Control System Studio

- CSS -

Overview

Kay Kasemir, Ph.D.

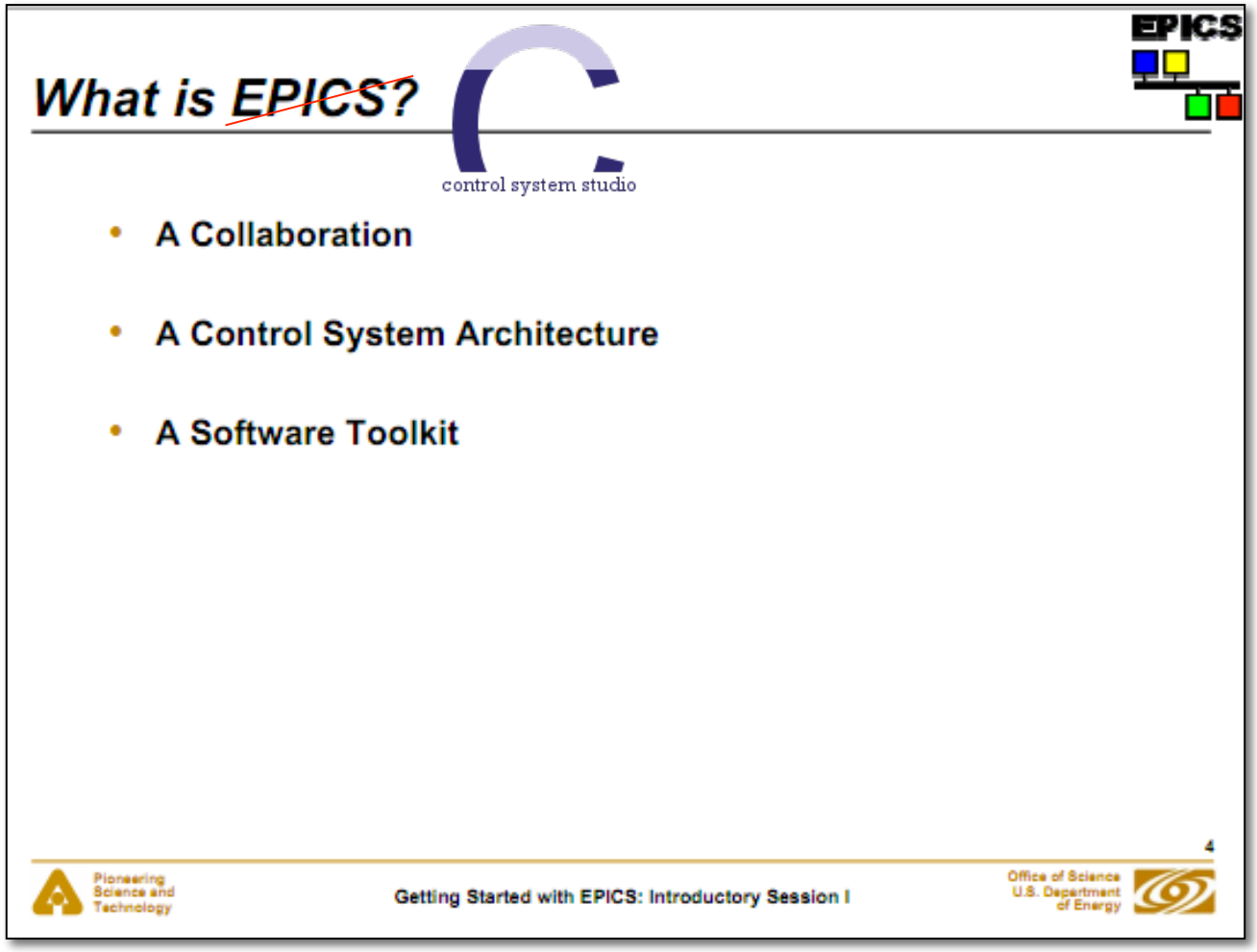
ORNL/SNS

kasemirk@ornl.gov

July 2011 at J-PARC

What is CSS ?

Answer: Similar to EPICS!



