEAL and CSS developers are working jointly.

**SEAL will be the first accelerator application suite based on Eclipse. The effort to integrate SEAL and CSS into each other will strengthen both frameworks.**



## Data Management: Database Generation

- Creating EPICS configuration databases from relational databases is still not a well established standard.
- Custom made implementations can still not be adopted to other EPICS sites. (but are available)
- VDCT could bridge the gap to relational databases.

**VDCT could play a bigger role once it's updated to Eclipse-GEF/EMF and provides interfaces to relational databases.**

# Data Management: IRMIS

- IRMIS - Integrated Relational Model of Installed Systems  
- represents the prescriptive approach for EPICS database configuration.
- IRMIS has a growing user community.
- Continuous improvements keep the toolkit up to date.

**The prescriptive way of IRMIS has a growing user base. Effort should be made to integrate IRMIS into other toolkits.**

# The EPICS Collaboration

One of the strongest  
arguments to use EPICS



# The EPICS Collabor

Come join the  
collaboration



One of the strongest  
arguments to use EPICS



# The EPICS Collabor

I like to dance  
TANGO more

Come join the  
collaboration



One of the strongest  
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# Industry

- The EPICS support by industry is increasing:
  - More companies are familiar with EPICS core software and with the EPICS applications.
  - It is now possible to outsource also EPICS core software developments.
  - Turn key systems can be purchased with EPICS support included.
  - A lot of hardware devices already come with EPICS drivers.
  - Outsourcing is a real option when using EPICS

**Industrial support for EPICS eases the integration of hardware. Outsourcing is a real option specifying EPICS as the control system.**

## What's missing: Wish List

- Documentation: A 'real' beginners document. An updated record reference doc.
- Code examples for drivers, records, etc.
- Better information within the collaboration about new developments.
- Better support for RTEMS. E.g. a VxWorks to RTEMS converter.
- Dynamic (online) record addition in IOC databases.
- Better VDCT support.

**Things to be worked on:**

**Documentation for beginners, Migration tools, Database Creation Tools**

## What's missing: Wish List – partly fulfilled

- Better time support
- New display manager: Should be not Motif based; should be able to read all existing configuration file formats.
- Redundancy for IOCs
- Support to store/handle alarms in RDBs.
- Better/ more support to create IOC databases from RDBs.

**Several requests for future EPICS releases will be fulfilled in due time.**



# Summary I

- **EPICS core has reached a very mature state.**  
**Support for more operating systems has been added**
- **Many small changes continuously improve EPICS.**  
**Code changes are managed by Argonne (Andrew Johnson)**
- **Behind the scene:** Enhancements for drivers
- **Robust time services (hard – and soft (NTP)) are key for IOC operations.**
- **The Java IOC brings flexibility to the front end controller**
- **The Java IOC opens the chance to integrate other network protocols.**
- **Redundancy adds High Availability to the reliable EPICS IOCs.**
- **Out of band XML diagnostics on the IOC add a new level of flexibility.**

## Summary II

- **The important function of the CA gateway is supported by continuous improvements. Adding redundancy improves the availability.**
- **EPICS on embedded (FPGA) cores add a direct interface to fast (feedback) control logic.**
- **CA support for flavored data as well as more data types improves versatility.**
- **CA is the workhorse for EPICS systems. New protocols might find their way into the EPICS framework.**
- **New approaches are under test to evaluate relational databases for archiving.**
- **A new set of alarm applications is in place to optimally use the built in alarm processing on the IOC.**

## Summary III

- **CSS is a set of convenience plugins written for a new generation of RCP based operator applications.**
- **Can SDS play the role of 'the' display manager?**
- **Web based displays will play a role at least for remote operations. The usability in the control room can be checked soon.**
- **Matlab plays an important role for machine commissioning and operations. MMLT integrates Matlab into the EPICS controls world.**
- **XAL is a leading accelerator physics framework for EPICS based control systems.**
- **SEAL will be the first accelerator application suite based on Eclipse. The effort to integrate SEAL and CSS into each other will strengthen both frameworks.**

## Summary IV

- **VDCT could play a bigger role once it's updated to Eclipse-GEF/EMF and provides interfaces to relational databases.**
- **The prescriptive way of IRMIS has a growing user base. Effort should be made to integrate IRMIS into other toolkits.**
- **The Collaboration: One of the strongest arguments to use EPICS**
- **Industrial support for EPICS eases the integration of hardware. Outsourcing is a real option specifying EPICS as the control system.**

# Outlook

- EPICS has reached a very mature state. This is the keystone for applications like redundant IOCs and IOC core software running on FPGA PPC cores.
- Continuous improvements keep the code up to date.
- New developments like the Java IOC and CSS show that maturity and new innovations can coexist.
- Support and experience in industry is still growing.
- The EPICS collaboration itself is the most valuable part of the EPICS toolkit.

**Let's keep it this way also in the future**

# Special Thanks

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**... for their fast response to my spontaneous poll on tech-talk**

# EPICS Future ...

