

# EPICSって何？

2014.3.5

Noboru Yamamoto

J-PARCセンタ 加速器ディビジョン

加速器 制御グループ

@ 若手科学者によるプラズマ研究会



Martin R. Kraimer

Jeffrey O. Hill

Leo R. Dalesio

# ICALEPCS 2009 (Kobe, JAPAN)

First Lifetime Achievement Award  
was presented to three EPICS experts

Leo R. Dalesio  
Jeffrey O. Hill  
(LANL:GTA)

X

Martin R. Kraimer  
(ANL:APS)

late 1980s: Project started to create  
common control system software



EPICS

Now, Used by MANY institutes over the world  
in various fields of science

# EPICS Collaboration

- ◆ Accelerators: Many (US, Canada, Germany, Swiss, England, Japan, China, Korea, Australia, India, ...)
- ◆ Beam Lines: APS, J-PARC NU(Slow Control) ,...
- ◆ Astronomy :KeckII, LIGO, KAGRA
- ◆ Plasma Physics: ITER, IFMIF、 KSTAR

参考： <http://ja.wikipedia.org/wiki/EPICS#EPICS> を利用している主な施設

Collaboration meeting Every half year  
around WORLD!

<http://www.aps.anl.gov/epics/meetings.php>

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## EPICS Sites

The organizations linked to below are just some of the users and developers of EPICS. This list is by no means complete, there are many other sites using EPICS in South Korea, Russia, Italy, Spain, China, and other countries. [Email me](#) a link to have your organization added to this page.

- [The Advanced Photon Source at Argonne National Laboratory](#)
- [Australian Synchrotron](#)
- [Berlin Electron Synchrotron \(BESSY II\)](#)
- [Brazilian Synchrotron Light Source \(LNLS\)](#)
- [Deutches Elektronen Synchrotron \(DESY\)](#)
- [Diamond Light Source](#)
- [Fermilab \(FNAL\)](#)
- [ITER project, France](#)
- [Jefferson Laboratory \(JLAB\)](#)
- [Keck Observatory](#)
- [KEK B-Factory](#)
- [Laboratori Nazionali di Legnaro \(INFN-LNL\)](#)
- [Lawrence Berkeley National Laboratory \(LBL\)](#)
- [Los Alamos National Laboratory \(LANL\)](#)
- [Pohang Accelerator Laboratory, Korea](#)
- [Rare Isotope Science Project, Korea](#)
- [Swiss Light Source \(SLS/PSI\)](#)
- [Spallation Neutron Source \(SNS\)](#)
- [Stanford Linear Accelerator Center \(SLAC\)](#)
- [iThemba Laboratory for Accelerator Based Sciences, South Africa](#)

## EPICS Commercially

The following companies provide some services for EPICS users, in the form of consulting, by providing device drivers for their hardware or by selling instruments with an embedded IOC. This list is provided for informational purposes only, and is not an endorsement of the companies named or their products. Note that most EPICS sites write their own or share in the development of drivers for COTS I/O and instrumentation, see the [Hardware Support database](#) for details of the available drivers.

<http://www.aps.anl.gov/epics/sites.php>

# EPICS

- ◆ Developed under the collaboration of multi Institutes
- ◆ Flexible & Expandable design

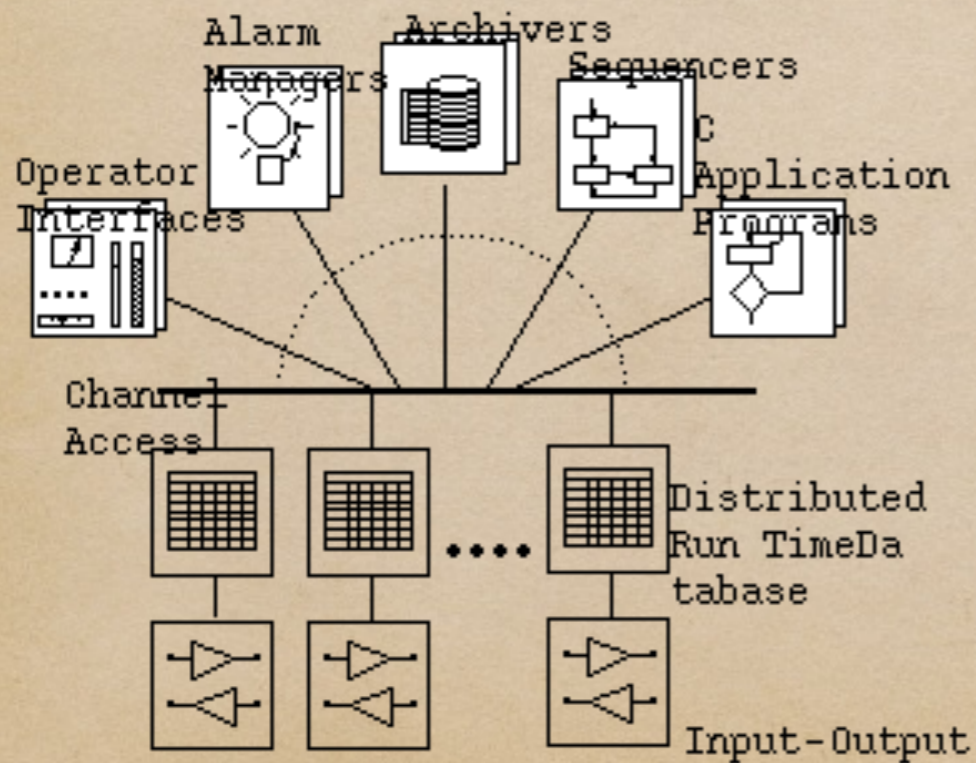


Figure 1. Software Architecture

Network Distributed  
Computer Controls system  
for Facility Automation

Inside of EPICS

# EPICS software Architecture

## Device Controller: IOC

- ◆ CA Server / Runtime Database

- ◆ デバイス制御は全てRuntime Database経由

- ◆ Unix (Linux, MacOSX, BSD / Windows / VxWorks / RTEMS)