Ned Arnold et al, http://aps.anl.gov/bcda/epicsgettingstarted/introduction/epics_intro_pt1.pdf

OAK RIDGE National Laboratory

CSS: A Collaboration

- Started 2006 between DESY and SNS, joined by CLS, APS, BNL, iter, Diamond, …, KEK/J-PARC?
- https://sourceforge.net/apps/trac/cs-studio/wiki
  - Wiki, Mailing lists, code repository
- Growing presence at EPICS meetings
- Benefits from Eclipse community
  - eclipseCON™ 2011 Participants from ~30 countries

Oak Ridge National Laboratory

CSS: A Control System Architecture

- Portable environment (Windows, Linux, OS X)
- Excellent development tools

- Extensible bundling: Plug-Ins, Extension points, Registry
- Rich Client Platform (RCP) for windows, menus, online help, preferences, online update, …

CSS: A Software Toolkit

- It's BIG
  - Repository: ~ 1.500.000 lines of Java Code
- You pick what you need
  - SNS uses ~300.000 (20%)
- Reasonably structured
  - 70 'core' plugins, about 300 total
  - About 40% of code is comments and formatting

Perl cloc tool on July 2011 cs-studio3.0 repo and SNS source snapshot, excluding zip files

OAK RIDGE National Laboratory

CSS plugin examples

- **Library Plug-Ins**
  - Life data access, Historic Data Access, Control system data types (PV, Sample, …), Logbook, EMail, Authentication, Authorization, …
  - Pluggable
    - Historic Data: XML-RPC, RDB, …
    - Authentication: Kerberos, LDAP, …
- **Application Plug-Ins**
  - Strip-Chart: Data Browser
  - OPI: SDS, BOY
  - Alarms: NAMS, BEAST
  - Archive: DESY Archive, BEAUTY
  - Utilities: Probe, Clock, PV Tree, Psychiatrist

List of plugins: http://cs-studio.sourceforge.net/plugins.html

OAK RIDGE National Laboratory

Example: Who uses what?

DESY	SNS	BROOKHAVEN NATIONAL LABORATORY NSLS2	Your Site
Data Browser, Probe, EPICS PV Tree	Data Browser, Probe, EPICS PV Tree	Data Browser, Probe, EPICS PV Tree	Same?
SDS	BOY	BOY	?
NAMS	BEAST	BEAST	?
NameSpaceBrowser	PV Util, Rack Util, PV Fields Viewer	Channel Finder	?
log4j, slf4j	java.util.logging	java.util.logging	

Compare to EPICS:

- **EDD/DM, MEDM, DM2K, EDM**
- **SDDS, Channel Archiver**
- **ALH**
- **IOC Log, CM Log**

See also https://sourceforge.net/apps/trac/cs-studio/wiki/CompareProducts

OAK RIDGE National Laboratory

Confused, yet?

Collaboration?

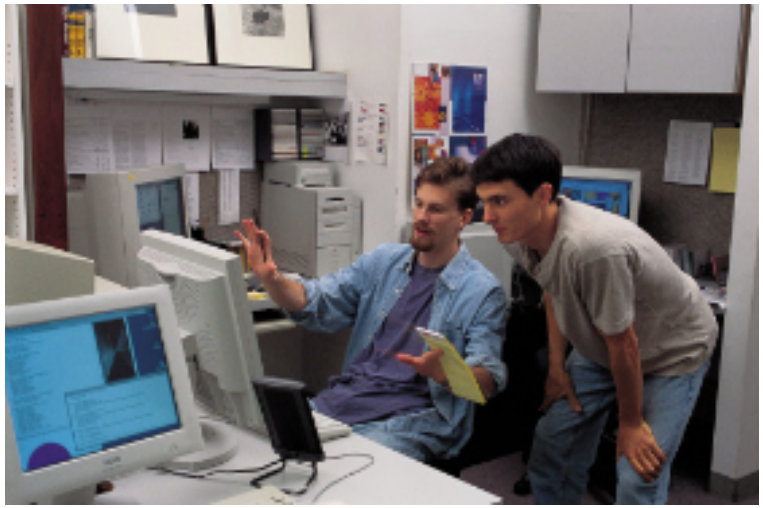
Architecture?

