Open-source data acquisition: EPICS

Experimental Physics and Industrial Control System

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epics.mpg.de

What is EPICS and where is it used?

- EPICS offers a collection of software tools for the construction of distributed control systems for experimental projects

- EPICS includes a runtime database, robust network protocols, an extensive collection of device drivers for hardware connectivity, and a set of client tools for operator control and monitoring

- It also includes data archiving and alarms

What is EPICS and where is it used?

- The modular design is extensible and can easily be used to meet the technical requirements of a variety of experimental projects
- The software is operating system and platform independent
- It is an open source product; you can make changes and improvements yourself at any time

What is EPICS and where is it used?
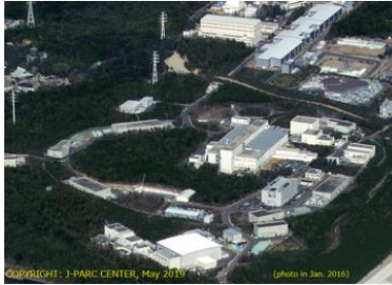
Japan Proton Accelerator Research Complex (J-PARC)

The Japan Proton Accelerator Research Complex (J-PARC) is an exciting accelerator research facility in Ibaraki, Japan,…

More

National Synchrotron Radiation Research Center (NSRRC)

The National Synchrotron Radiation Research Center (NSRRC) operates two synchrotron light sources, named Taiwan Light…

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Experiments at GSI and FAIR

GSI Helmholtzzentrum für Sch werionenforschung (GSI Helmholtz Centre for Heavy Ion Research) operates a large-scale worldwide unique accelerator facility for…

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China Spallation Neutron Source (CSNS)

The China Spallation Neutron Source (CSNS), operated by the Institute of High Energy Physics (IHEP),…

More

What is EPICS and where is it used?

STAR Detector at RHIC

The STAR detector at Brookhaven National Lab specializes in tracking the thousands of particles produced by…

More

Beijing Electron Positron Collider (BEPC-II)

BEPC-II is the upgrade project of Beijing Electron Positron Collider (BEPC), located at the Institute…

More

Antarctic Bright Star Survey Telescope (BSST)

The Antarctic Bright Star Survey Telescope (BSST) is an optical telescope built by University of…

More

Kyoto University Fixed Field Alternating Gradient Accelerator Complex (KUFFA)

The Kyoto University Fixed Field Alternating Gradient Accelerator Complex (KUFFA) was developed as a proton driver…

What is EPICS and where is it used?

East Asian Observatory (JCMT, UKIRT)

The EAO (East Asian Observatory) is formed by EACOA (East Asian Core Observatories Association)

Brazilian Synchrotron Light Laboratory (LNLS)

The Brazilian Synchrotron Light Laboratory (LNLS), located in Campinas, São Paulo state, operates the only…

Spallation Neutron Source (SNS)

SNS is a one-of-a-kind research facility that provides the most intense pulsed neutron beams in…

Fritz Haber Institute Free-Electron Laser (FHI FEL)

The free-electron laser (FEL) at the Fritz Haber Institute (FHI) generates intense pulses of infrared…

What is EPICS and where is it used?

Why we what to establish EPICS in the MPG

- Independence from commercial products
- More flexible in scientific questions
- Reduce the hurdle to using open source software and hardware
- Improve the documentation of EPICS and create training documents (English and German)
- Set up of Demo hardware
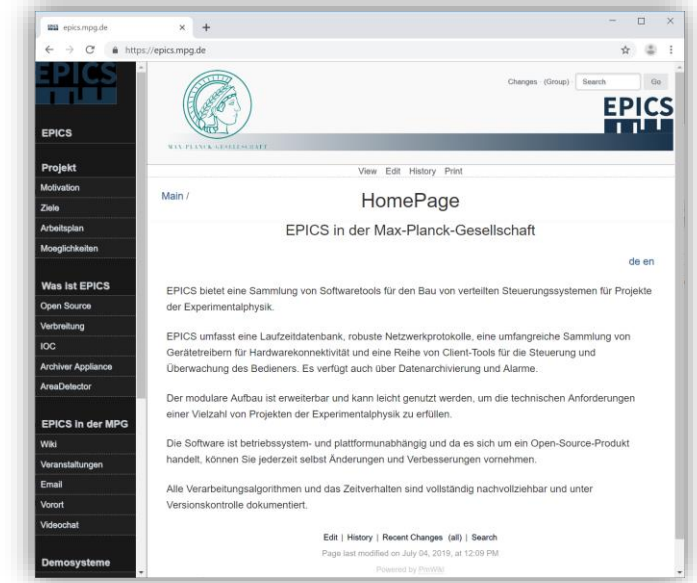
EPICS base with modules and Archiver Appliance