- ◆ Input/Output

- ◆ VME/VXI/PCI/PLC... : モジュール/ボード型I/O

- ◆ Serial link/Network/FA-Link/GP-IB/... : 通信型のI/O

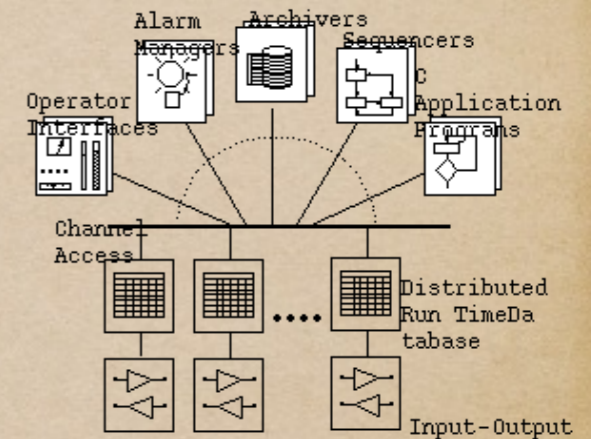


Figure 1. Software Architecture



# EPICS software Architecture

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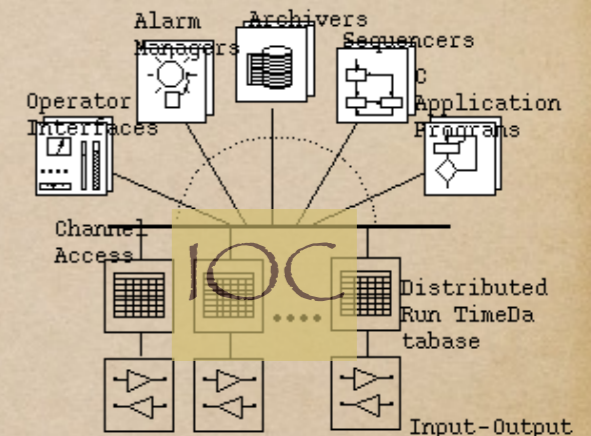
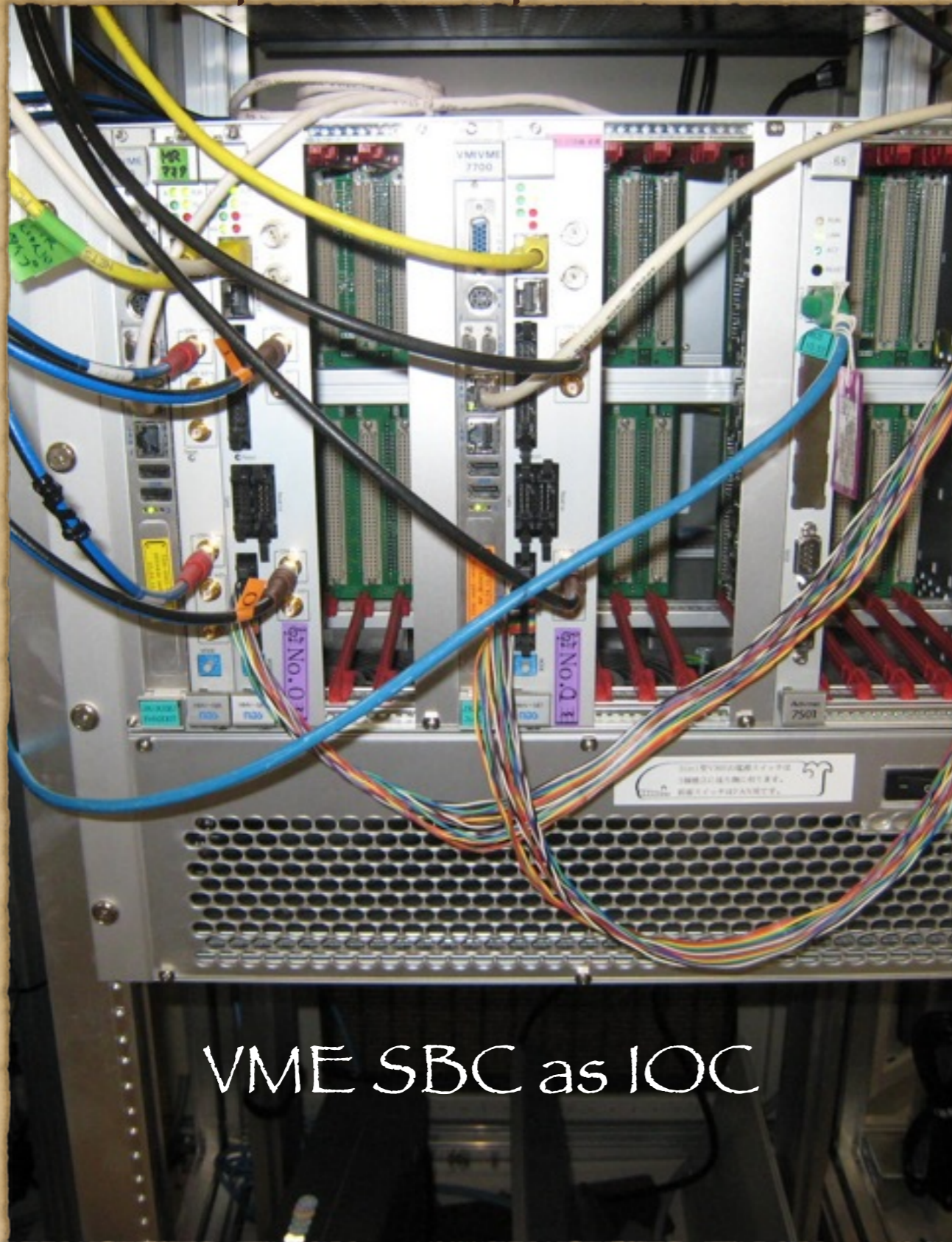


