

Partner ---

Or

EPICS – It Has Industry In Its Name.

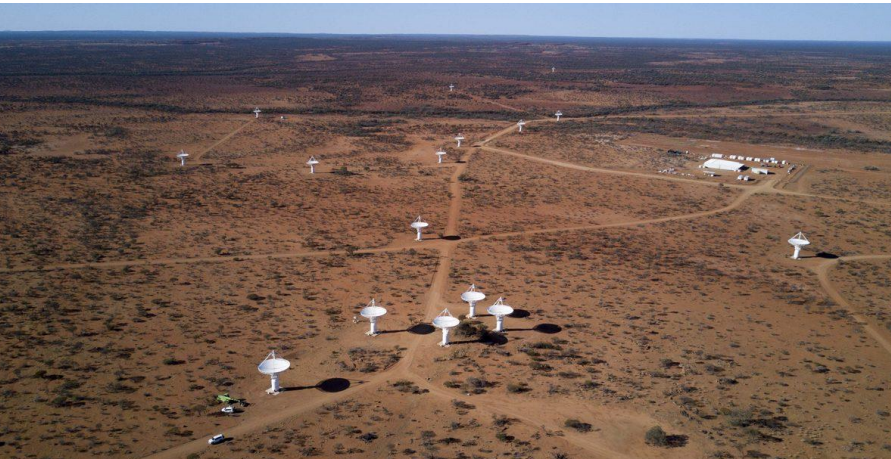
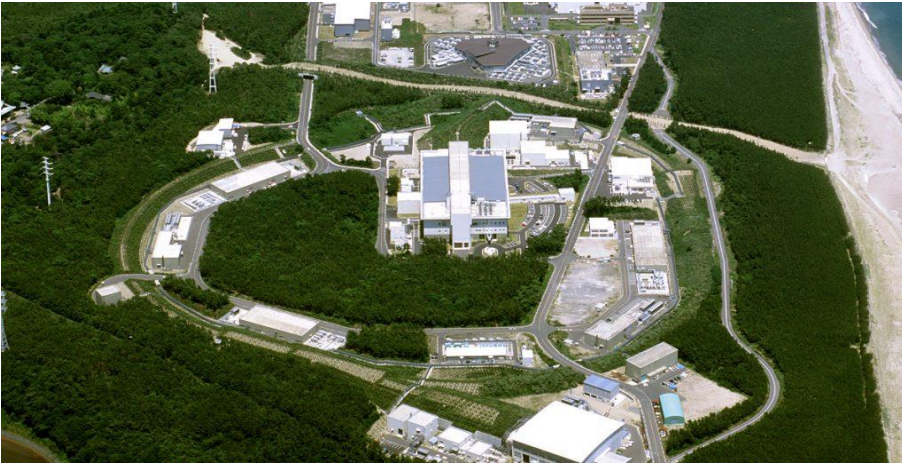
Bob Dalesio - Short Bio

- Team Developed and applied the EMC Controls Emcon D3 Control System: Steel Plant Provo, Utah, Oil Refinery, Puerto Rico Early 80s
This company was started by a group that split off from Foxboro
- Team Developed and applied the Computer Products Industry Control System: UTC Fuel Cell, %\$# and ^%\$ Laser Control Systems Mid 80s
- Team Developed and deployed the Ground Test Accelerator Control System aka Low Energy Development Accelerator in the late 80's
- Team Developed and supported the deployment of The Experimental Physics and Industrial Control System from 1990's to the present.

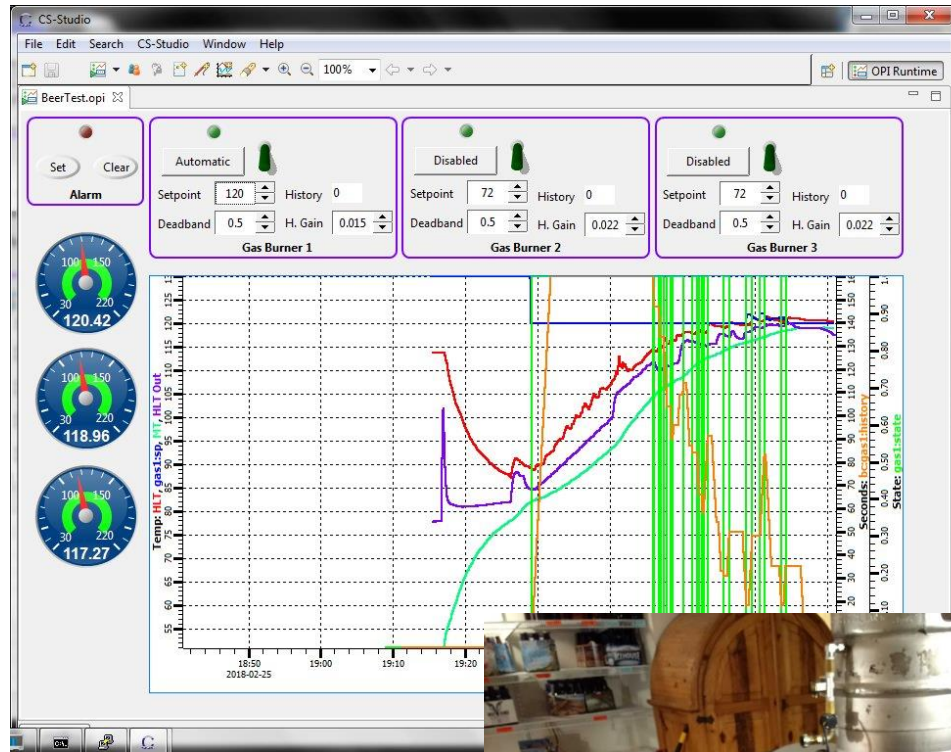
The Experimental Physics and Industrial Control System (EPICS)

- Was developed to provide tools for process control engineers with no programming.
- EPICS is widely used in Industrial and Research Applications of all Sizes.
- Architectural Features of EPICS support Industrial and Research Control
- Interfaces to support extensions and high-resolution timing
- Support from Commercial Companies for tools and application

EPICS at Large Facilities On All Continents



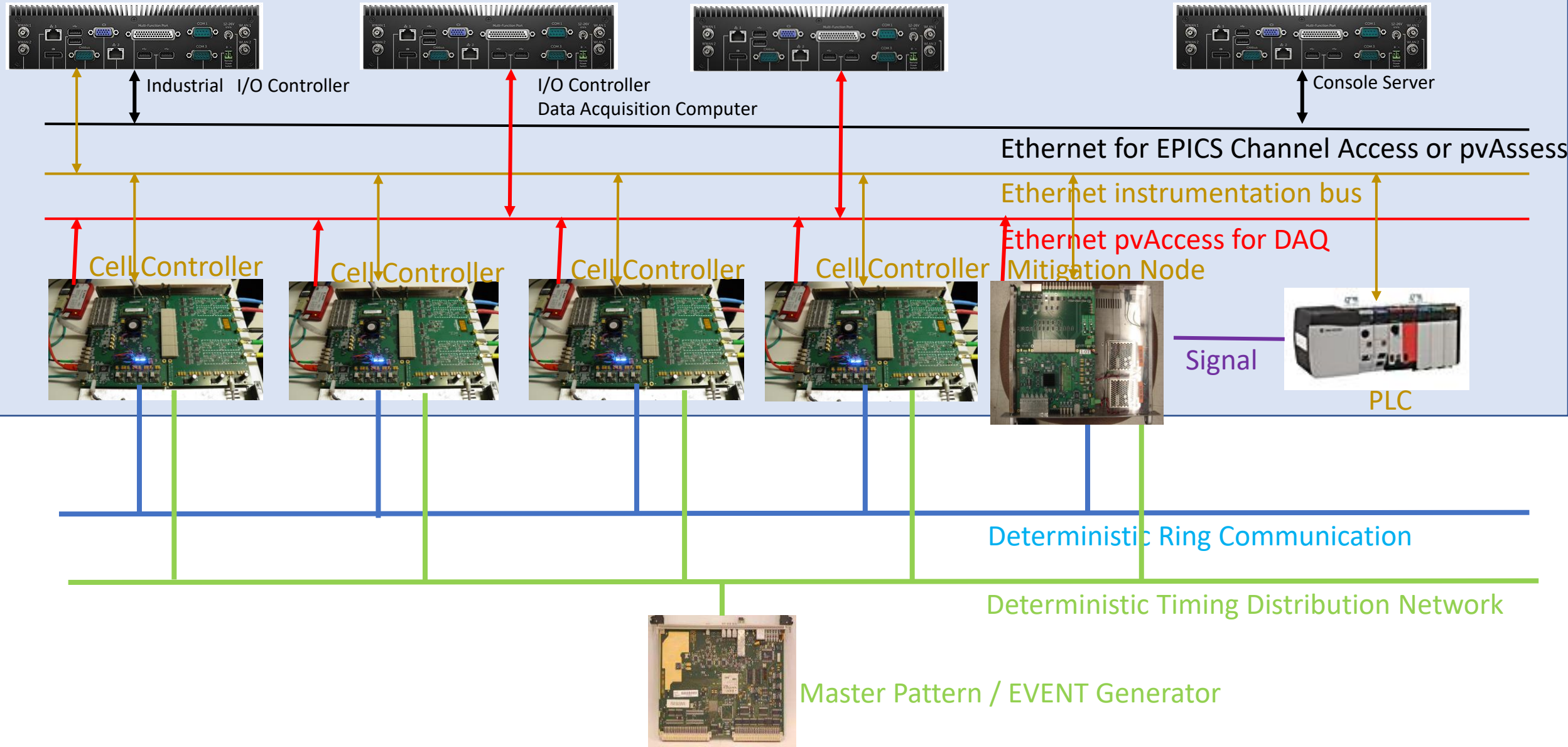
EPICS Scales Down to PCs and Raspberry Pi's



Industrial IO is 60% of all IO at Accelerators

- Vacuum Control – Vacuum Controllers and PLC IO
- Cryo Control – CEBAF was the first facility to use EPICS for this
- Vibration Monitoring
- Cooling Water Control
- Temperature Monitoring
- Power Supplies: high voltage RF, regular and pulsed magnets
- Access Control into restricted areas
- Facility Control – Sverdrup used EPICS for SNS facility with AB PLCs
- Power Distribution and rack monitoring


Hardware Architecture



Non-Industrial Instrumentation

- Beam Diagnostics (>300 MHz)
- Radio Frequency Field Control (>300 MHz)
- Fast Orbit Feedback (10 kHz)
- RF Phase Control (>300 MHz)
- Triggered acquisition (<10 psec jitter, <1 nsec resolution)
- Fast corrector magnet power supplies (10 kHz)
- Beam Loss Detection (<3 usecs latency)
- Beam Loss Mitigation (<10 usec)
- Data Correlation (1 nsec)

Commercial Research and Development Agreements Yielded Three Partners in the 90'

- 
- Baltimore Gas & Electric - LNG terminal, Pipeline compressors (3)
 - LOF - Float glass manufacturing, Glass coating (3)
 - NASA - Satellite ground station instrument monitoring
 - WLSSD - Sewage treatment & incineration
 - S. Nevada - Water treatment, pumping & storage
 - Citgo - Refinery tank farm automation, Product movement
 - AMD - Chip 'fab' environmental controls/HVAC
 - SAIC - Automated/portable weapons disposal plant, (2)
 - Los Alamos - Particle accelerator vacuum system control
 - California ISO - Power grid monitoring, metering and AGC
 - San Diego Gas & Electric - SCADA/Remedial Action System
 - City of N. Wales - Water pumping & distribution
 - City of Milwaukee - Sewage treatment & Water treatment (5)
 - Nippon Sheet Glass - Glass coating line
 - Anne Arundle Co. - Waste treatment, Water treatment/distribution (6)
 - Austin Regional - Sewage treatment and collection/pumping
 - Tong Yang - Cement plant automation
 - S. Nevada - Water distribution/pumping system expansion
 - Citgo Lake Charles - Tank farm automation
 - Northwest Indiana - Water treatment, storage and distribution
 - River Mtn. Treatment Plant - Water treatment, and distribution
 - San Diego Gas & Electric - Distribution SCADA & load shedding

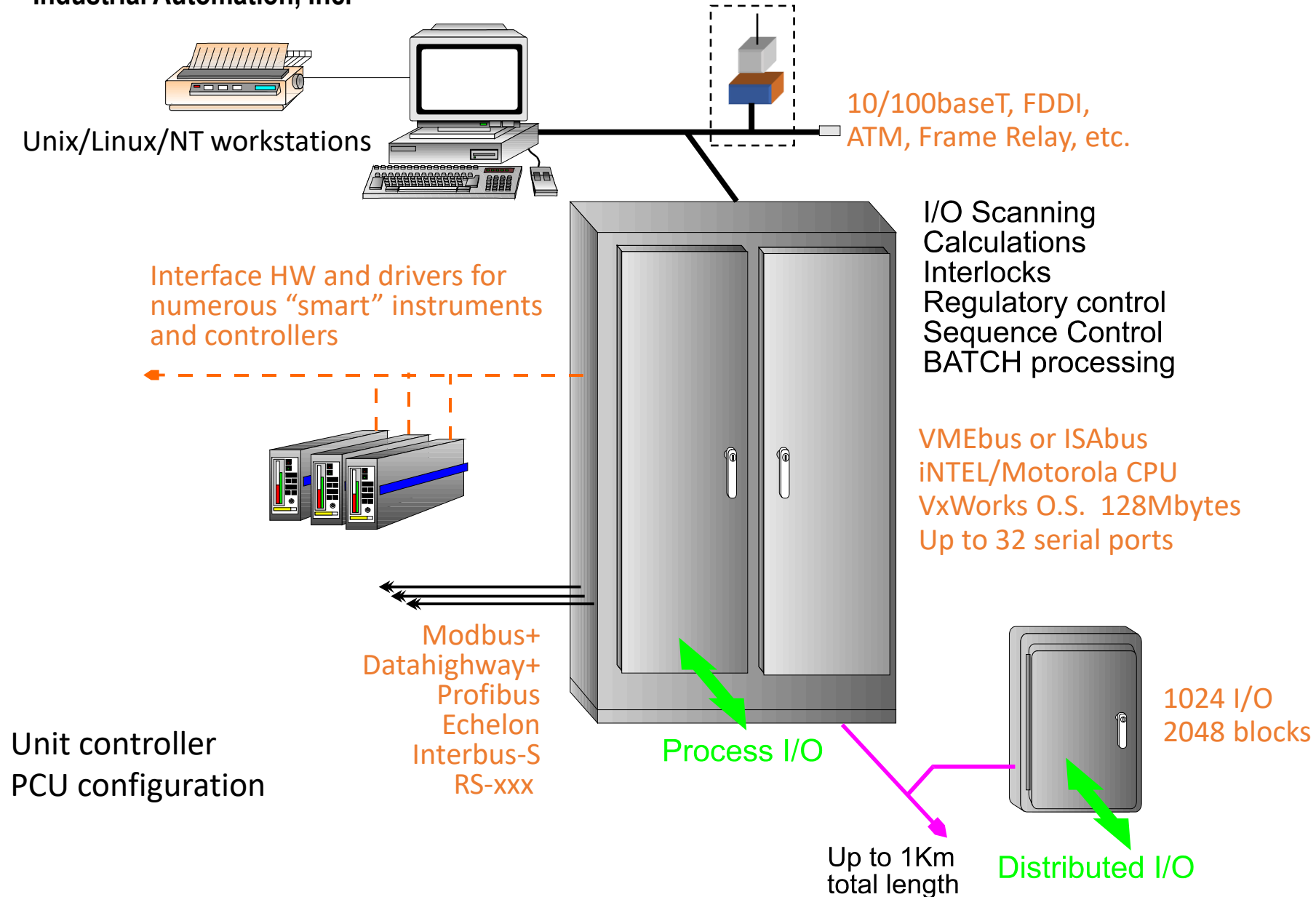
Hathaway

Industrial Automation, Inc.