- EPICS base is the main core of EPICS, which includes the build system and tools, common and operating system interface libraries
  - Process value client and server libraries, static and database processing code and standard dataset, device and driver support

- EPICS Archiver Appliance is an implementation of an Archiver for EPICS control systems that aims to archive millions of PVs
  - Possibility of bundling and scaling appliances by adding appliances to the cluster
  - Multiple stages and an integrated method for data transfer between stages
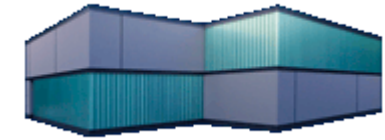
Machine Learning / Big Data

- FEL optimization by analysis of the FEL data of the last 10 years
- Time stamp and shot number and practically any profile of a shot with all "environmental parameters"
- EPICS Archiver Appliance saved data such as FEL-magnets, accelerator and even building management such as water temperature and flow through the magnets and modulators

The FHI free-electron laser (FEL) facility
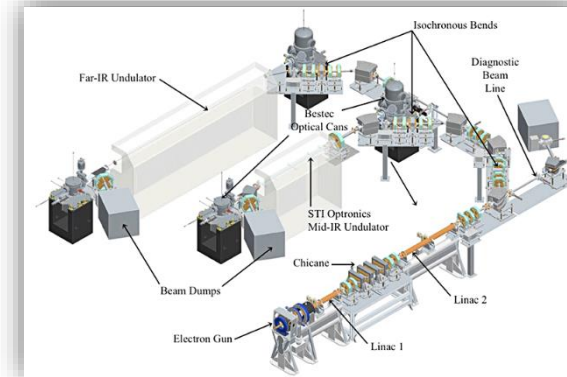
LabVIEW™ and EPICS: CA Lab SoftIOC

- Researcher like LabVIEW™

- Requirements:
  - communication with LabVIEW
  - easy to integrate
  - data acquisition
  - long-term data storage
  - Hardware and therefore number of channels expandable
  - FAIR principles (research data should be searchable, accessible, interoperable and reusable)

LabVIEW™ and EPICS: CA Lab SoftIOC

- interface between LabVIEW™ and EPICS
- CA Lab works with Windows® and Linux
- Any VI can use caLabGet.vi to read or caLabPut.vi to write EPICS variables
- CaLabSoftIOC.vi
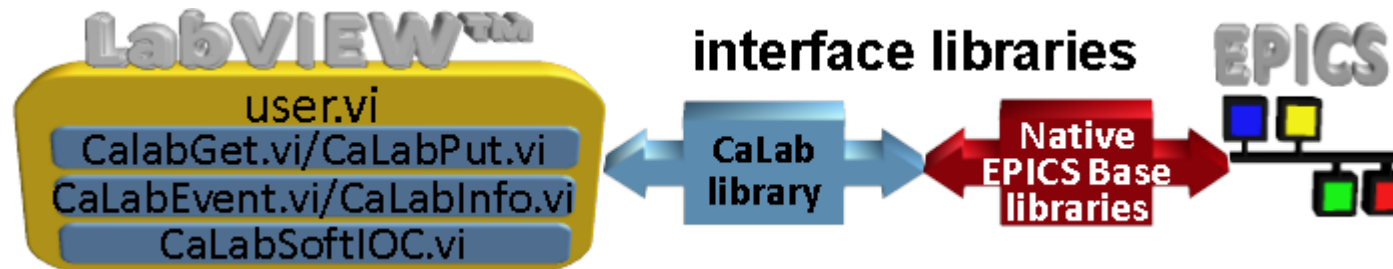
LabVIEW™ and EPICS: CA Lab SoftIOC