Figure 1. Software Architecture

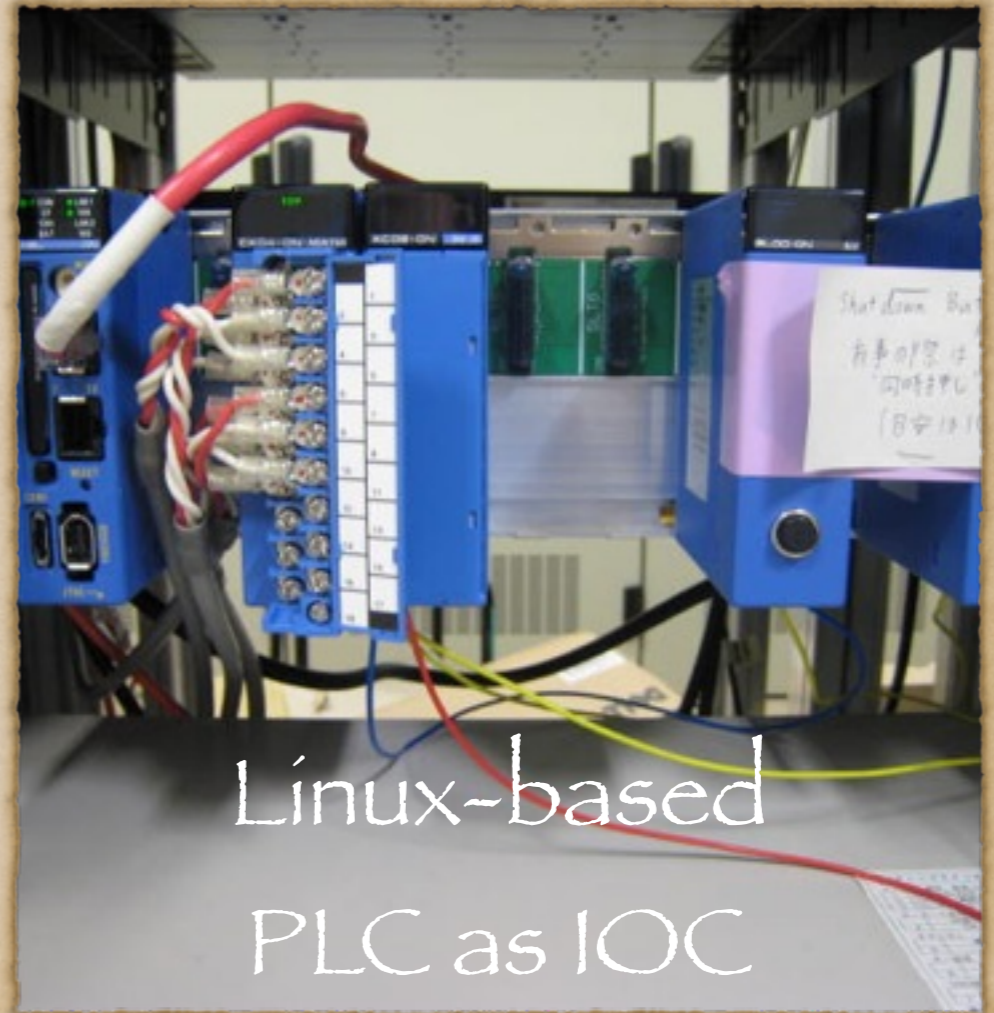
# IOC: Input/Output Controller



VME SBC as IOC



RPi as IOC



Linux-based  
PLC as IOC

# EPICS software Architecture Network

- ◆ Channel Access

- ◆ Based on TCP&UDP/IP

- ◆ Data (Int/Float/String,...)+Time Stamp + Status

- ◆ Channel Name

- ◆ Automatic Connection Management

- ◆ Gateway/Nameserver for Large Installation

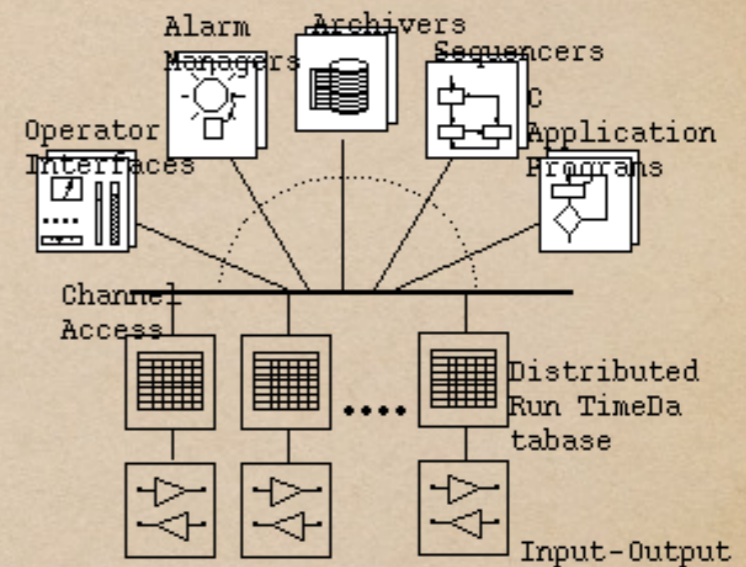


Figure 1. Software Architecture

# CA コマンド実行例

```
% caget -a fred
```

```
fred          2014-02-26 15:48:31.221148 -3.00397
```

チャンネル名      タイムスタンプ                      データ値

```
% camonitor fred
```

```
fred          2014-02-26 15:48:31.221148 -3.00397
```

```
fred          2014-02-26 15:48:37.859037 -3.08474
```

```
fred          2014-02-26 15:48:39.854837 -3.1091
```

```
fred          2014-02-26 15:48:41.849909 -3.15141
```

```
fred          2014-02-26 15:48:43.845974 -3.13209
```

Monitor機能を使うと、

データの更新時に新しいデータが送られてくる。

# EPICS software Architecture

## Control room Application

- ◆ Operator Interface: medm, edm, CSS

- ◆ Alarm: Alarm Handler, CSS

- ◆ Data Archiver: Channel Archiver, CSS

- ◆ Sequencer: SNL

- ◆ Application Program: Tcl/Tk, Python, C/C++  
+, WebCA....