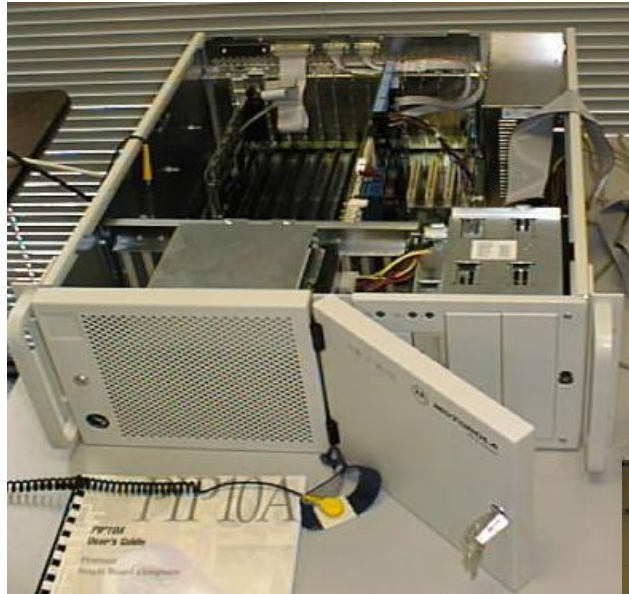
Non-Traditional (Distributed) SCADA and DCS systems:

- Designed to provide for Inter/Intra/ExtraNet communications
 - **Incorporates SSL layer TCP/IP plus digital “certs”/VPN technology**
 - Uses “digital” communication systems
 - Works well at 56Kbps and better with more bandwidth
 - Uses a “publish and subscribe” data exchange methodology
 - Co-exists with other traffic (video, VoIP, data, FTP, etc.)
 - **Can be part of a “hybrid” system (traditional plus distributed)**
- “REPLACE IN PLACE” was the marketing approach to integrate existing systems**
..... and then upgrade incrementally

TIS-4000 Systems



TIS-4000 Systems



ISAbus RSU
Pentium II CPU

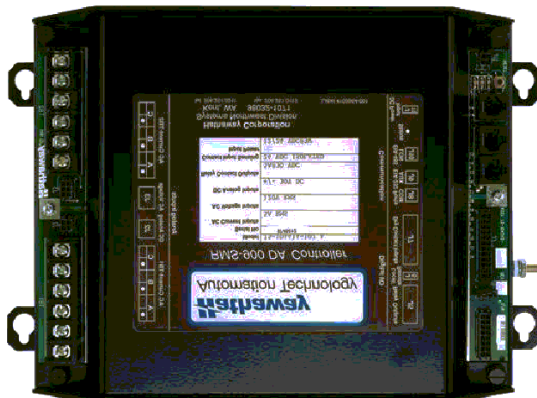
PLC remote
unit

Floor mounted
"Smart" RTU

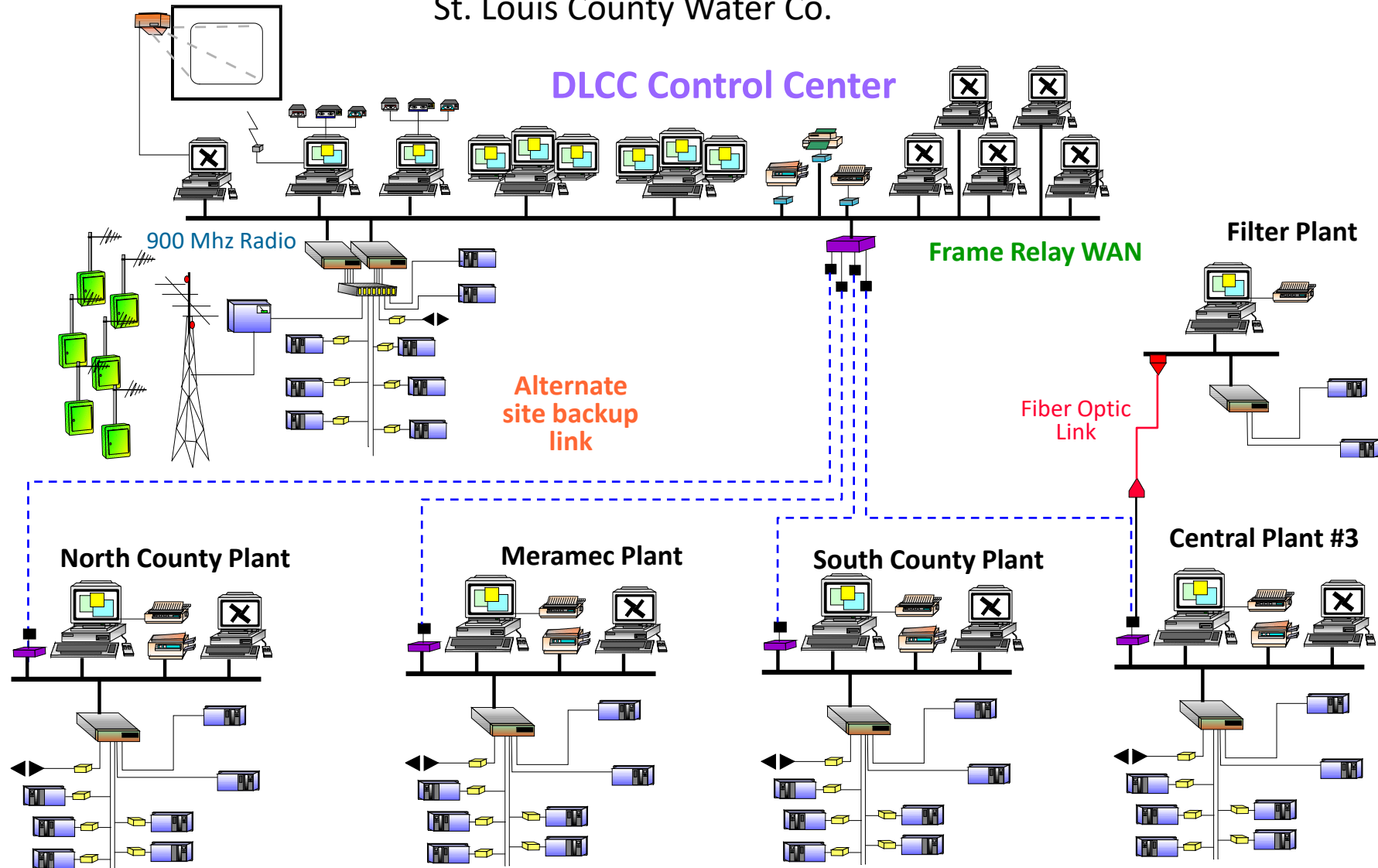


VMEbus RSU
M68040 CPU

Pole-top RMS900
"Smart" RTU



St. Louis County Water Co.

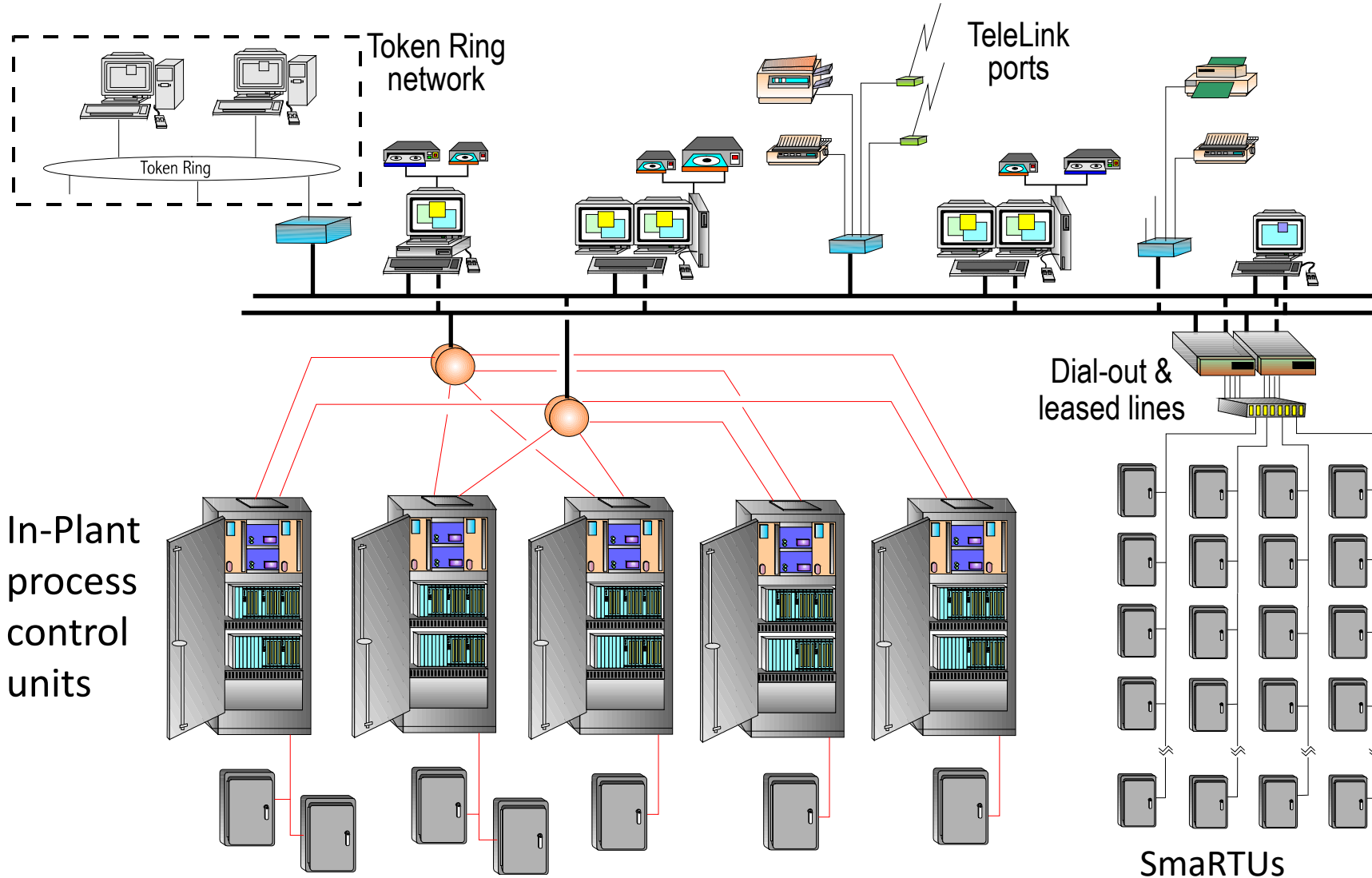




Industrial Automation, Inc.