Toolkit?

So what does it do??

OAK RIDGE National Laboratory

Two Views of CSS



Developer

- Understands Toolkit, Architecture, Java, Eclipse
- Installs CSS in control room
- Offers CSS download for local office users
- Extends CSS for local needs

End User

- Uses CSS

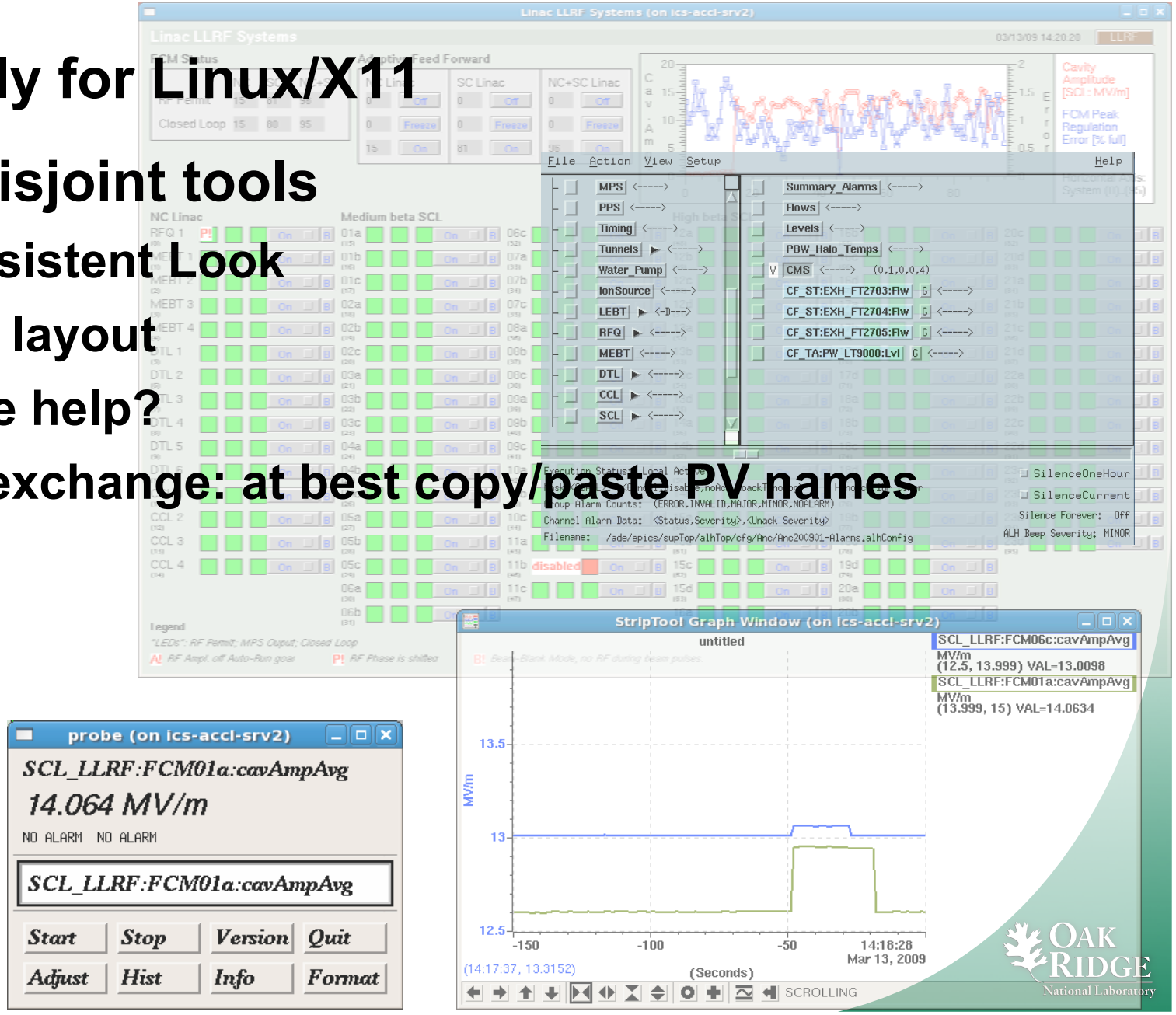
http://www.citytowninfo.com/images/education-articles/how-to-become-a-software-engineer-2.jpg