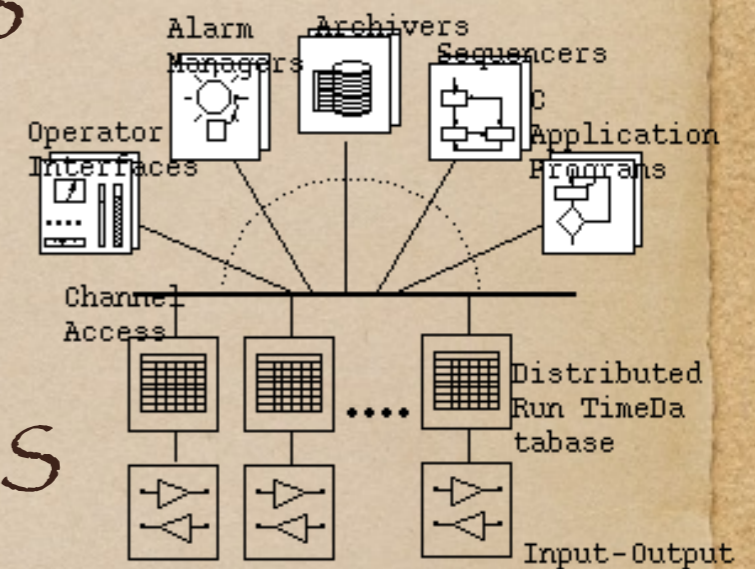


Figure 1. Software Architecture

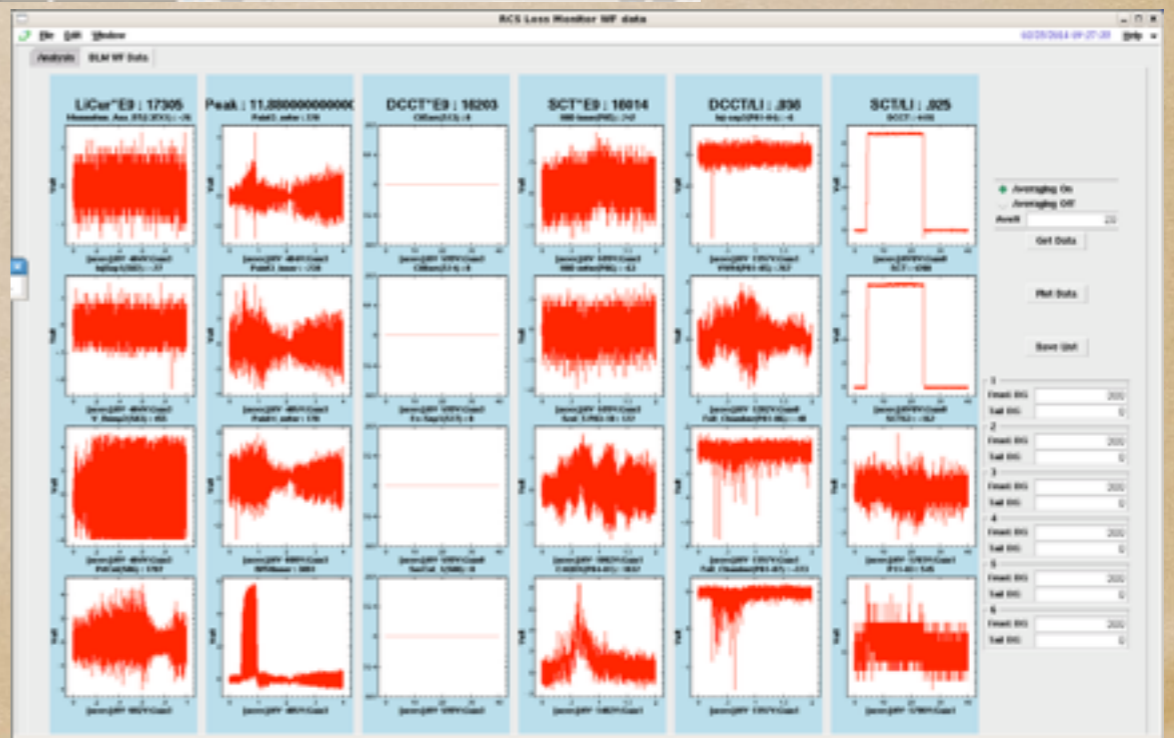
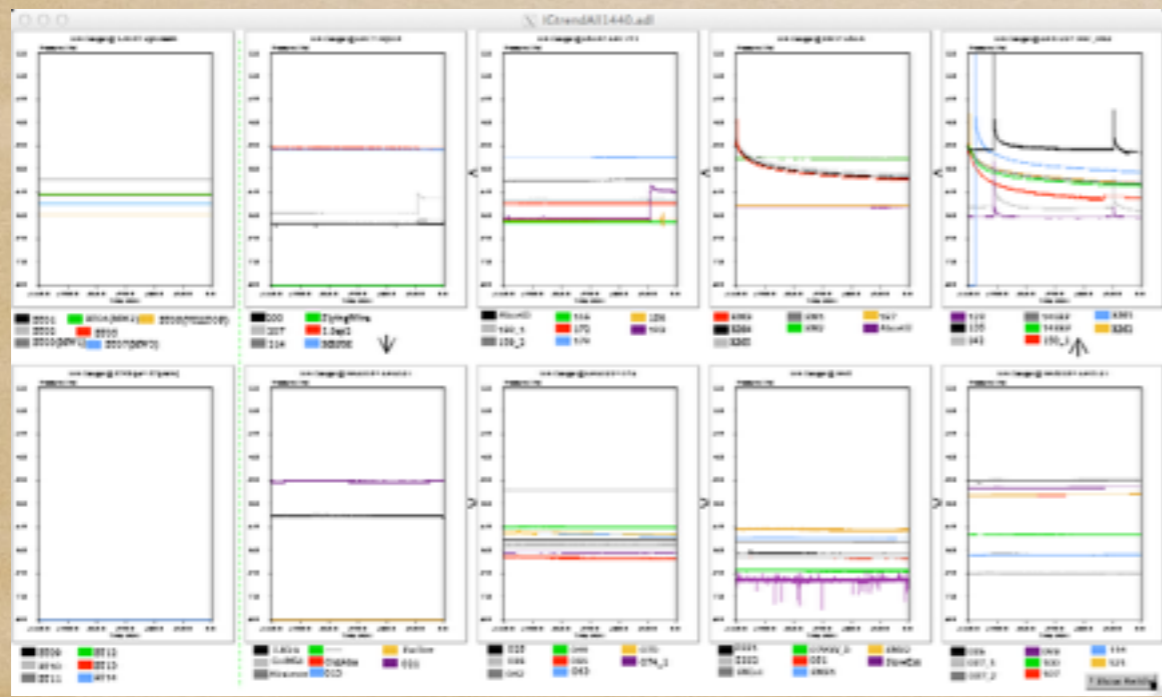
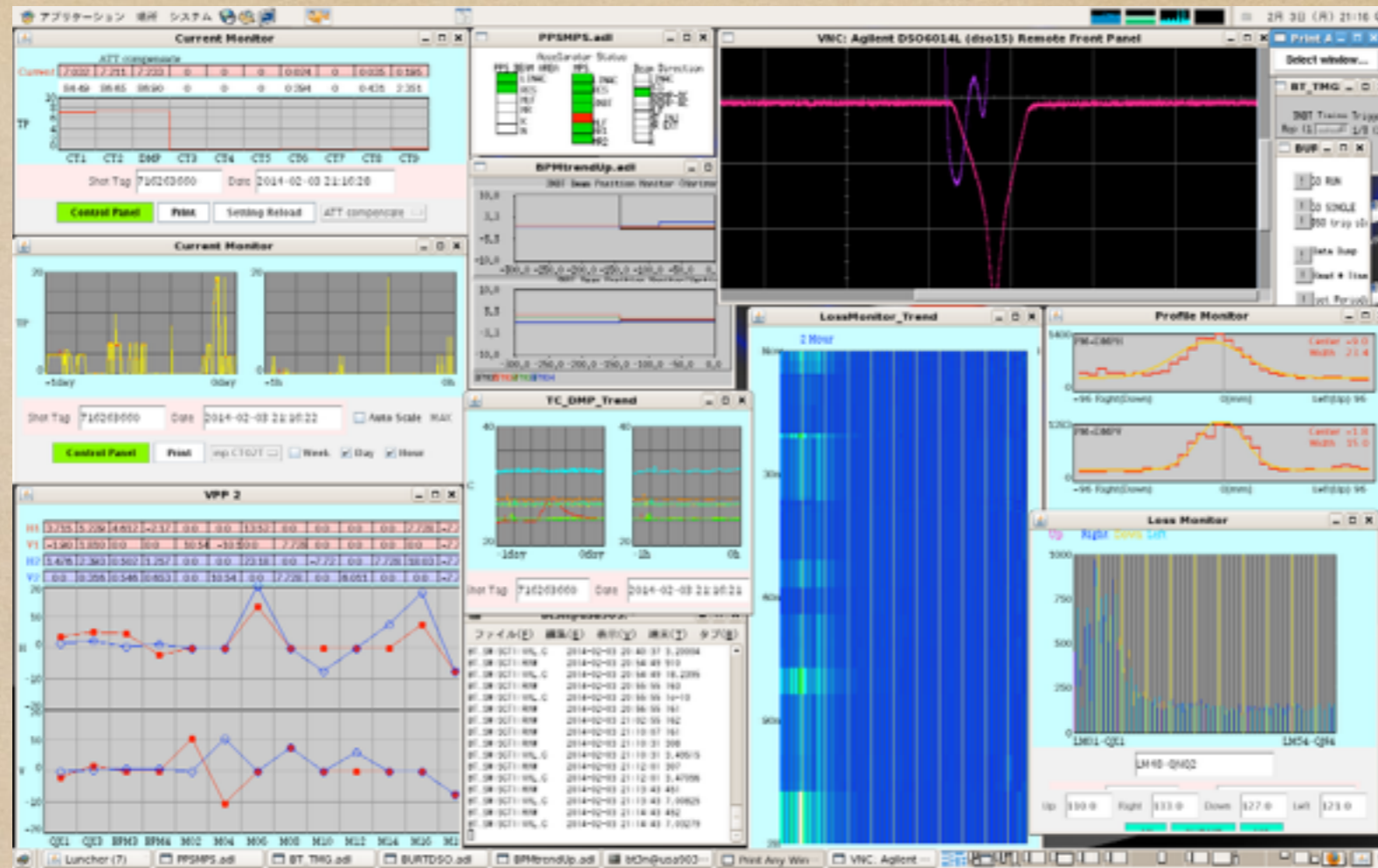