Western Lake Superior Sanitary District

TIS-4000 Systems



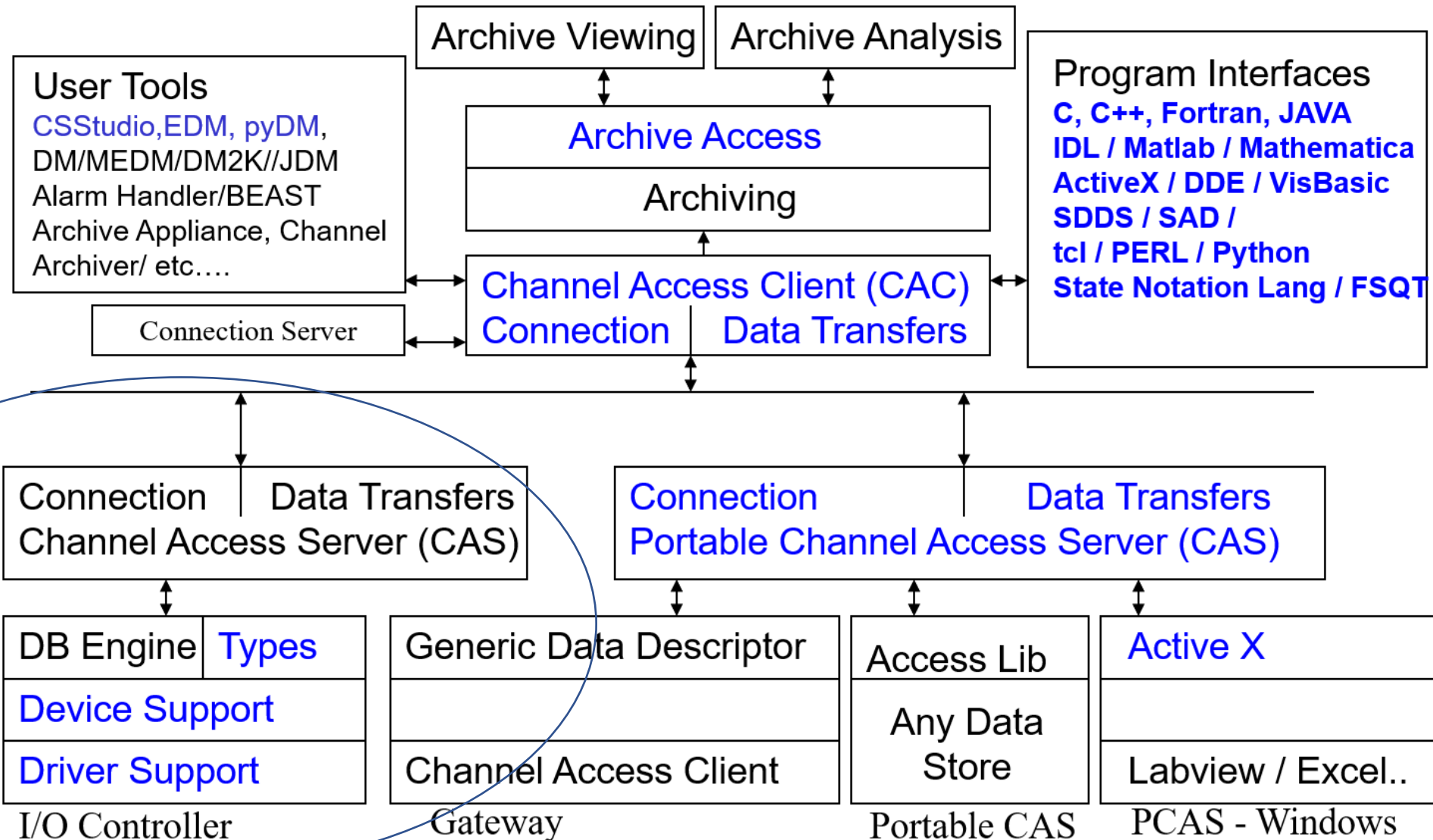
EPICS Is an Established Standard Toolkit

- The Experimental Physics and Industrial Control System is used successfully in both Industry and Research Facilities since the late 1990's
- EPICS is a set of tools (not a solution) that have been applied to small and large systems worldwide.
- Domain Expertise Applies Tools to Effectively, Efficiently and Reliably Solve a wide variety of Process Control Problems.
- Commercial Companies have a lot more time to create marketing material.

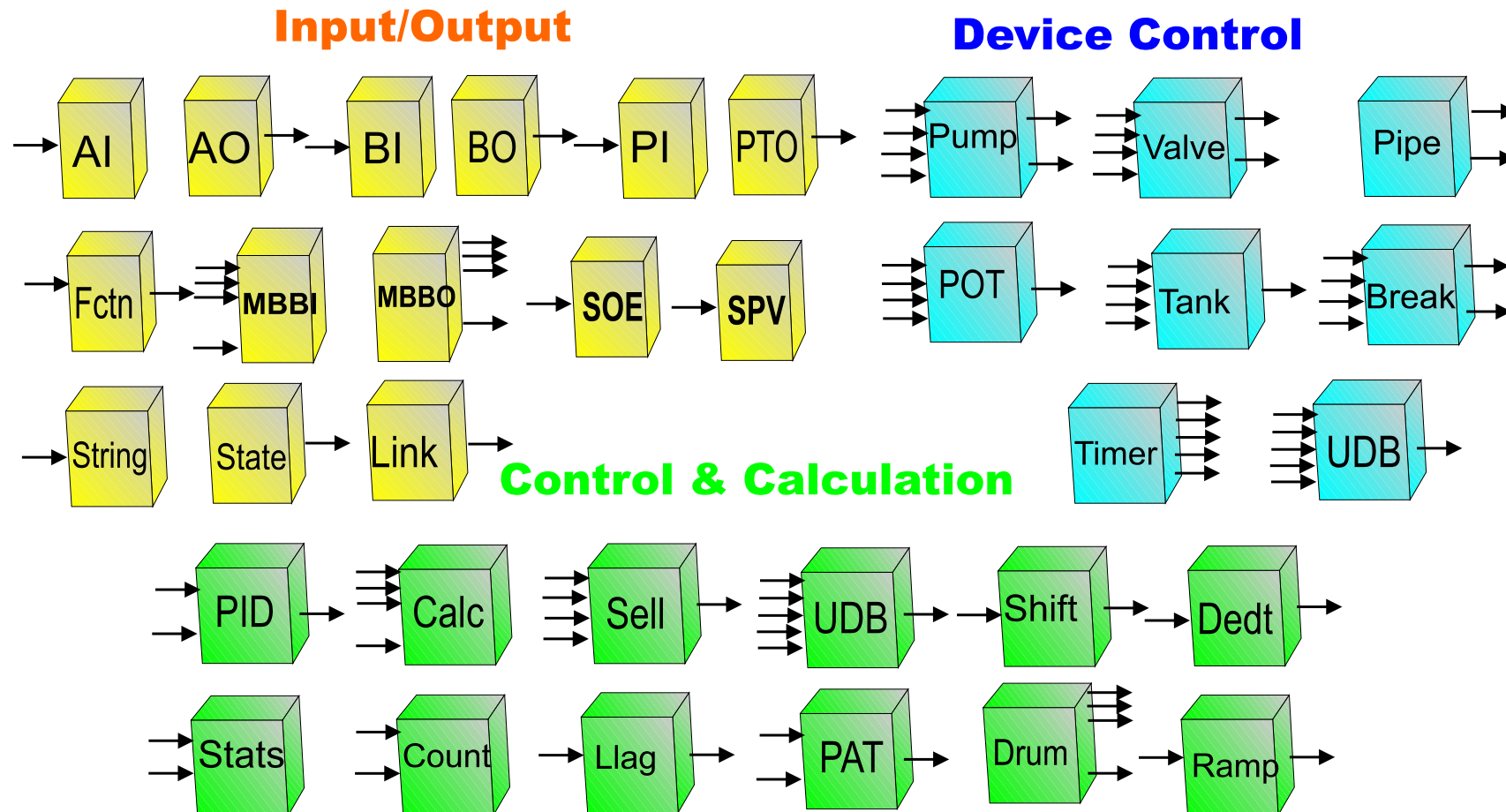
EPICS Architecture has Significant Differences compared to Industrial Control Systems

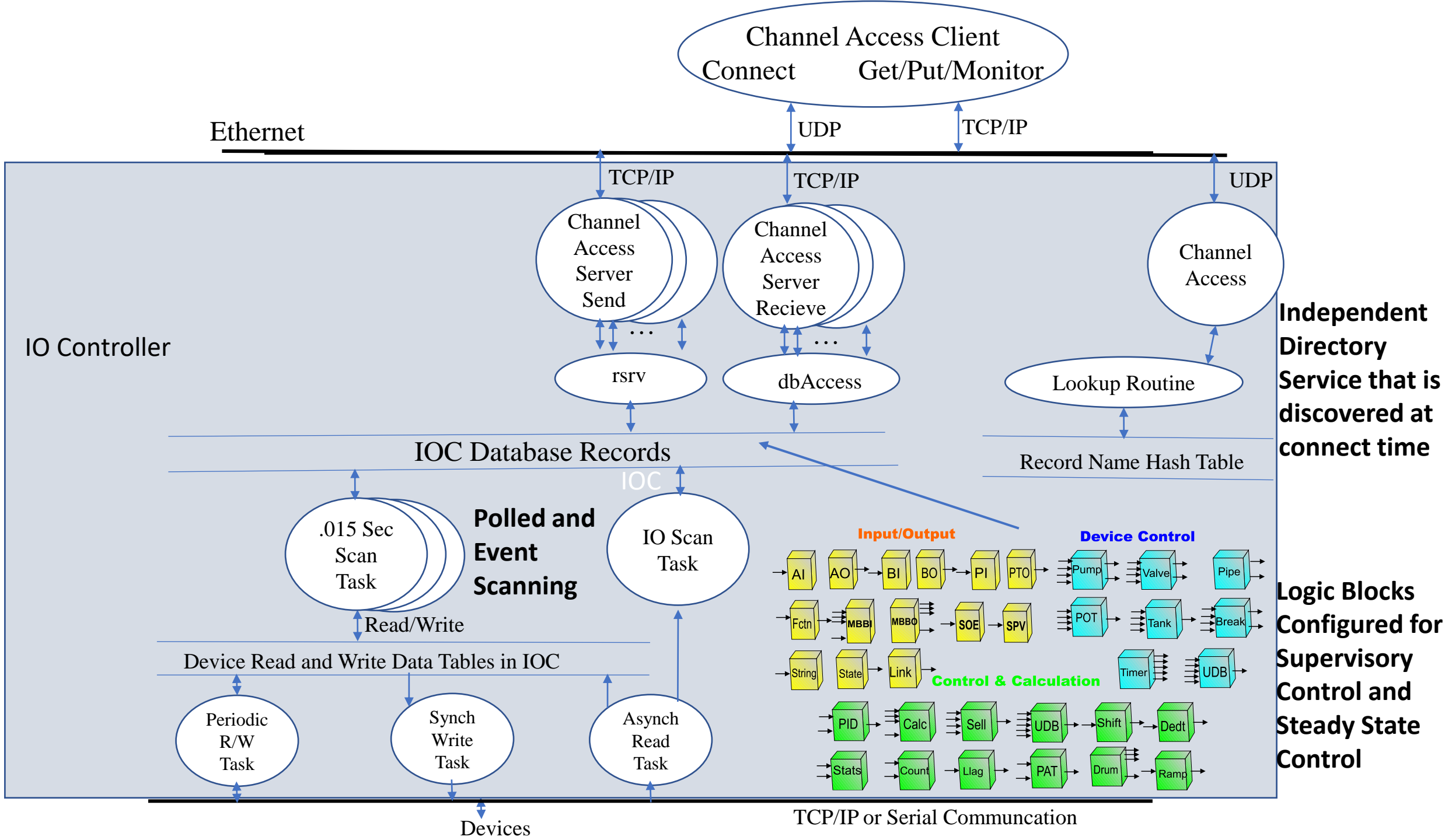
- A three-tier architecture was deemed the “standard model” for control systems: Field IO/Instrumentation, Computer Front End as Data Servers and Client Applications
- **The unique feature of EPICS was to create well defined interfaces at all level of the software to support the independent development and extensions to EPICS base (Channel Access Protocol and the Process Database).**
- Configuration tools are provided to reduce the programming time and risk. The same EPICS core runs at all facilities.
- The open source collaboration worked cooperatively or individually to extend the functionality as needed.

Interfaces Support Independent Development



Process Database Configuration of DBTypes – Building Blocks that form atomic operations