http://www.wendolene.co.uk/Pictures/Happy.jpg

OAK RIDGE National Laboratory

Original EPICS Operator Interface

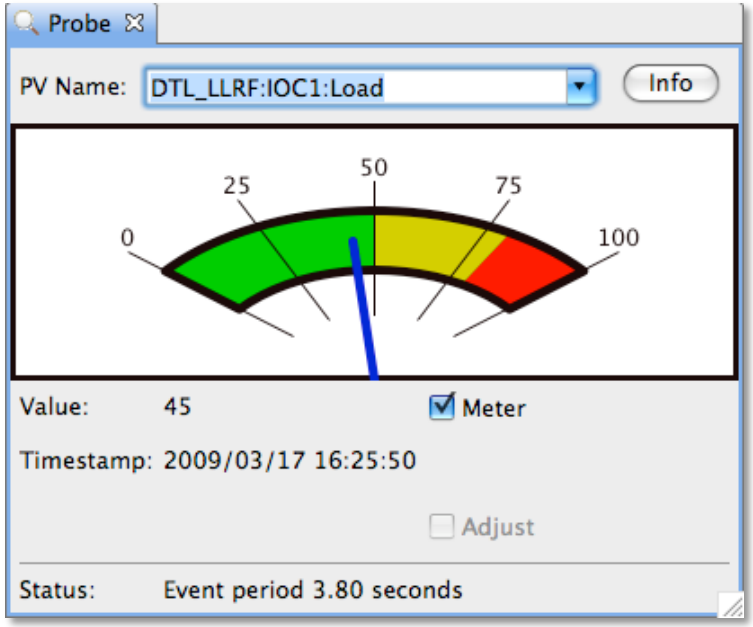
- primarily for Linux/X11
- Many disjoint tools
  - Inconsistent Look
  - Static layout
  - Online help?
  - Data exchange: at best copy/paste PV names