J-PARC加速器中央制御室



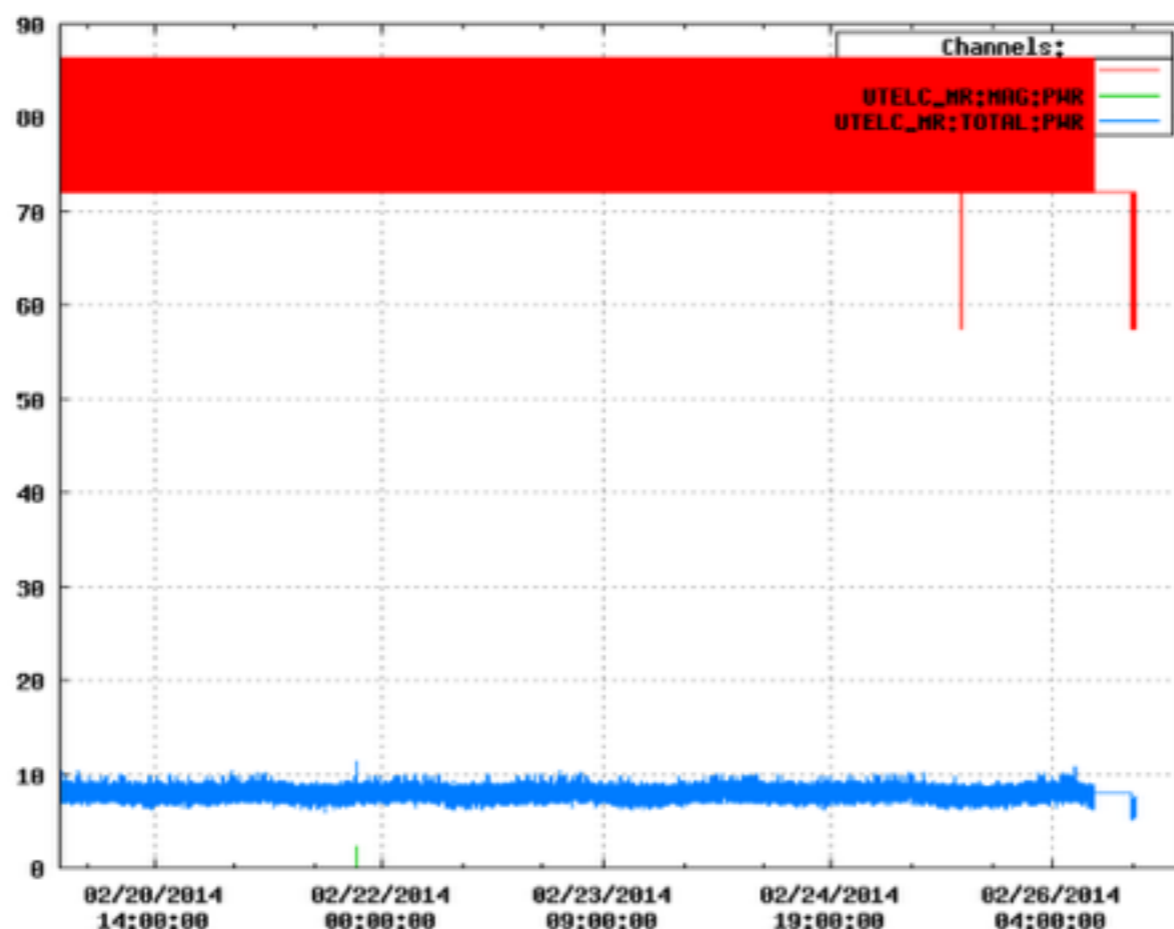
J-PARC 制御システムのNetwork/Server/Storage

# J-PARC 加速器制御画面の例





## Archiver XML-RPC Interface (Utility)



Pattern:

record names

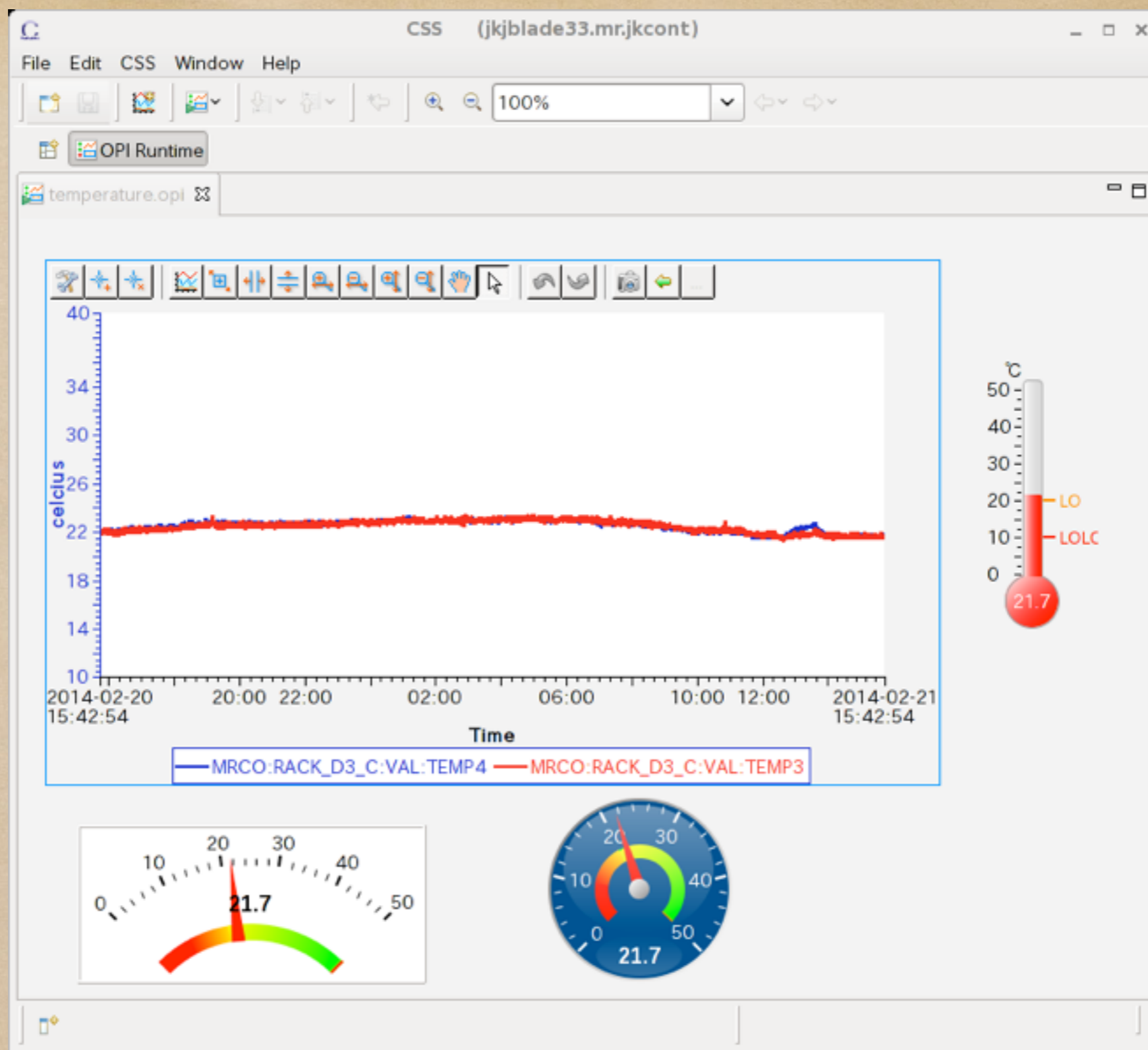
Start: Day (m/d/y)    Time (h:m:s)

End: Day (m/d/y)    Time (h:m:s)

Y Range: min  max

scale:  normal  Log10

Archiverにより保存されたデータを閲覧する



CSS: Control System Studioの一例(BOY)

Widgets

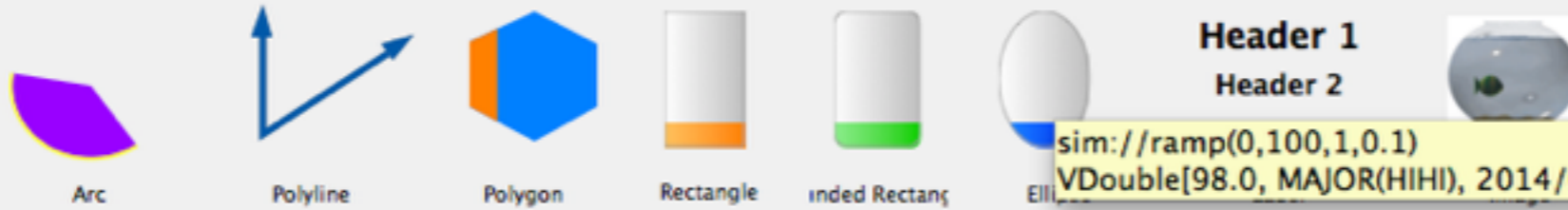
Go Home

BOY Widgets Demo

See Online Help

Graphics/Monitors/Controls Native Widgets/Others

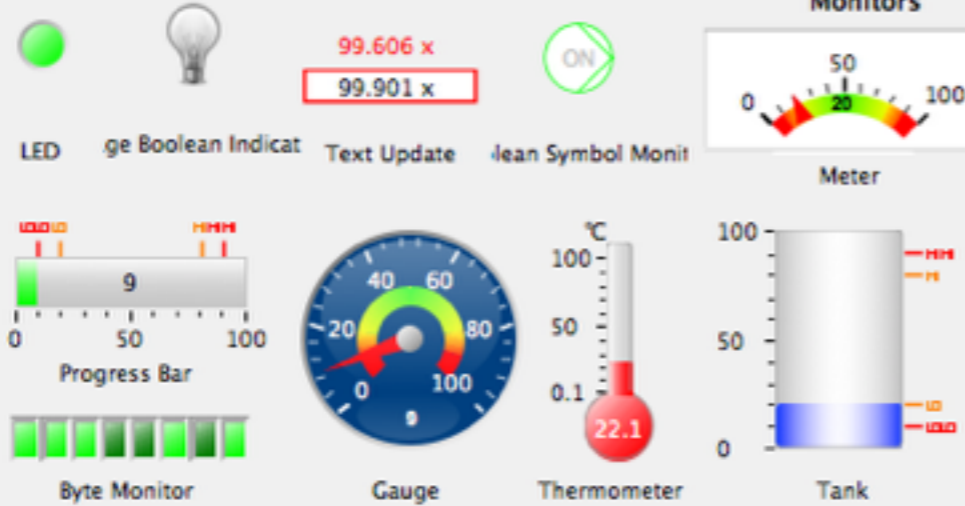
Graphics



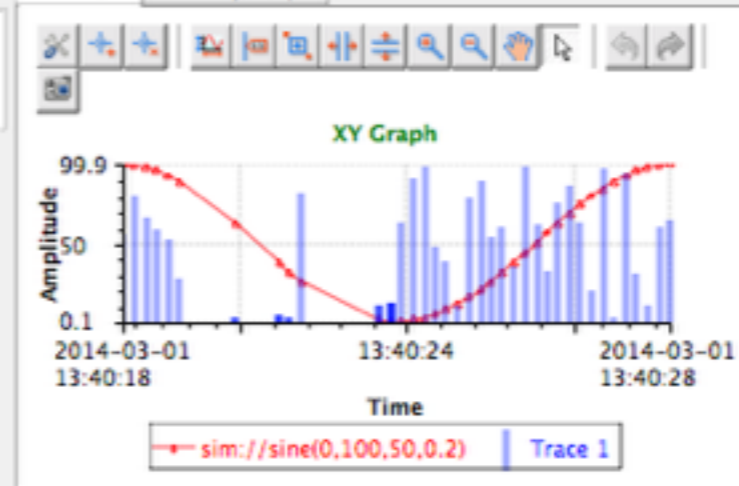
Header 1  
Header 2

sim://ramp(0,100,1,0.1)  
VDouble[98.0, MAJOR(HIHI), 2014/03/01 01:40:26.337]