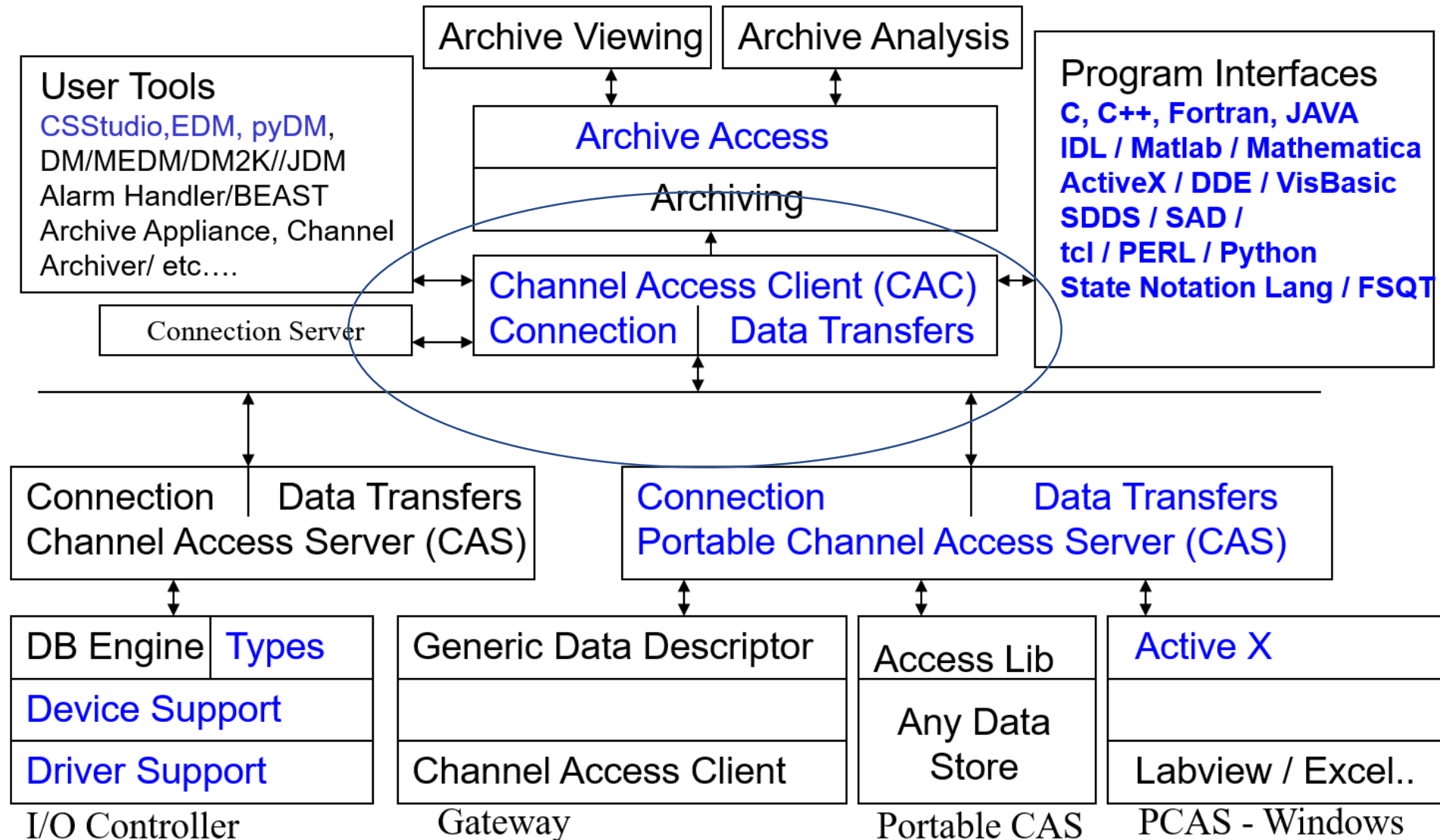




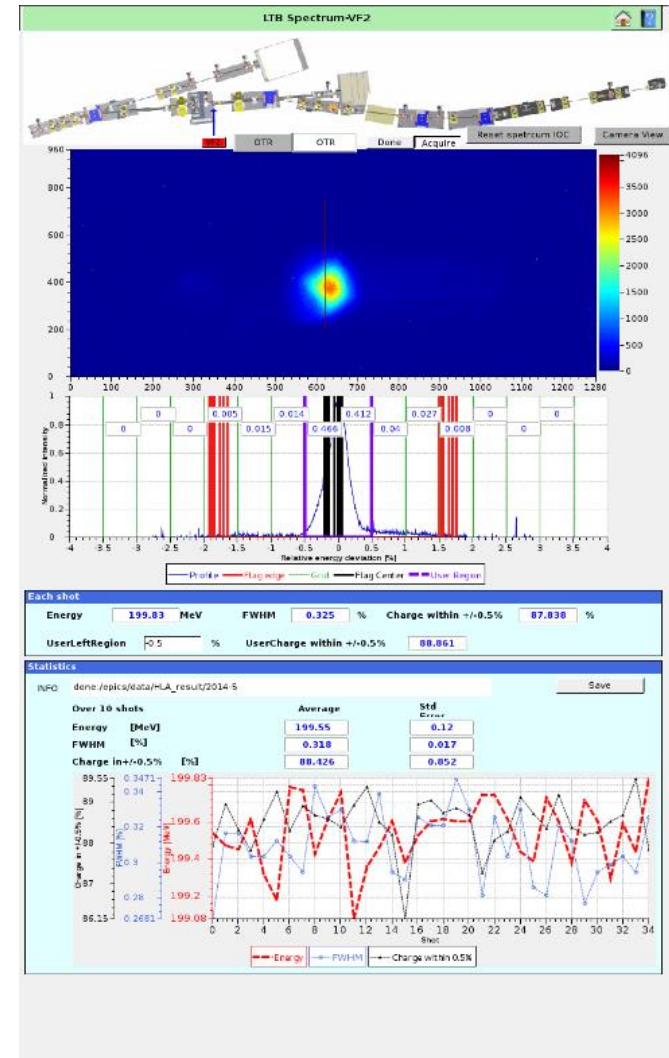
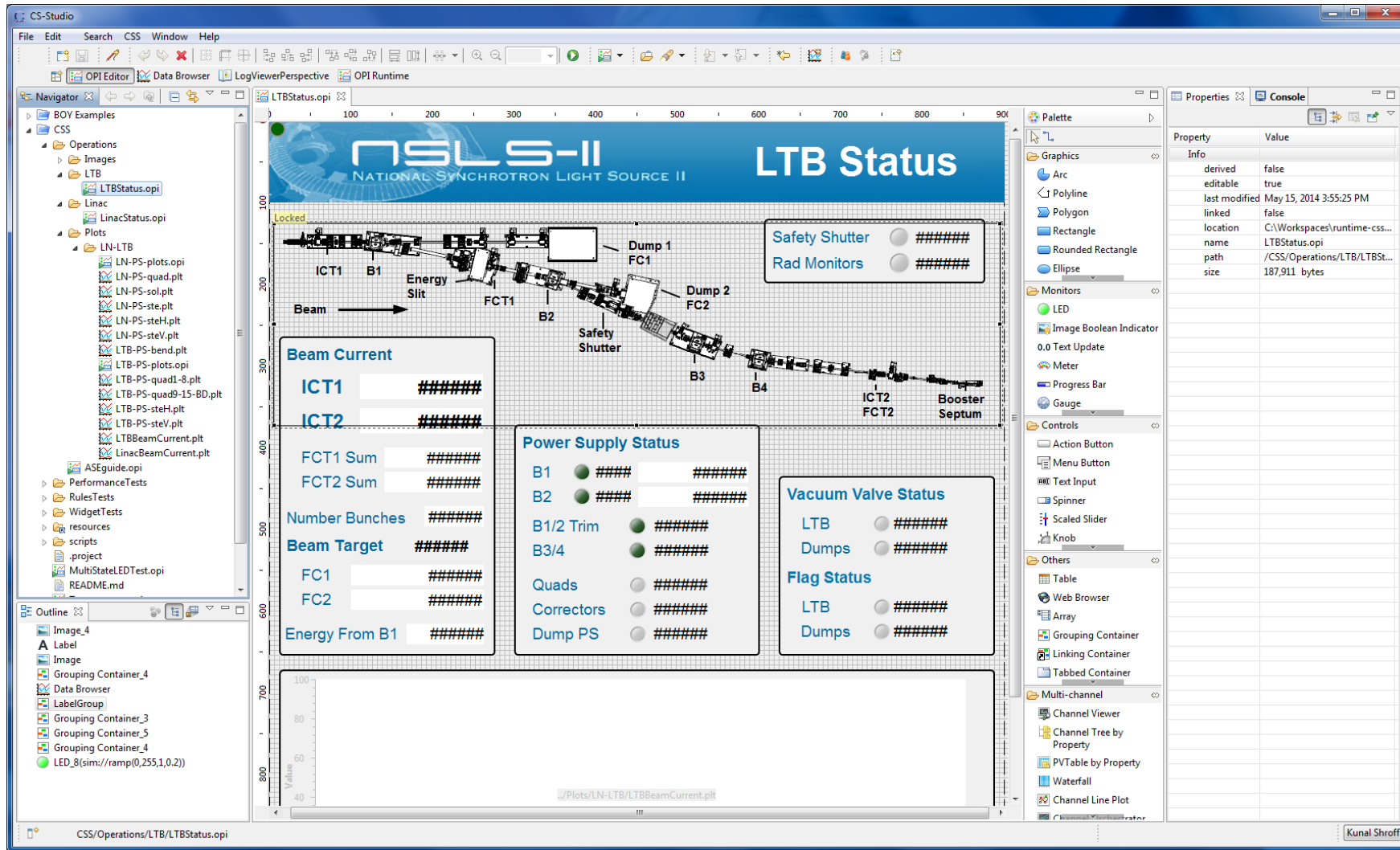
Getting the time stamp into a record

- Allow the device support to provide the timestamp from the Device.
- Get the time stamp from the local time server NTP or PTP
- Use the time stamp of the Record from which a value was read

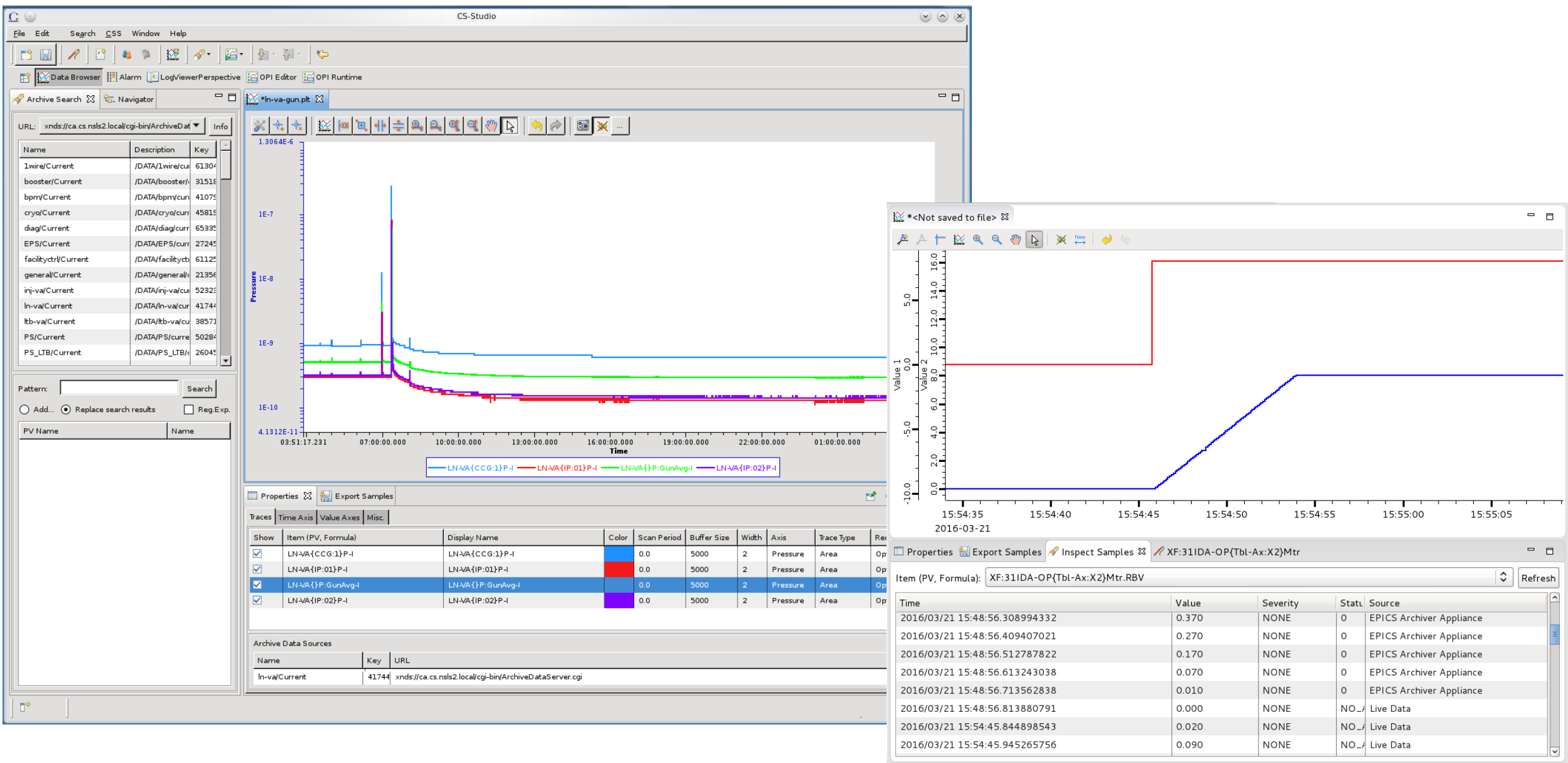
Interfaces Support Independent Development



Synoptic Editor and Runtime



Archive Appliance



Alarm Viewer

CS-Studio

File Edit Search CSS Window Help

100%

Data Browser Alarm LogViewerPerspective OPI Editor OPI Runtime

Alarm Area Panel

Common environment

Linac

Booster

Storage ring

NSLS-II Linac Vacuum System

7E-10 KLYIP2

3.6E-12 KLYIP1

WGIP7

2.8E-8

WGIP6

7E-9

8.5E-9 WGIP3

6.8E-11 WGIP2

4.7E-10 WGIP1

7E-11 IP08

1.4E-10 IP07

8.5E-11 IP06

1.1E-10 IP05

3E-10 IP04

3E-10 IP03

1.4E-10 IP02

1.2E-10 IP01

Acc #2

Acc #1

GUN

Detail Info

Readings & History

Settings Download

Linac Reset

Linac Reset

Alarm Tree

NSLS2_OPR

Area: Common environment

Area: Linac (major-ack'd/STATE_ALARM)

System: Vacuum (major-ack'd/STATE_ALARM)

System: Linac Vacuum (major-ack'd/STATE_ALARM)

System: GV

System: CCG

System: IP (major-ack'd/STATE_ALARM)

PV: LN-VA{ES:1}HVSD-Sts

PV: LN-VA{CAB:2}LWL-SUM-Sts (r)

PV: LN-VA{CAB:2}LN:Box-Sts

PV: LN-VA{CAB:2}VAK:ES-Sts

Alarm Table

Current Alarms (999999)

| PV | Description | Alarm Time | Current Seve | Current Statu | Alarm Sev | Alarm Status | Alarm Value |
|-------------------------|--|---------------------|--------------|---------------|-----------|--------------|-------------|
| BR:IS-PS{PS:KIC4}Trip-S | MAJOR alarm: Booster Injection kicker 4 | 2014/05/13 10:50:00 | OK | NO_ALARM | MAJOR | STATE_ALARM | Trip |
| SR:C07-MG{PS}AlarmS | MAJOR alarm: Storage Ring Cell 7 Power Supply Sur | 2014/05/13 13:06:00 | OK | NO_ALARM | MAJOR | STATE_ALARM | Alarm |
| SR:C14-MG{PS}AlarmS | MAJOR alarm: Storage Ring Cell 14 Power Supply Sur | 2014/05/13 16:42:00 | OK | NO_ALARM | MAJOR | STATE_ALARM | Alarm |
| SR:C20-MG{PS}AlarmS | MAJOR alarm: Storage Ring Cell 20 Power Supply Sur | 2014/05/13 22:43:00 | MAJOR | STATE_ALARM | MAJOR | STATE_ALARM | Alarm |
| SR:C25-MG{PS}AlarmS | MAJOR alarm: Storage Ring Cell 25 Power Supply Sur | 2014/05/13 15:35:00 | MAJOR | STATE_ALARM | MAJOR | STATE_ALARM | Alarm |
| SR:IS-PS{ACsept}Alarm | MAJOR alarm: Storage Ring AC septum Fault | 2014/05/13 12:05:00 | MAJOR | STATE_ALARM | MAJOR | STATE_ALARM | Alarm |
| SR:IS-PS{Kick4}Alarm-S | MAJOR alarm: Storage Ring Injection Kicker 4 Fault | 2014/05/13 12:06:00 | MAJOR | STATE_ALARM | MAJOR | STATE_ALARM | Alarm |