- Practice

Read value
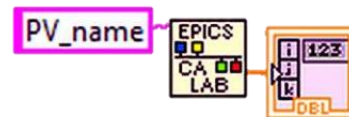
write value
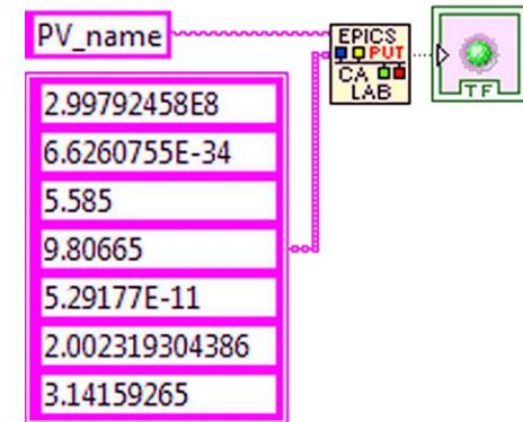
Event
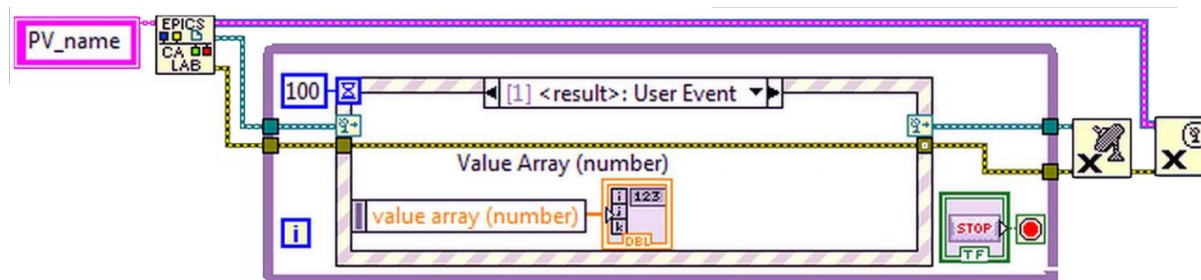
- Conclusion
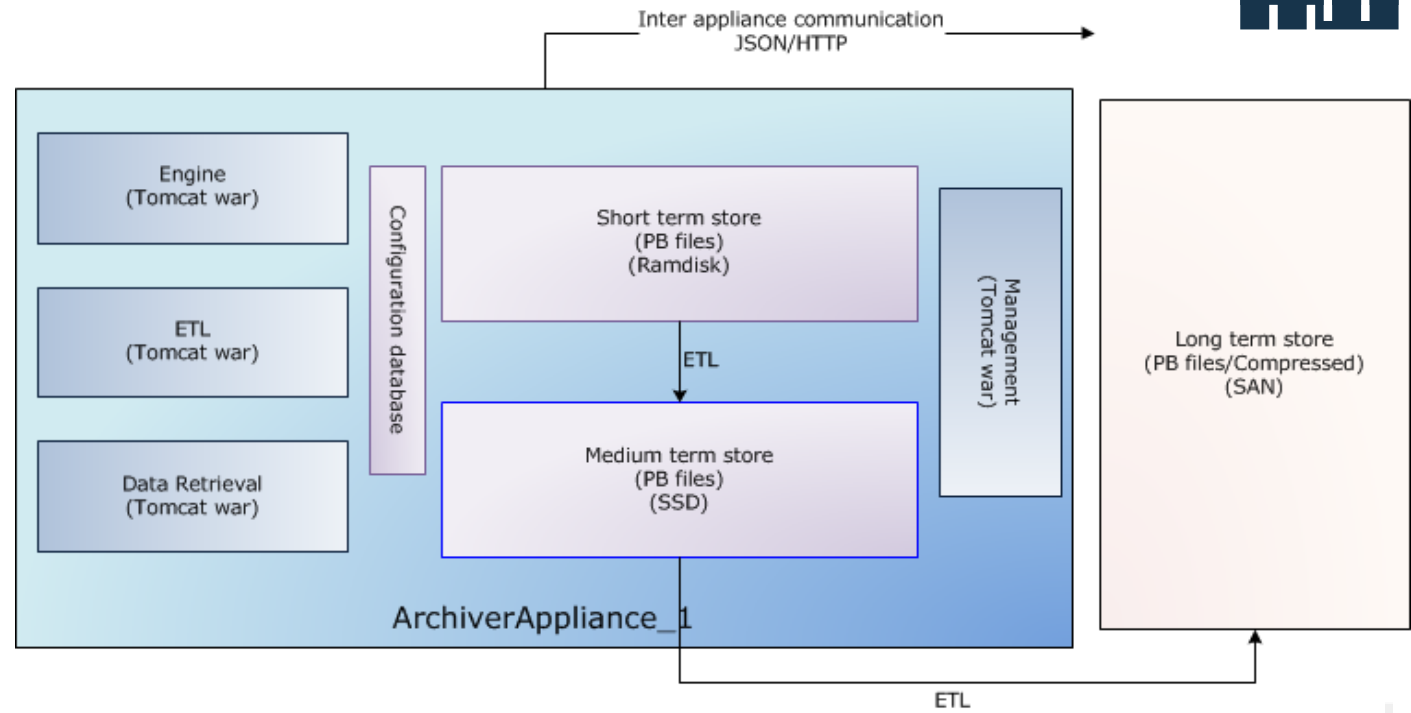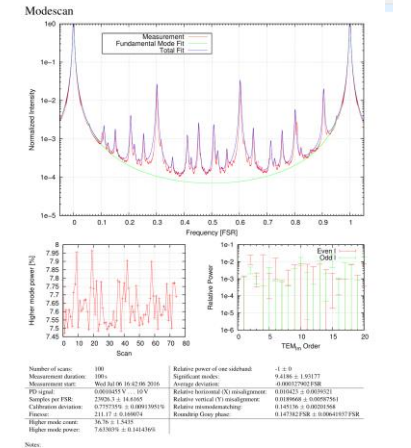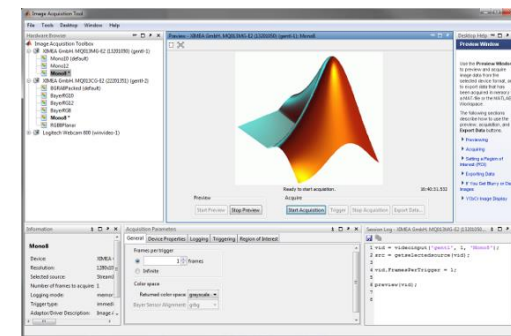 - Very easy handling of EPICS variables in LabVIEW™