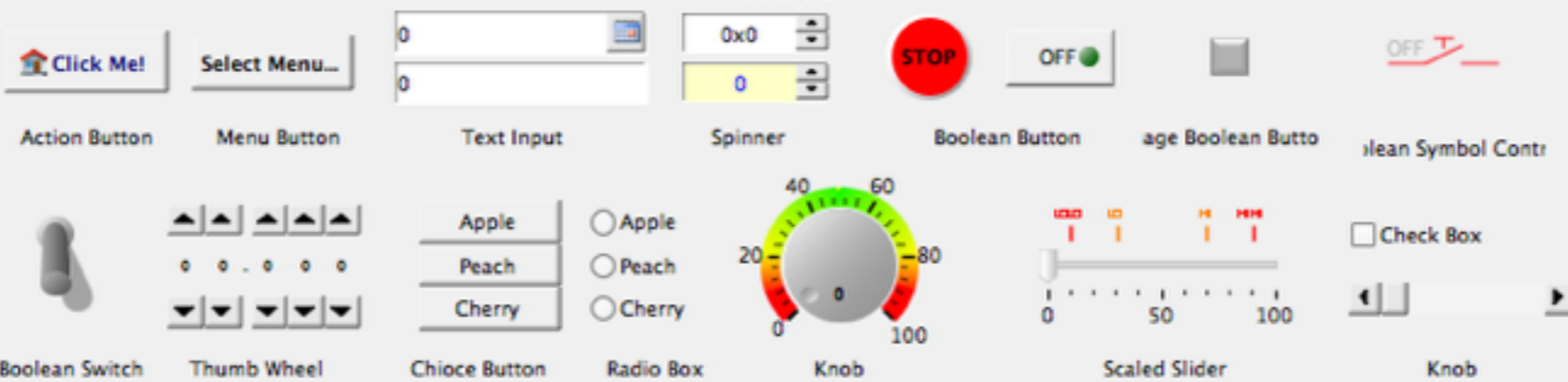
Monitors



XY Graph Intensity Graph

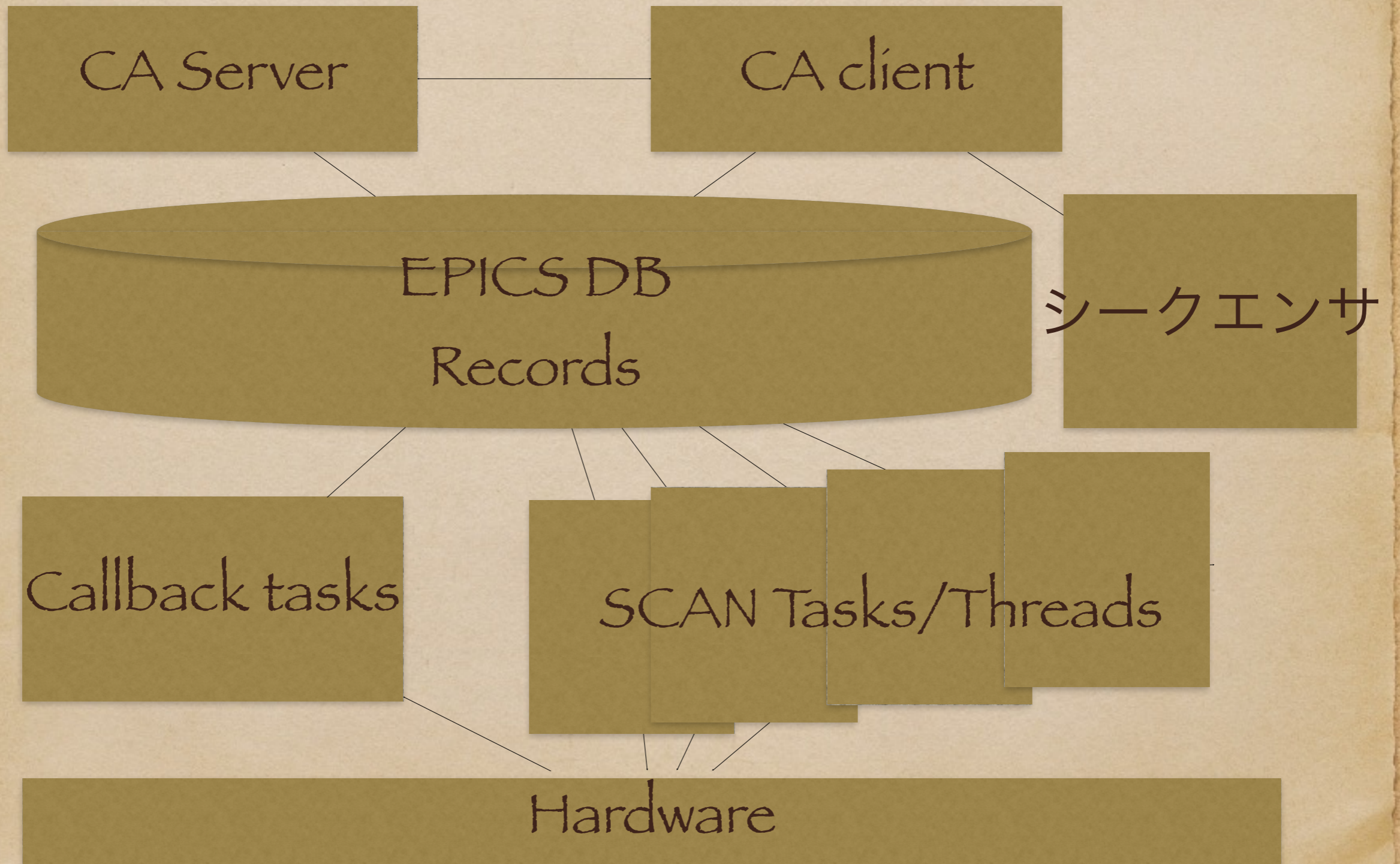


Controls



EPICS Database

# IOCsh



# EPICS Database

- ◆ EPICS Databaseの公式
- ◆  $DB = \text{Records} + \text{Links}$
- ◆  $\text{Records} = \text{Type} + \text{Fields} + \text{Action}$