Acknowledged Alarms (999999)

| PV | Description | Alarm Time | Current Seve | Current Statu | Alarm Sev | Alarm Status | Alarm Value |
|----|-------------|------------|--------------|---------------|-----------|--------------|-------------|
|----|-------------|------------|--------------|---------------|-----------|--------------|-------------|

shroffk

Save/Compare/Restore

The screenshot displays the 'Save & Restore Browser' window in CS-Studio. The window title is 'CS-Studio'. The menu bar includes 'File', 'Edit', 'Search', 'Run', 'CS-Studio', 'Window', and 'Help'. The toolbar contains various icons for file operations and a 'Quick Access' section. The main area is divided into several sections:

- Save & Restore Browser:** Shows a tree view with 'XF31 (masarService)' expanded, containing 'Save Sets for XF31' with buttons 'Import', 'New', 'Edit', and 'Open'. Below this is a list of 'm1-m6'.
- Snapshots of m1-m6:** A list of snapshots with buttons 'Open', 'Compare', and 'Tag'. The list includes:
 - 2017 Sep 28 16:52:13: (Kunal Shroff) snapshot for motors m1-6 (SNAPSHOT ID: 3)
 - 2017 Sep 28 16:50:59: (Kunal Shroff) A first snapshot of motors m1-6 (SNAPSHOT ID: 2)
- Snapshot Details:** Fields for 'Comm...' (snapshot for motors m1-6), 'Creator:' (Kunal Shroff), 'In...' (SNAPSHOT ID: 3), 'Timesta...' (2017 Sep 28 16:52:13), and buttons 'Res...', 'Take Snaps...', and 'Save Snaps...'.
- Table:** A table with columns: #, Setpoint PV Name, Timestamp, Status, Severity, *Stored Setpoint* (Stored Setpoint, Δ Live Setpoint), and Live Setpoint. The table contains 6 rows of data.

| # | Setpoint PV Name | Timestamp | Status | Severity | *Stored Setpoint* | | Live Setpoint |
|---|---------------------|--------------------------|----------|----------|---------------------|-----------------|---------------|
| | | | | | Stored Setpoint | Δ Live Setpoint | |
| 1 | XF:31IDA-OP{Tbl-... | 16:52:12.139 Sep 28 2017 | NO_ALARM | NONE | 0.0 | 0.0 | 0.0 |
| 2 | XF:31IDA-OP{Tbl-... | 16:52:11.538 Sep 28 2017 | NO_ALARM | NONE | 1.089 | -0.011000000... | 1.1 |
| 3 | XF:31IDA-OP{Tbl-... | 16:52:11.404 Sep 28 2017 | NO_ALARM | NONE | 11.8799999999999... | -0.120000000... | 12.0 |
| 4 | XF:31IDA-OP{Tbl-... | 16:52:11.404 Sep 28 2017 | NO_ALARM | NONE | 0.0 | 0.0 | 0.0 |
| 5 | XF:31IDA-OP{Tbl-... | 14:35:29.899 Jun 14 2017 | NO_ALARM | NONE | 1.782 | -0.018000000... | 1.8 |
| 6 | XF:31IDA-OP{Tbl-... | 14:35:29.899 Jun 14 2017 | NO_ALARM | NONE | 0.0 | 0.0 | 0.0 |

The bottom status bar shows 'Kunal Shroff'.

Scan Service

Table Scan

Table: /tmp/10076-mapping_Mg-4-1mm.csv

| Comment | BL7:CS:IPTS | X | Y | Z | Wait For | Value | Or Time |
|--------------|-------------|---|-------|---|----------|----------|---------|
| point 1 bent | 10076 | | -0.45 | | bm2 | 17600000 | 15300 |
| point 2 edge | | | 4.45 | | bm2 | 17600000 | 15300 |
| point 3 edge | | | 9.55 | | bm2 | 17600000 | 15300 |
| point 4 edge | | | | | | | |

Load

Save

Submit

*mapping_exp3.csv - Gnumeric

File Edit View Insert Format Tools Statistics Data Help

Sans 10

E1 = HROT

| | A | B | C | D | E | F | G | H | I | J | K | L |
|----|-------------|--------------------|----|------|------|--------|--------|----------|---------|----------|---------|---------|
| 1 | BL7:CS:IPTS | Comment | X | Y | HROT | Speed1 | Speed2 | BL7:Choi | Wavelen | Wait For | Value | Or Time |
| 2 | 11090 | 60Hz, 1mm X step | -5 | 0 | 0 | 60 | 60 | 1.44 | 1.5 | bm2 | 1000000 | 3600 |
| 3 | | 60Hz, 1mm X step | -4 | | 0.1 | | | | | bm2 | 1000000 | 3600 |
| 4 | | 60Hz, 1mm X step | -3 | | 0.2 | | | | | bm2 | 1000000 | 3600 |
| | | 60Hz, 1mm X step | -2 | | 0.3 | | | | | bm2 | 1000000 | 3600 |
| | | 60Hz, 1mm X step | -1 | | 0.4 | | | | | bm2 | 1000000 | 3600 |
| | | 60Hz, 1mm X step | 0 | | 0.5 | | | | | bm2 | 1000000 | 3600 |
| | | 60Hz, 1mm X step | 1 | | 0.6 | | | | | bm2 | 1000000 | 3600 |
| | | 60Hz, 1mm X step | 2 | | 0.7 | | | | | bm2 | 1000000 | 3600 |
| | | 60Hz, 1mm X step | 3 | | 0.8 | | | | | bm2 | 1000000 | 3600 |
| | | 60Hz, 1mm X step | 4 | | 0.9 | | | | | bm2 | 1000000 | 3600 |
| 12 | | 30Hz, 0.4mm Y Step | 0 | -2 | 1 | 30 | 30 | 2.88 | 2 | neutrons | 1000000 | 3600 |
| 13 | | 30Hz, 0.4mm Y Step | | -1.6 | 1.1 | | | | | neutrons | 1000000 | 3600 |
| 14 | | 30Hz, 0.4mm Y Step | | -1.2 | 1.2 | | | | | neutrons | 1000000 | 3600 |
| 15 | | 30Hz, 0.4mm Y Step | | -0.8 | 1.3 | | | | | neutrons | 1000000 | 3600 |
| 16 | | 30Hz, 0.4mm Y Step | | 0.4 | 1.4 | | | | | neutrons | 1000000 | 3600 |

mapping_exp3.csv

Sum=19

| position | Wait For | Value | Or Time |
|----------|----------|-------|----------|
| [2,4,7] | counter | 10000 | 01:00:00 |

Operator Logbook – Web Viewer

The screenshot displays the Operator Logbook Web Viewer interface, showing two different log entries. The interface is divided into several sections: a left sidebar for navigation, a main log entry list, and a detailed view of a selected entry.

Top Screenshot (Entry #8022_1):

- Filter Log Entries:** Includes a search bar and filters for LOGBOOKS (Controls Commissioning, Electronics Maintenance, LOTO, Machine Physics, Mechanical Technicians, Operations), TAGS, and CREATED FROM/TO.
- Log Entry List:** Shows a list of log entries. The selected entry is:
rfiller, 2/4/14, 3:43 pm
Linac in MBM mode. 1.55nC on ICT1. Energy: 199.6 +/-0.01 MeV Spread: 0.706+/-0.034% Useful charge: 82.6+/-0.557% This is GREAT! This is the best so far.
- Details View:** Shows the full text of the selected entry, including a note: "This is GREAT! This is the best so far." and an attachment titled "LTD Spectrum-VF2" which is a 2D heatmap plot.

Bottom Screenshot (Entry #8022_1):

- Filter Log Entries:** Similar to the top screenshot, but the selected entry is:
xiyang, 2/4/14, 3:44 pm
Make online live machine model for LTB in CSS. Now only LTB-B1 is in ap-HLA, and will wait for all the LTB dipoles are included in ap-hla in order for the final test of the code.
- Details View:** Shows the full text of the selected entry, including a note: "Make online live machine model for LTB in CSS. Now only LTB-B1 is in ap-HLA, and will wait for all the LTB dipoles are included in ap-hla in order for the final test of the code." and an attachment titled "Live LTB Machine Model" which is a line graph showing "Twiss at Start of LTB" and "Online Model Twiss".

EPICS Architecture V3 (1991 – present)

- Has been successfully deployed internationally for a wide variety of facilities over a wide range of domains.
- The Configuration tools for SCADA and DCS have been demonstrated.
- A multitude of facilities have integrated a wide range of I/O.
- The Channel Access Interface has been used on all platforms and programming languages to develop general purpose and application specific clients.
- Scalar data is well supported in V3, however, faster ADCs and real time access to SQL and non-SQL databases provide new opportunities.

**Matlab (MMLT),
SDDS, XAL:**

Physics Applications:

Name Mapping
Physics Model
Unit Conversion
Scripting
Logging, Save Sets

Channel Access

DAQ and Model Control Need More

C, C++, Java, Python
Matlab, State
Notation Language

Channel Access

Channel Access Server

Channel Access
Gateway

Channel Access Client

CS Studio:

Synoptic Display
Synoptic Display
Directory Clients
Elog Client
Archive Browser
MASAR Client (restore)