Basic CSS Tools

Probe

– Current value of a PV

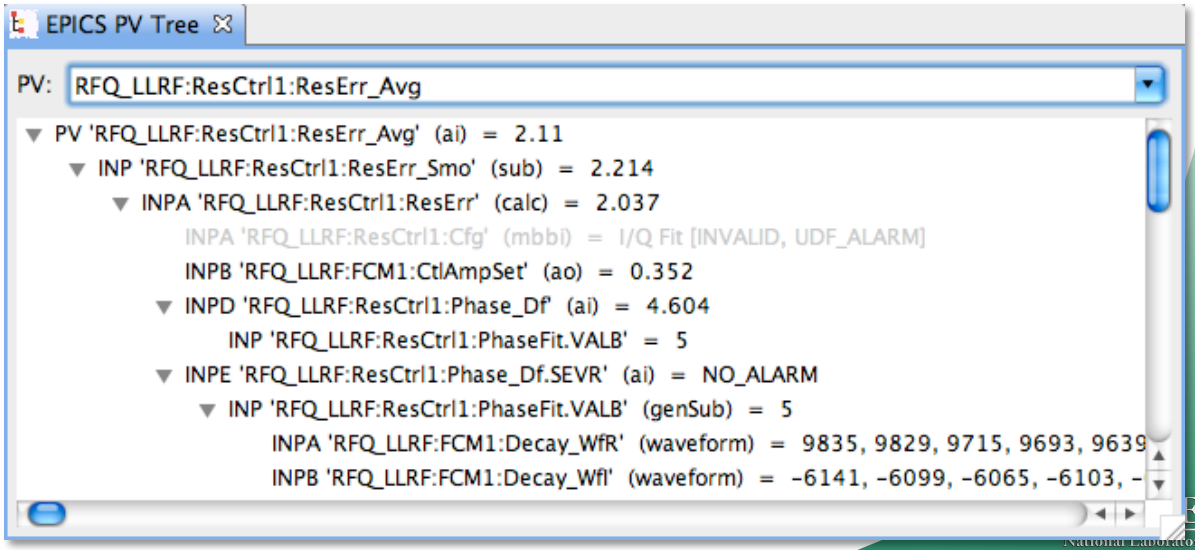


EPICS PV Tree

– Trace PV links

✓ Resize

✓ Drop-downs keep previous entries

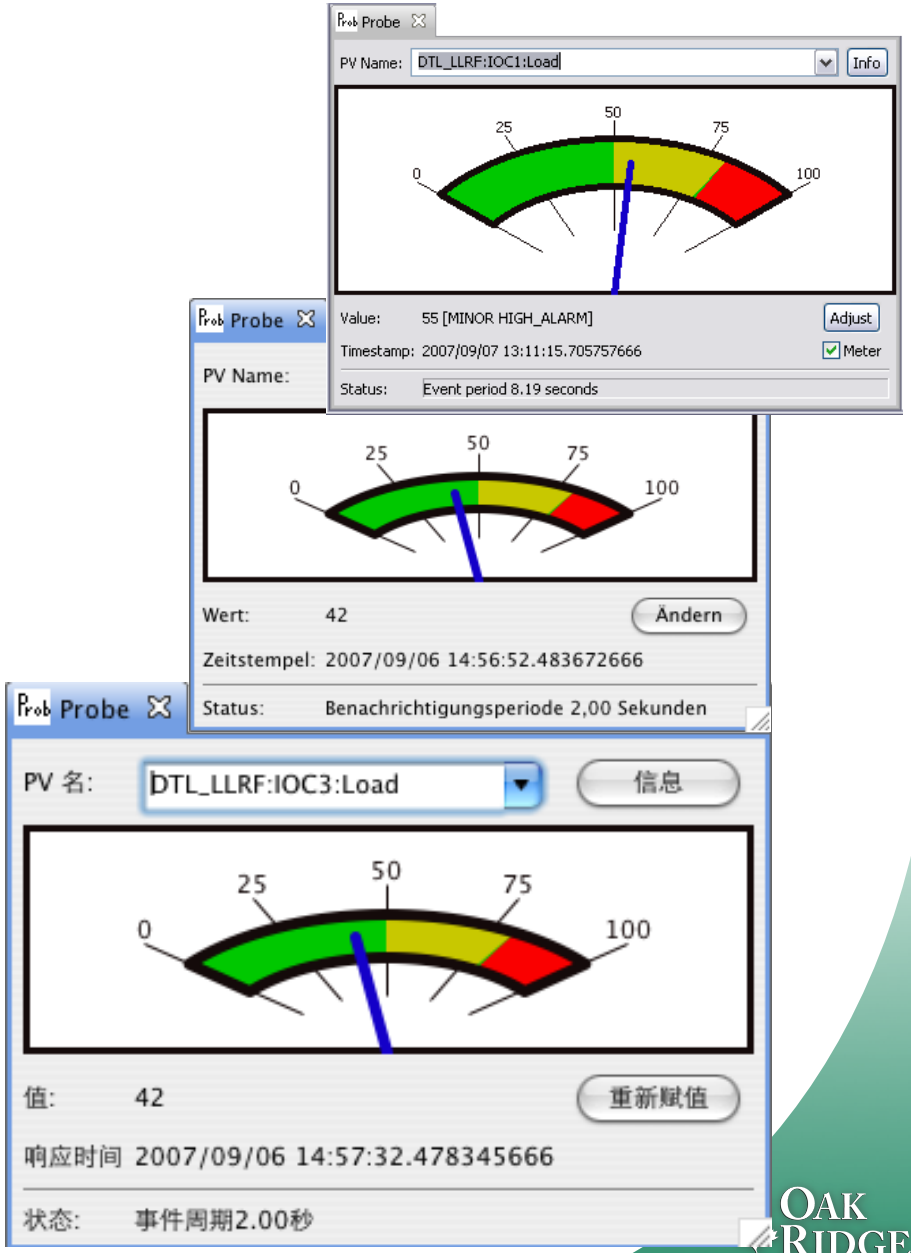


Localization

CSS Translations

- All: (US) English
- Most: German
- Few: French, Chinese

Could be 日本!