# EPICS Records

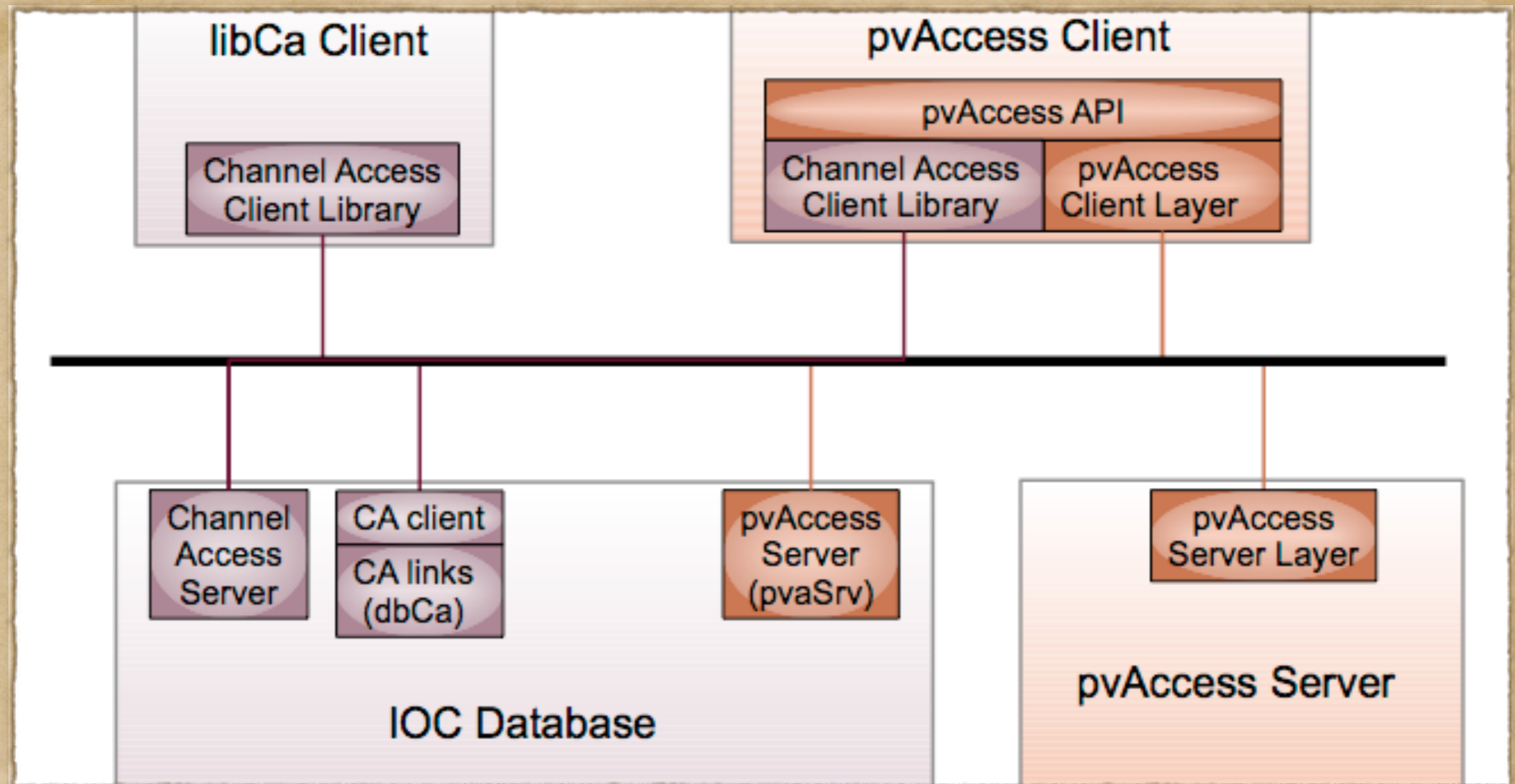
- ◆ Records for I/O
  - ◆ AI/AO, LI/LO, BI/BO, StringIn/StringOut
  - ◆ waveform
- ◆ Soft records
  - ◆ CALC, Select, Compress, Event, SubArray
  - ◆ fanout, dfanout

# EPICS Database

- ◆ EPICSアプリケーションの設計においては、Databaseの設定が中心となる。
- ◆ 必要に応じてRecord型の拡張や新規の装置型 (Device Type) の導入を考慮する。



EPICS V4



# EPICS V4

- 現行のEPICS CA プロトコル(ver.3)では取り扱えるデータ構造は限られている。
- クライアントソフトを考慮した新しいEPICS Protocol (PvAccess) が作られている。







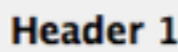
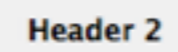
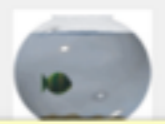
EPICS V4 FAQ: <http://epics-pvdata.sourceforge.net/faq.html>

Widgets

BOY Widgets Demo [See Online Help](#)



Graphics/Monitors/Controls Native Widgets/Others

### Graphics


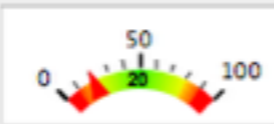
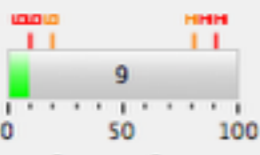

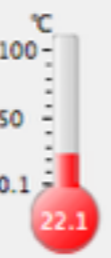
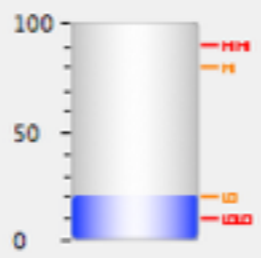
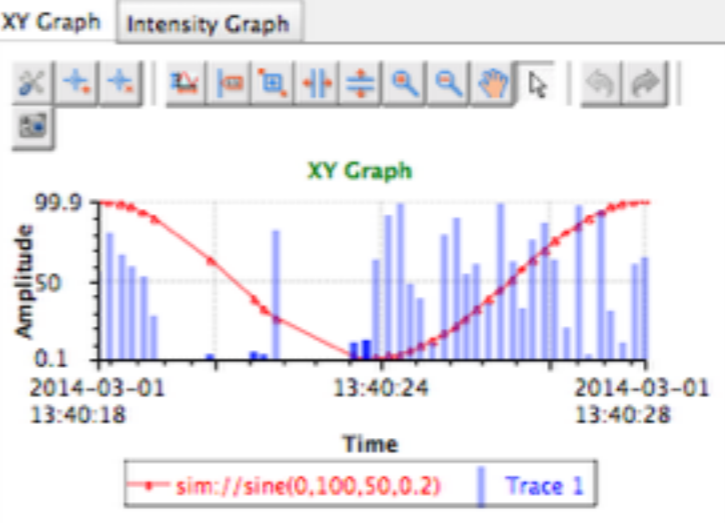










sim://ramp(0,100,1,0.1)  
VDouble[98.0, MAJOR(HIHI), 2014/03/01 01:40:26.337]

### Monitors

99.606 x  
99.901 x

sim://sine(0,100,50,0.2) Trace 1

### Controls




0  
0










Apple  
Peach  
Cherry






Check Box

# 結び

- ◆ EPICSは実用的な制御システム構築のためのソフトウェアフレームワーク
- ◆ 世界中でEPICSに基づいた制御システムが構築され、利用されている。
- ◆ より使い易いソフトウェアを目指して、開発が継続されている。