s Client

Ethernet

CAS/CAC

Diagnostic
IOCs

Instrumentation

CAS/CAC

Power
Supply IOCs

Instrumentation

CAS/CAC

RF IOC

Instrumentation

CAS/CAC

Vacuum IOC

Instrumentation

CAS/CAC

Injection
Extraction
IOC

Instrumentation

CAS/CAC

Beamline
DAQ IOX

areaDetector
Image Data

Instrumentation

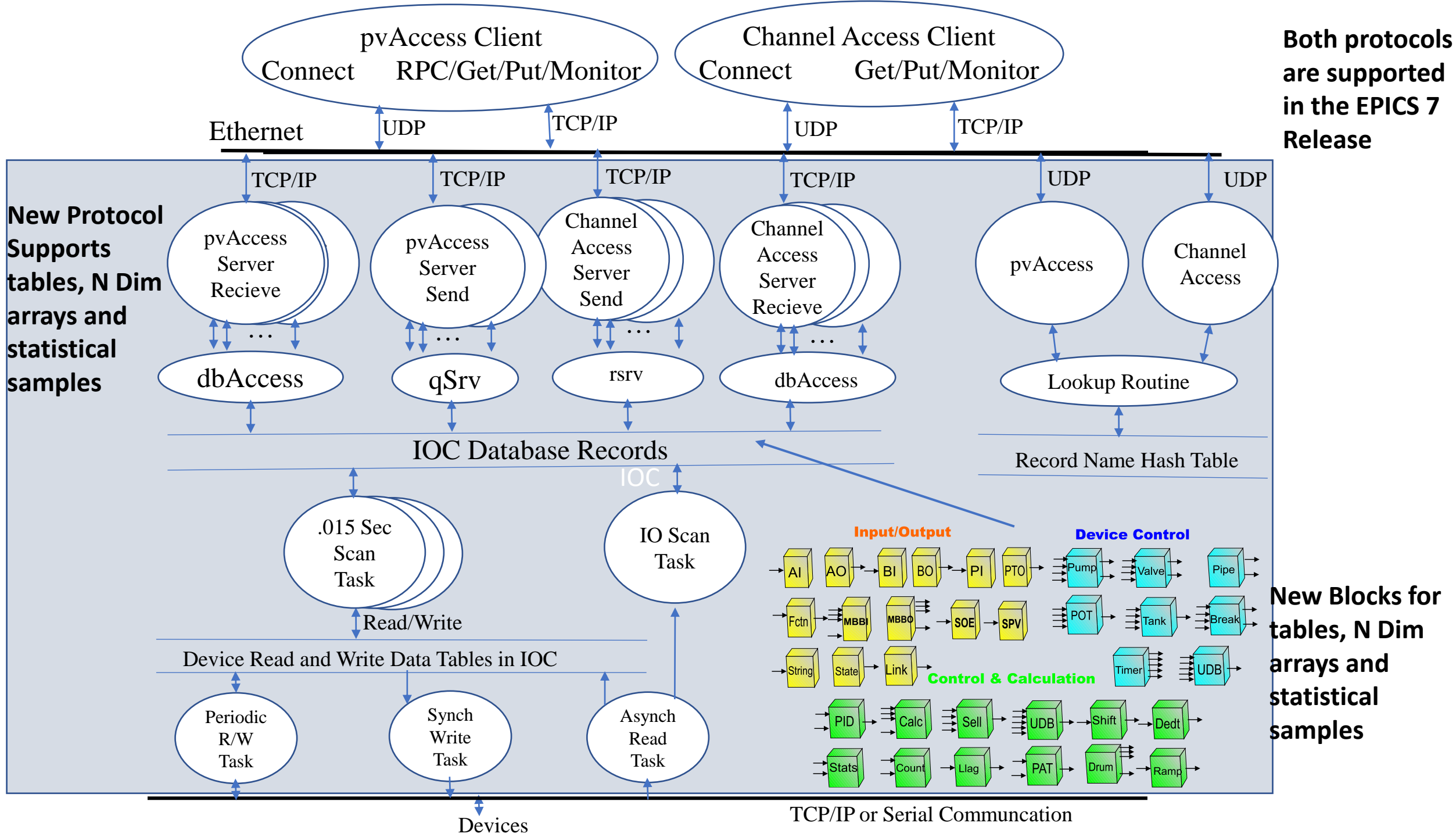
CAS/CAC

Simulation
IOCs

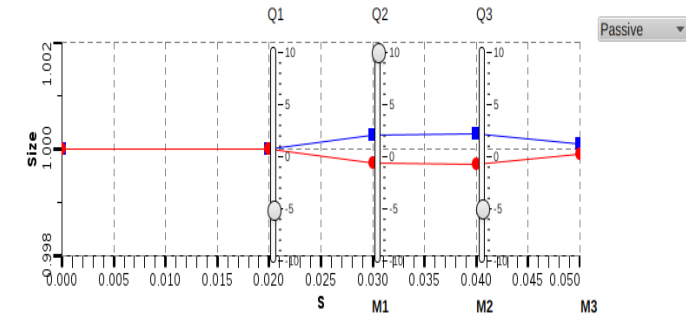
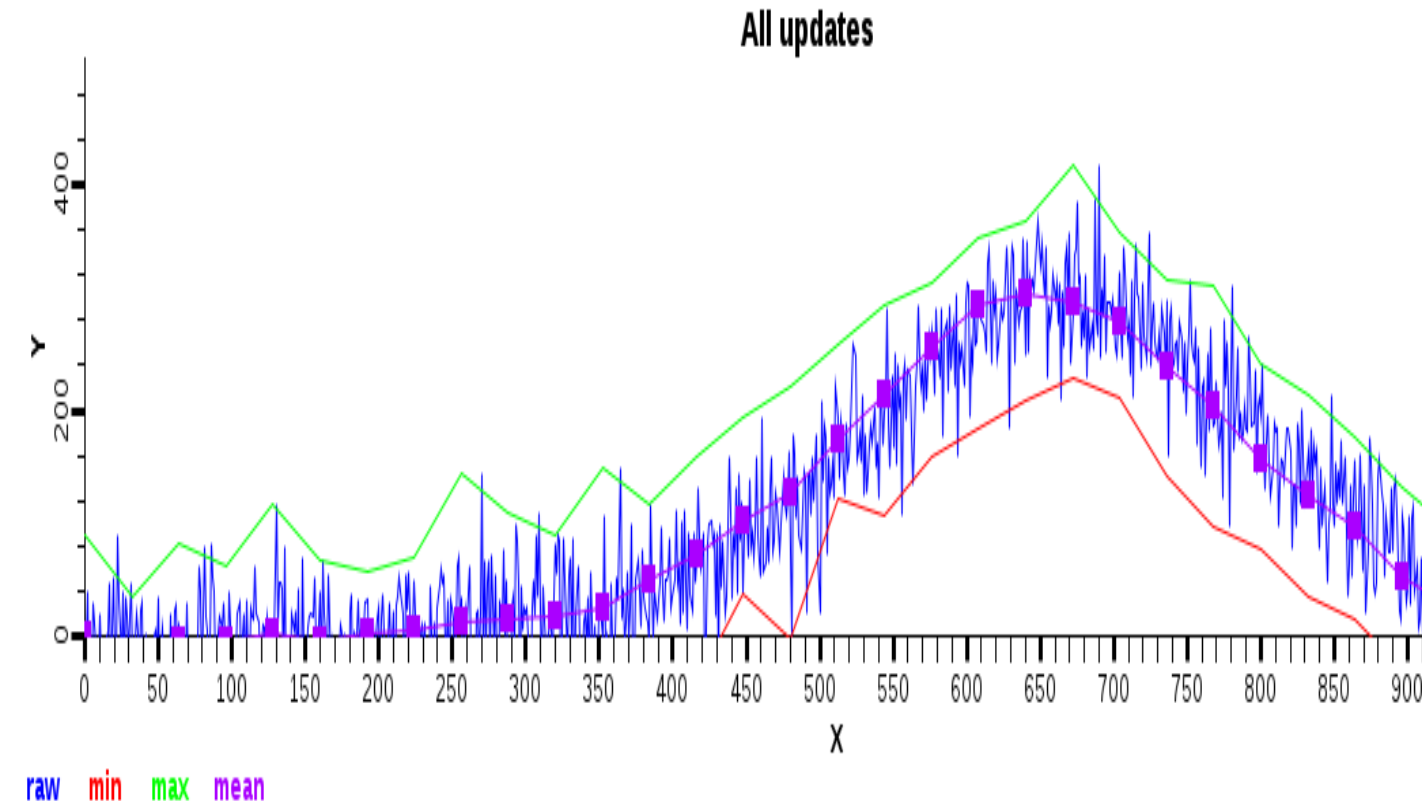
DLS Simulation

New Standards Create Opportunities to Improve Capabilities

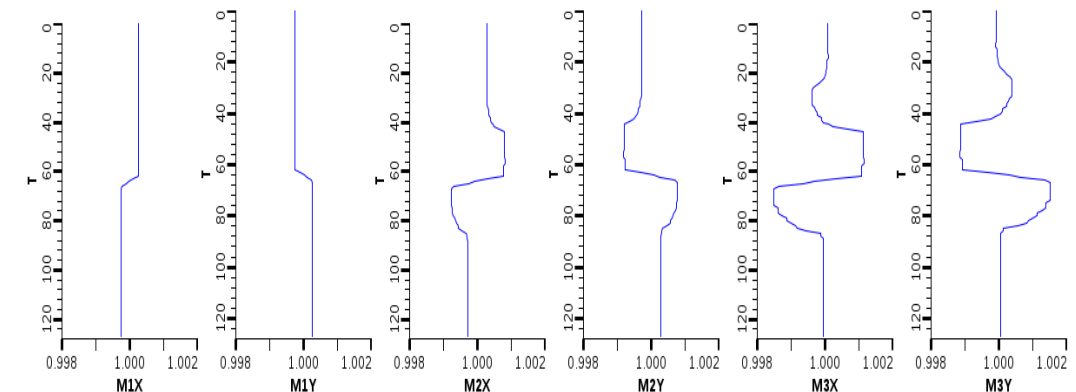
- Expand Process Database
 - N Dimensional Arrays
 - Tables
 - Statistical Samples
- Middle Layer Services Improve capabilities
 - Directory Service – hierarchical views of 1M Process Variables
 - Aggregate Alarm Data
 - Snap shot data
- Phoebe /CS Studio
 - Data passing between client applications
- Data Management Tools from configuration to snapshot data
 - Inventory, Device Types, electronic travelers, machine design



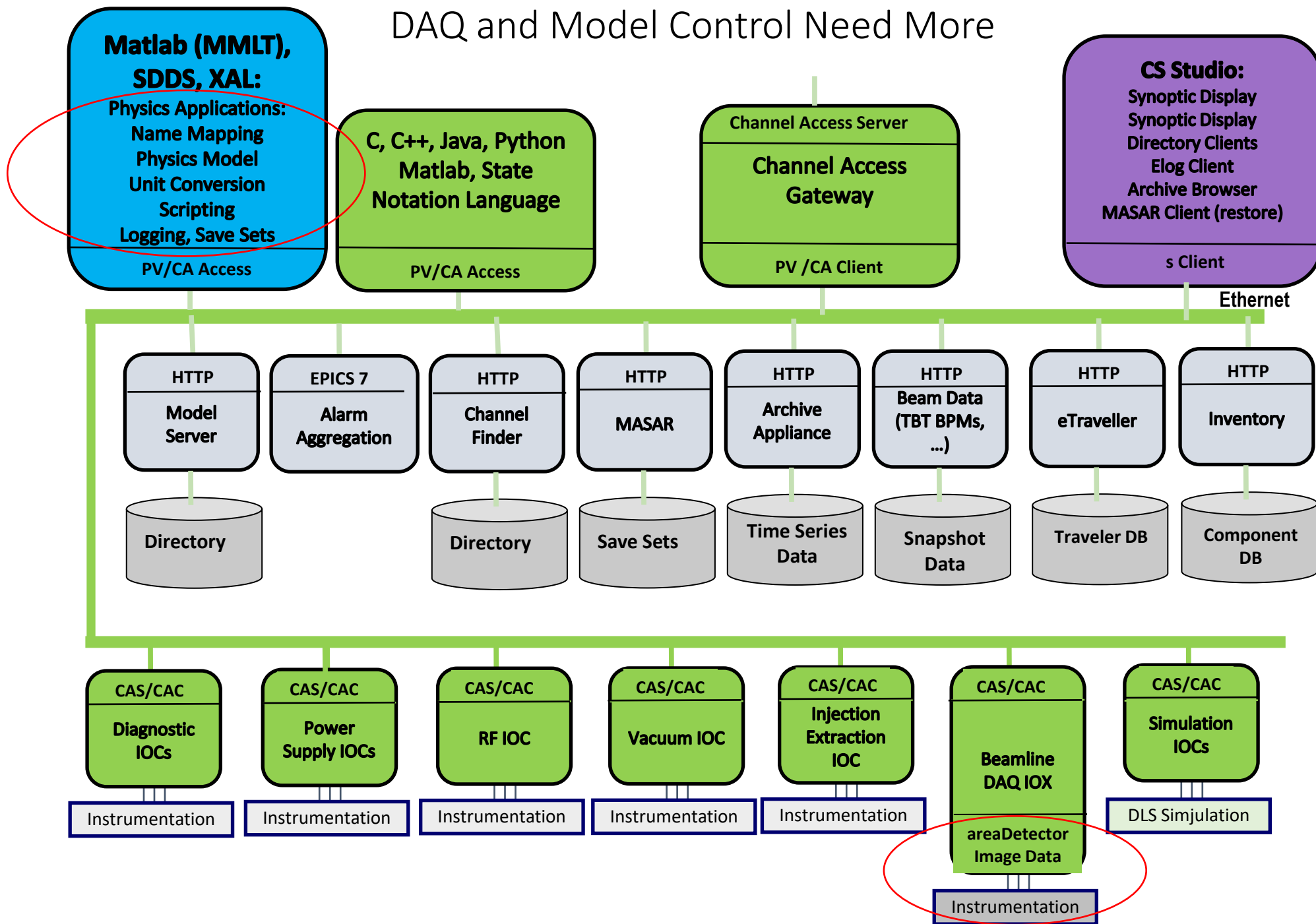
Client Viewer for statistics and Table Data



| sec | ns | M1X | M1Y | M2X | M2Y | M3X | M3Y |
|------------|-----------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 1603141226 | 765062686 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141226 | 665122230 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141226 | 565074401 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141226 | 464971846 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141226 | 365205607 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141226 | 265059730 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141226 | 165069099 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141226 | 65138234 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141225 | 965105451 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141225 | 865097427 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141225 | 764951385 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141225 | 664930303 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141225 | 565014047 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000849847268154 | 0.9999142530780648 |
| 1603141225 | 465091000 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000971825976501 | 0.9999020607099068 |
| 1603141225 | 365117716 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.0000971825976501 | 0.9999020607099068 |
| 1603141225 | 265165692 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.000054490266667 | 0.9999447342152903 |
| 1603141225 | 165125928 | 1.0002622065798652 | 0.9997378163355621 | 1.0002925650424335 | 0.9997071991852091 | 1.000048391411827 | 0.9999508304799065 |



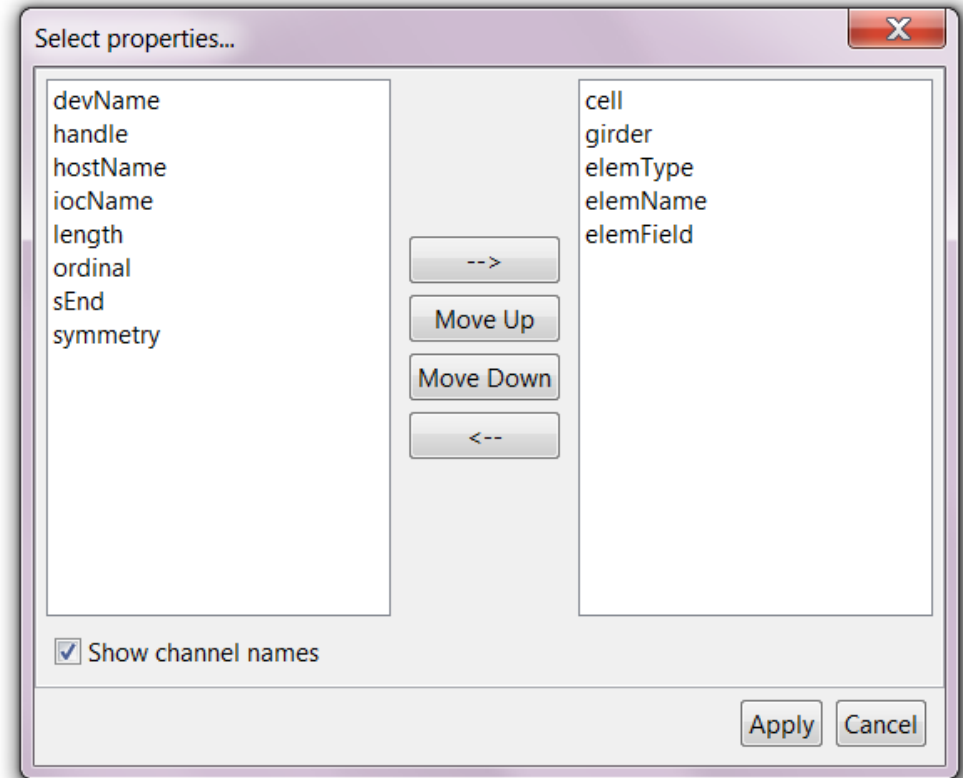
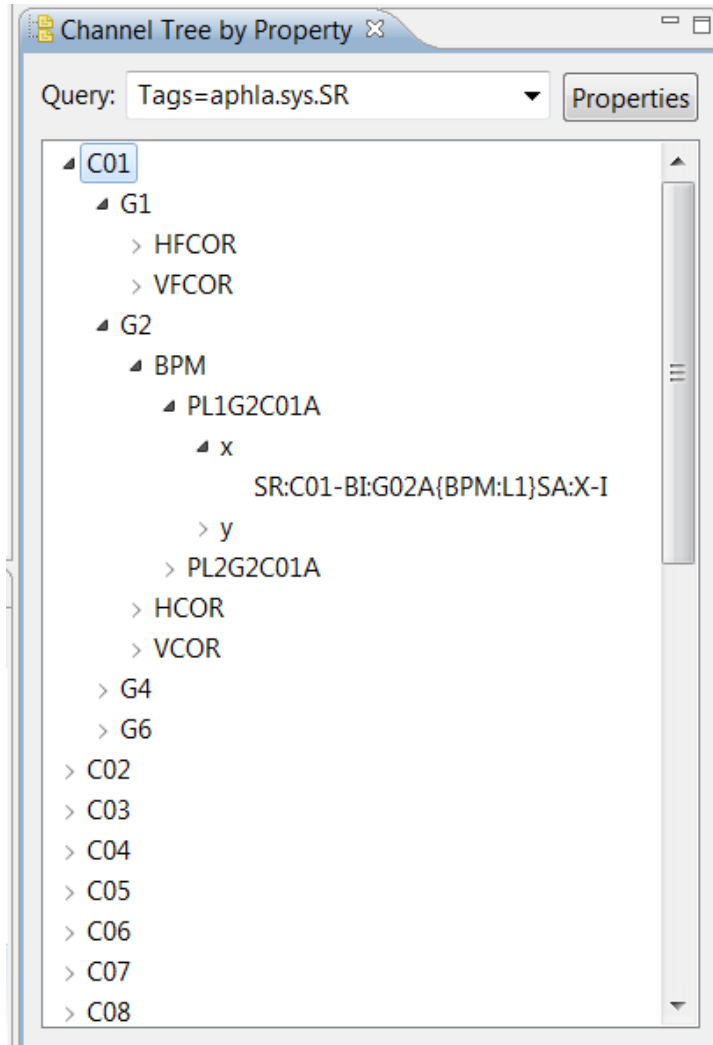
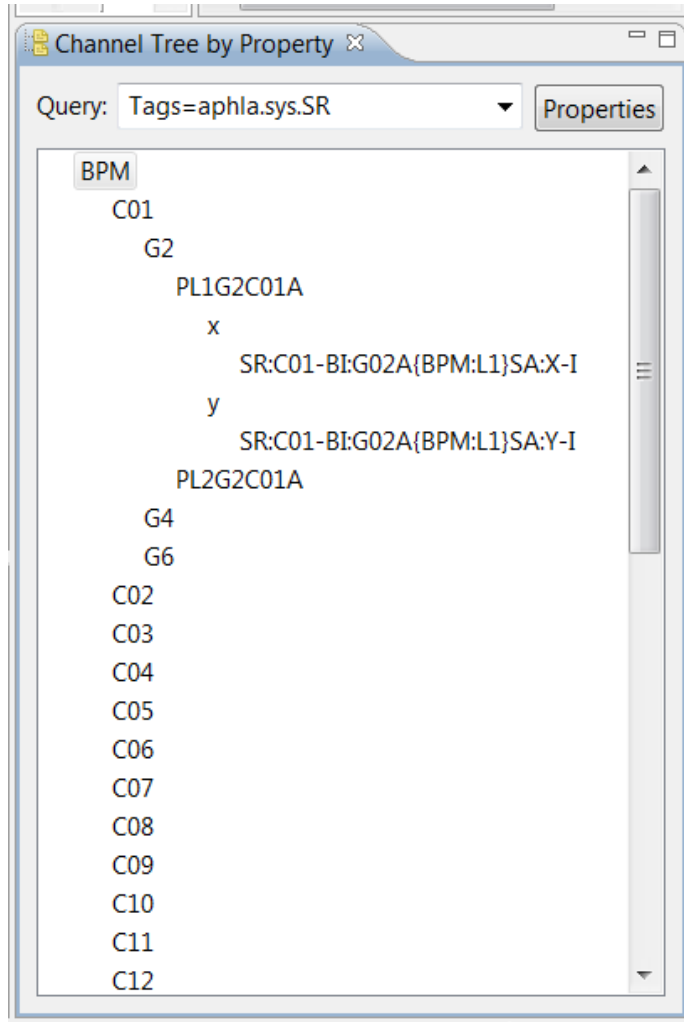
DAQ and Model Control Need More