Data evaluation

- EPICS Archiver Appliance
  - summarize different experiments in one data storage

- Data using
  - CS-Studio (Phoebus)
  - ArchiveViewer
  - Matlab
  - Script

Data evaluation

Inter appliance communication
JSON/HTTP

- EPICS Archiver Appliance
  - summarize different experiments in one data storage

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  - CS-Studio (Phoebus)
  - ArchiveViewer
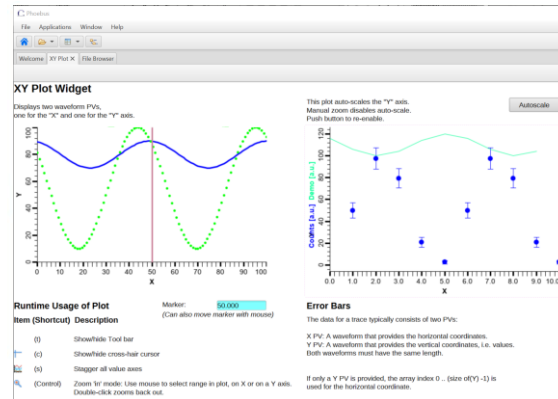 - Matlab
  - Script

Data evaluation

- EPICS Archiver Appliance
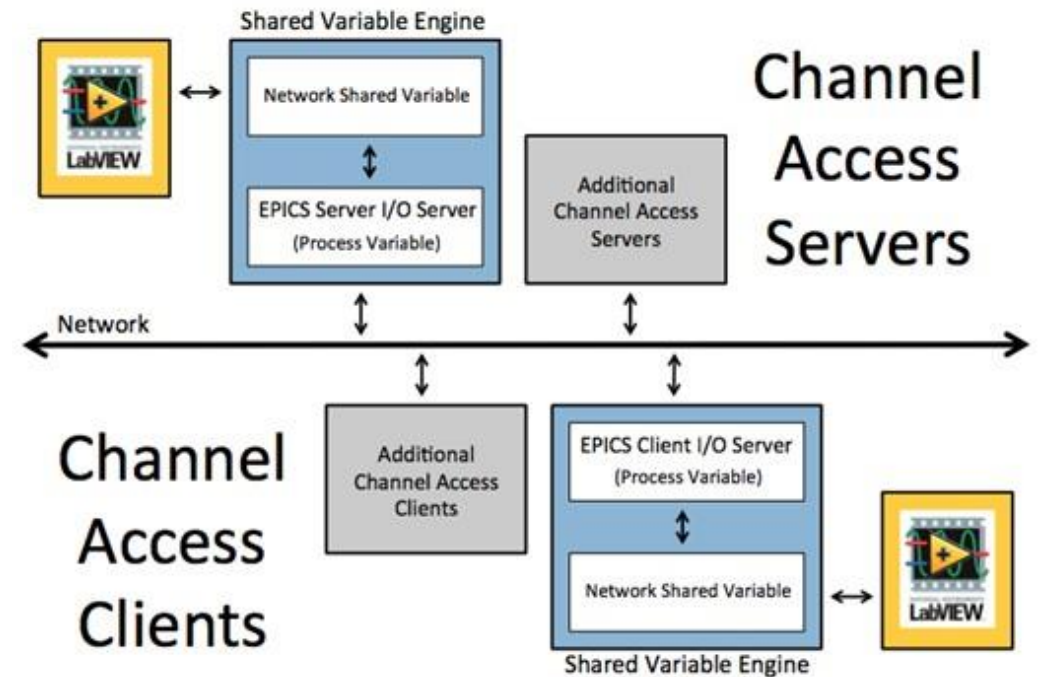 - summarize different experiments in one data storage

- Data using
  - CS-Studio (Phoebus)
  - ArchiveViewer
  - Matlab
  - Script

Take one more step:
EPICS Device Support for cRIO and FlexRIO

- EPICS Device Support for cRIO and FlexRIO FPGA

- IRIO software tools
  - Templates with the description of the EPICS records, organized by functionality
  - IRIO EPICS device driver uses records connected with asyn-layer using the standard device support

Thank you for your attention!
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