Directory Service - Alias Properties

| SR:C0* elemType=HCOR,BPM Tags=aphla.sys.SR | | | | | | | | | | | |
|--|-----------|----------|--------|------|---------|-----------|------------|-----------|----------|---------|--------|
| Channel Name | Owner | handle | girder | cell | ordinal | devName | elemName | elemField | elemType | sEnd | length |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 120 | PL1G2C01A | PL1G2C01A | x | BPM | 29.9886 | 0.0 |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 120 | PL1G2C01A | PL1G2C01A | y | BPM | 29.9886 | 0.0 |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 120 | PL1G2C01A | PL1G2C01A | | BPM | 29.9886 | 0.0 |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 120 | PL1G2C01A | PL1G2C01A | | BPM | 29.9886 | 0.0 |
| SR:C01-BI:G02A... | cf-update | SETPOINT | G2 | C01 | 120 | PL1G2C01A | PL1G2C01A | | BPM | 29.9886 | 0.0 |
| SR:C01-BI:G02A... | cf-update | SETPOINT | G2 | C01 | 120 | PL1G2C01A | PL1G2C01A | | BPM | 29.9886 | 0.0 |
| SR:C01-MG:G02... | cf-update | SETPOINT | G2 | C01 | 125 | CL1G2C01A | CXL1G2C01A | x | HCOR | 30.6673 | 0.2 |
| SR:C01-MG:G02... | cf-update | READBACK | G2 | C01 | 125 | CL1G2C01A | CXL1G2C01A | x | HCOR | 30.6673 | 0.2 |
| SR:C01-MG:G02... | cf-update | READBACK | G2 | C01 | 133 | CL2G2C01A | CXL2G2C01A | x | HCOR | 32.1047 | 0.2 |
| SR:C01-MG:G02... | cf-update | SETPOINT | G2 | C01 | 133 | CL2G2C01A | CXL2G2C01A | x | HCOR | 32.1047 | 0.2 |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 138 | PL2G2C01A | PL2G2C01A | y | BPM | 32.5523 | 0.0 |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 138 | PL2G2C01A | PL2G2C01A | x | BPM | 32.5523 | 0.0 |
| SR:C01-BI:G02A... | cf-update | SETPOINT | G2 | C01 | 138 | PL2G2C01A | PL2G2C01A | | BPM | 32.5523 | 0.0 |
| SR:C01-BI:G02A... | cf-update | SETPOINT | G2 | C01 | 138 | PL2G2C01A | PL2G2C01A | | BPM | 32.5523 | 0.0 |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 138 | PL2G2C01A | PL2G2C01A | | BPM | 32.5523 | 0.0 |
| SR:C01-BI:G02A... | cf-update | READBACK | G2 | C01 | 138 | PL2G2C01A | PL2G2C01A | | BPM | 32.5523 | 0.0 |
| SR:C01-MG:G04... | cf-update | READBACK | G4 | C01 | 150 | SQMG4C01A | CXMG4C01A | x | HCOR | 36.7222 | 0.2 |
| SR:C01-MG:G04... | cf-update | SETPOINT | G4 | C01 | 150 | SQMG4C01A | CXMG4C01A | x | HCOR | 36.7222 | 0.2 |
| SR:C01-BI:G04A... | cf-update | SETPOINT | G4 | C01 | 161 | PM1G4C01A | PM1G4C01A | | BPM | 38.3018 | 0.0 |
| SR:C01-BI:G04A... | cf-update | SETPOINT | G4 | C01 | 161 | PM1G4C01A | PM1G4C01A | | BPM | 38.3018 | 0.0 |
| SR:C01-BI:G04A... | cf-update | READBACK | G4 | C01 | 161 | PM1G4C01A | PM1G4C01A | x | BPM | 38.3018 | 0.0 |
| SR:C01-BI:G04A... | cf-update | READBACK | G4 | C01 | 161 | PM1G4C01A | PM1G4C01A | | BPM | 38.3018 | 0.0 |
| SR:C01-BI:G04A... | cf-update | READBACK | G4 | C01 | 161 | PM1G4C01A | PM1G4C01A | | BPM | 38.3018 | 0.0 |
| SR:C01-BI:G04A... | cf-update | READBACK | G4 | C01 | 161 | PM1G4C01A | PM1G4C01A | y | BPM | 38.3018 | 0.0 |
| SR:C01-BI:G04B... | cf-update | SETPOINT | G4 | C01 | 171 | PM1G4C01B | PM1G4C01B | | BPM | 40.5345 | 0.0 |
| SR:C01-BI:G04B... | cf-update | SETPOINT | G4 | C01 | 171 | PM1G4C01B | PM1G4C01B | | BPM | 40.5345 | 0.0 |
| SR:C01-BI:G04B... | cf-update | READBACK | G4 | C01 | 171 | PM1G4C01B | PM1G4C01B | | BPM | 40.5345 | 0.0 |

Directory Service – Configures Hierarchy



Directory Service – Used to provide parameter displays

PVTable by Property

Query: Tags=aphla.sys.SR cell=C01

Row: devName Column: elemField

| devName \ elemField | x | y |
|---------------------|------------------------|-----|
| CH1G6C01B | 0.0 | 0.0 |
| CH2G6C01B | 0.0 | 0.0 |
| CL1G2C01A | 0.0 | 0.0 |
| CL2G2C01A | 0.0 | 0.0 |
| CM1G4C01B | 0.0 | 0.0 |
| FL1G1C01A | 0.0 | 0.0 |
| FL2G1C01A | 0.0 | 0.0 |
| FM1G4C01A | 0.0 | 0.0 |
| PH1G6C01B | -7.216569742425744E-7 | 0.0 |
| PH2G6C01B | -2.1431258791651994E-7 | 0.0 |
| PL1G2C01A | -1.500986653185494E-6 | 0.0 |
| PL2G2C01A | -1.806087679109317E-6 | 0.0 |
| PM1G4C01A | 1.6492499142893348E-6 | 0.0 |
| PM1G4C01B | 1.3008445367347664E-6 | 0.0 |
| SQMG4C01A | 0.0 | 0.0 |

Phoebus uses Directory Service to improve workflow

The screenshot displays the Channel Orchestrator software interface. The main window shows a table of channels with columns for Channel, hostName, Min, Value, Max, Weight, Step1, Step2, and Step3. The table lists 12 channels, all with hostName 'virtac' and Weight 1.0. The Step1 column contains numerical values, while Step2 and Step3 are empty. Below the table, there are fields for Step Count (3) and Step Size (1), and a 'Generate Setpoints' button. An 'Apply' button is at the bottom of the main window.

A pop-up window titled 'sim://noise' is open, showing the PV Formula: LTB-BI{BPM:6}Pos:X-. The window displays the following information:

- Value: -3.5
- Timestamp:
- New Value:
- Data source:
- Type: VDO
- Display limit:
- Alarm limits:
- Warning limits: -3 - 3
- Control limits: -5 - 5
- Unit: x
- Status: Connected

The pop-up window also shows a 'History' section with 0 matching items and a 'ChannelFinder' section with 5 matching items:

- LTB-BI{BPM:6}Pos:X-SQHST
- LTB-BI{BPM:6}Pos:X-RMSHST
- LTB-BI{BPM:6}Pos:X-I
- LTB-BI{BPM:6}Pos:X-SQ
- LTB-BI{BPM:6}Pos:X-RMS

Operator Log – Entry Creation

File Edit Search CS-Studio Window Help

Create Log Entry

User Name: olog-user Password:

Date: Mar 27, 2016 Level: Info

Creating the first simple entry.
Instructions for creating log entries
username: olog-user
password: 1234

Logbooks: Operations

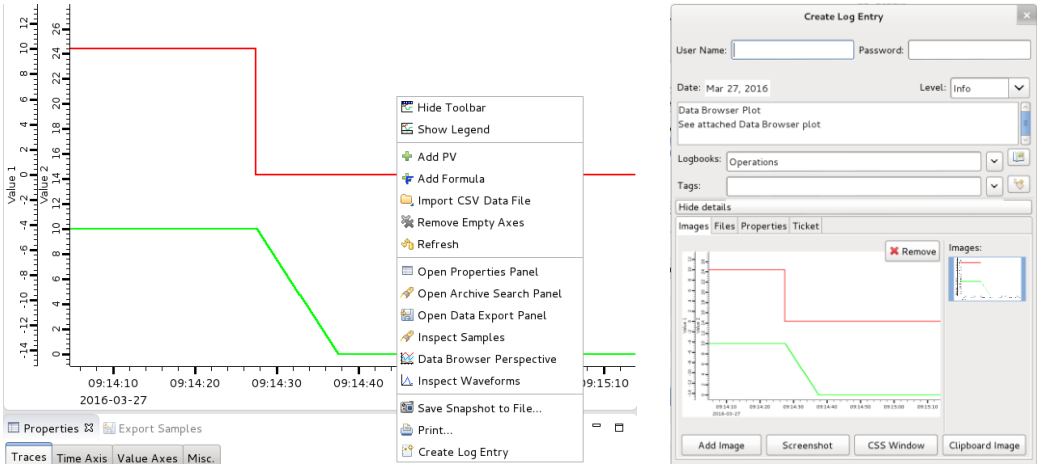
Tags:

Details

Cancel Submit

Create Entry

Time
Owner
Text
Attachments
Logbooks
Tags
Properties

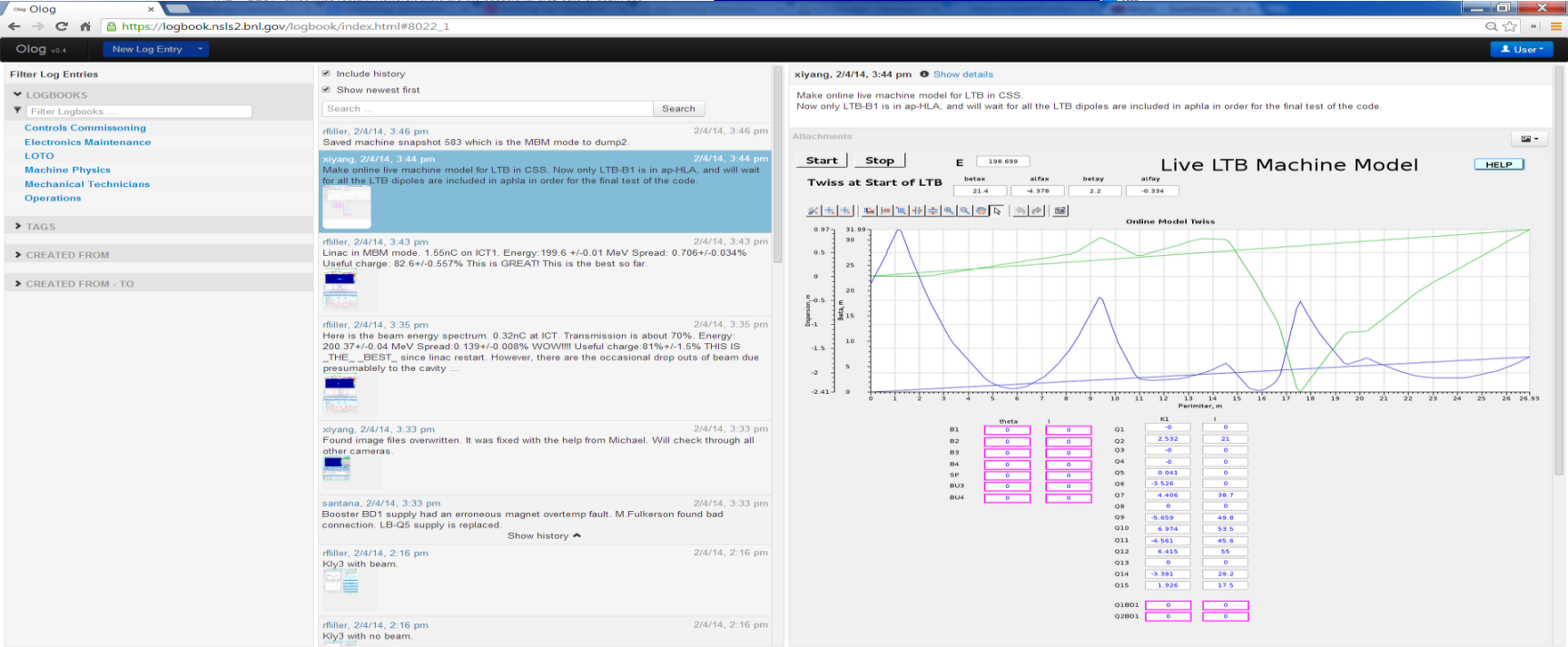
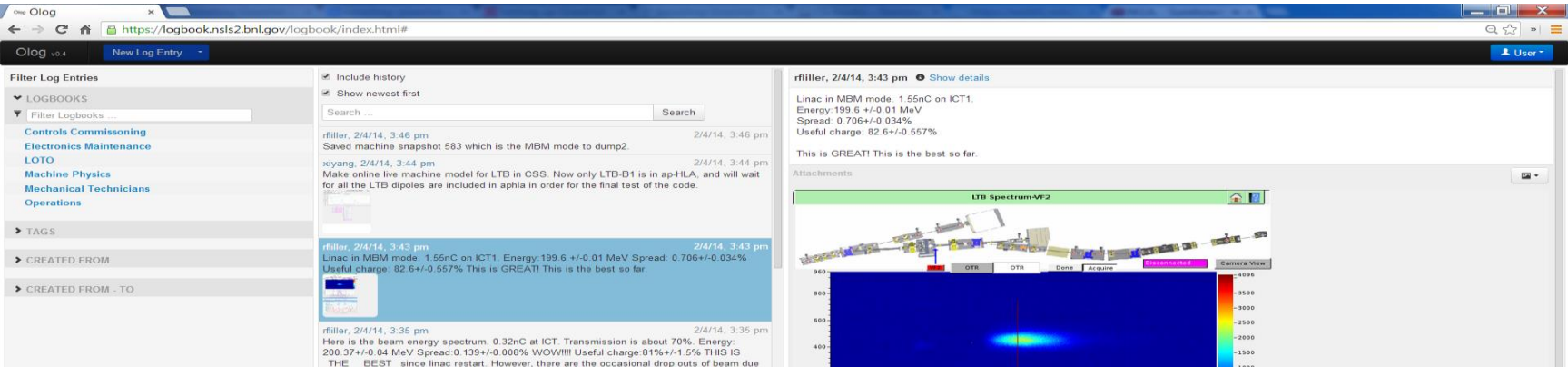


Create Entry from Data Browser

The screenshot shows the 'Create Log Entry' dialog box with an alarm list and a context menu. The alarm list has columns for 'Alarm Name', 'Alarm Time', 'Alarm Status', 'Alarm Message', and 'Alarm Value'. It contains several entries with status 'OK' or 'Alarm'. A context menu is open over the alarm list, listing various actions like 'Hide Toolbar', 'Show Legend', 'Add PV', 'Add Formula', 'Import CSV Data File', 'Remove Empty Axes', 'Refresh', 'Open Properties Panel', 'Open Archive Search Panel', 'Open Data Export Panel', 'Inspect Samples', 'Data Browser Perspective', 'Inspect Waveforms', 'Save Snapshot to File...', 'Print...', and 'Create Log Entry'.

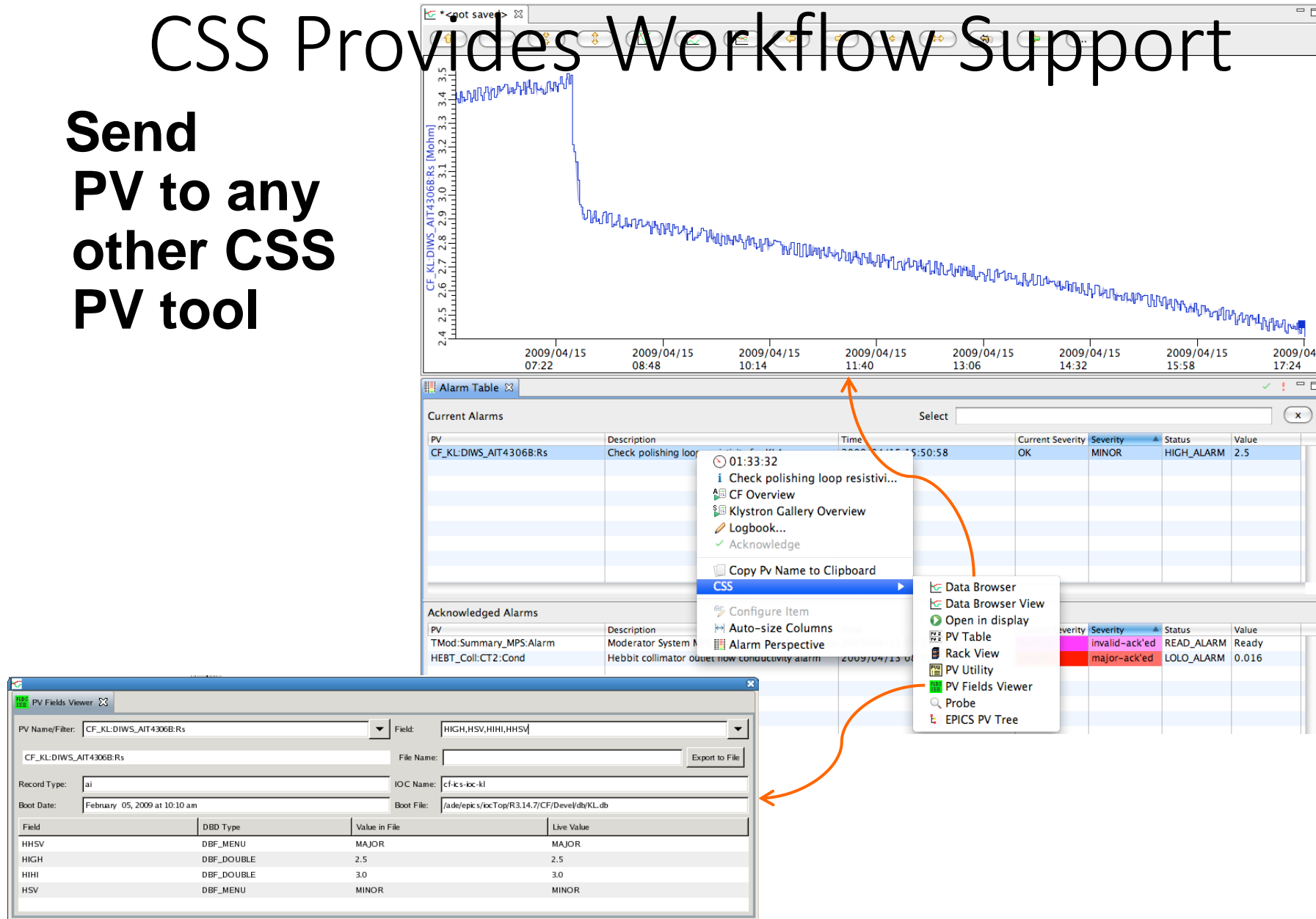
Create Entry from Alarm Viewer

Operator Log – Web Viewer



CSS Provides Workflow Support

**Send
PV to any
other CSS
PV tool**



Data Management Tools – electronic traveler

test1

label

☐ checkbox test

test area

inside the input

some hint...

Label

test area

Keep the label brief and unique

Placeholder

inside the input

Row

3

Help

some hint...

Done

test

the form self



Form builder

label

[illegible]

[Centers](#)
[Traveler](#)
[Report a problem](#)
[Logout](#)

[New Form](#)
[All travelers](#)
[Reload](#)
[Migrate](#)
[Profile](#)
[Users](#)
[About](#)

My forms

Shared forms

Group shared forms

My travelers

Shared travelers

Group shared travelers

Isolated travelers

Active travelers

Complete travelers

Frozen travelers

Archived travelers

Copy








Print

Save

10

records per page

Search:

| Title | Status | Devices | Shared with | Shared groups | Created by | Created | Deadline | Updated by | Updated | Estimated progress |
|---|--------|---------|---|---|------------|-------------|----------|------------|----------------|-----------------------------|
|  LIN-CMAS03-CAV/H-ASSY | active | SC0002 | | | victory | 2 hours ago | | victory | 51 minutes ago | <div><div>7.45</div></div> |
|  SRF Facility Weekly Maintenance | active | | Whaley, Joseph; Clark, Alex; Whitestone, Caleb; Metzgar, Ethan; Victory, Daniel; Malloch, Ian; Barker, Brian; Popolanski, Laura; Ignatowski, Daniel; Oja, Byron; Elkort, Kyle; Dobczynski, Alyssa; Hunk, Ryan | | ignatows | 4 hours ago | | ignatows | 45 minutes ago | <div><div>8.73</div></div> |
|  LIN-CMAS03-CAV/H-IPR | active | SB0-002 | | LAB F.HB ASD SRP; LAD.FRID.ASD.SRP.CavityProcessing | malloch | 3 days ago | | victory | 3 days ago | <div><div>1.62</div></div> |
|  LIN-CMAS29-CAV-RETCH | active | 829-001 | | LAB.FRID.ASD.SRP; LAB.FRID.ASD.SRP.CavityProcessing | malloch | 3 days ago | | malloch | 2 hours ago | <div><div>23.25</div></div> |
|  LIN-CMAS03-CAV/H-ASSY | active | 03-003 | | | victory | 3 days ago | | victory | 3 days ago | <div><div>3.46</div></div> |
|  LIN-CMAS 065-CAV-USC DEGRASE | active | 965-004 | | | barkerbr | 4 days ago | | barkerbr | 4 days ago | <div><div>5.8</div></div> |
|  LIN-CMAS03-CAV/H-IPR | active | SB0-002 | | LAB F.HB ASD SRP; LAD.FRID.ASD.SRP.CavityProcessing | malloch | 4 days ago | | malloch | 4 days ago | <div><div>17.01</div></div> |
| | | | | | vellanof | 4 days ago | | vellanof | 4 days ago | <div><div>1.54</div></div> |
| | | | | | barkerbr | 5 days ago | | barkerbr | 4 days ago | <div><div>13.43</div></div> |
| | | | | | vellanof | 5 days ago | | vellanof | 5 days ago | <div><div>1.54</div></div> |

Shared with

Shared groups

Created by

Update

Previous

1

2

3

4

5

Next

Traveler Page

Data Management Tools – inventory/installation

Component Instance Details

QR Id 000 000 108

Component [DMM SEXTUPOLE S1A001](#)
[\[Sextupole:Magnets\]](#)

Tag S1A001

Serial Number -

Location [h](#) 314

Location Details -




Description Sextupole magnet for DMM instance 105

[More Info](#) [Return](#)




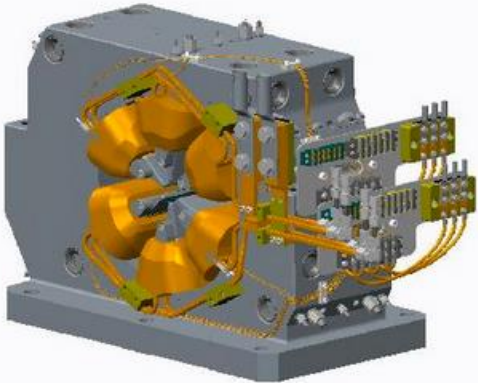
Component Instance Properties

| Type | Tag | Value | Units | Dynamic | Actions |
|--------------------------------|-----|-----------------------------------|-------|---------|-------------------------------------|
| Traveler Instance (Electronic) | | EAA to 314 | | | h i |
| Traveler Instance (Electronic) | | S1A001 EAA to 314 | | | h i |
| Traveler Instance (ICMS) | | APSU 1694686 | | | h |
| Traveler Instance (Electronic) | | 314 to EAA | | | h i |

Component Properties

| Type | Tag | Value | Units | Dynamic | Actions |
|--------------------------------|------------------|---|-------|---------|-------------------------------------|
| PDMLink Drawing | Yoke | U221020202-112000.drw | | | h i |
| Purchase Requisition | | F5-013070 | | | h |
| Image | Iso View |  | | | h |
| PDMLink Drawing | Magnet Assembly | U221020202-112100 | | | h i |
| Image | Front View |  | | | h |
| Image | Upstream View |  | | | h |
| Component Design | Reference Design | DMM SEXTUPOLE U221020202-112100 | | | h |
| Traveler Template (Electronic) | | APS-U Rigging Daily Lift Checklist | | | h |

Gallery



EPICS 7 Enables New Solutions

- EPICS 7 is the EPICS 3 and EPICS 4 protocols running simultaneously where V4 has new capabilities in Normative Data Types and Communication Mechanisms.
- The Middle Layer Services provides an aggregation layer allows for use in multiple user interfaces tools.
- New Tools are developed to improve control system development
- The collaboration continues to contribute to this open source control system with concern for the large installed base.

Commercial Support for EPICS

- There are commercial applications that use EPICS.
- There are a number of companies that sell their instrumentation with EPICS support such as drivers or a full implementation provided
- Companies are providing support for EPICS develop or use in applications: Observatory Sciences, CosyLab and Osprey Distributed Control Systems.
- As EPICS is open source, anyone could be using it and there could be more that are not listed here.

Conclusions

- Architectural Features of EPICS support Industrial and Research Control Systems.
- EPICS is used in Industrial Applications and Research Successfully for over 30 years.
- The open source community continues to support and extend EPICS to support new technology in control applications.