OAK RIDGE National Laboratory

Data Browser

Plot ‘live’ and historic data over time

Control System Studio (SNS)

Data Browser | Alarm | CSS

Data Browser Archives | Navigator

URL: xnds://ics-srv-web2.sns.ornl.gov/arc | Info

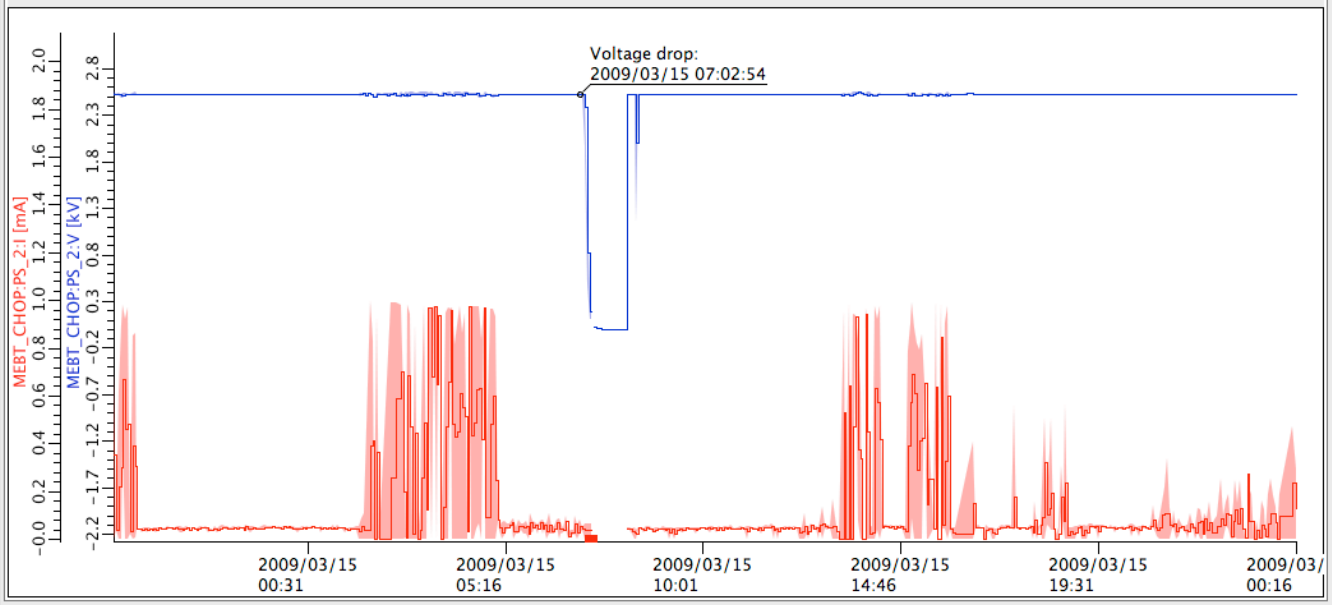
Archive	Key	Description
CF rn (last restart)	4033	/arch/CF/rn/current_index
CF pwrMon (last resta	4034	/arch/CF/pwrMon/current_
CF ta (last restart)	4035	/arch/CF/ta/current_index
CEC	4040	/arch/CEC/master_index
CEC cec (last restart)	4041	/arch/CEC/cec/current_ind
FE ctl-ioc1,2,3	4060	/arch/FE/master_index
FE ctl-ioc1 (last restar	4061	/arch/FE/ctl-ioc1/current_i
FE ctl-ioc2 (last restar	4062	/arch/FE/ctl-ioc2/current_i
FE ctl-ioc3 (last restar	4063	/arch/FE/ctl-ioc3/current_i
ICS mps, tim	4090	/arch/ICS/indexconfig.xml
ICS tim (last restart)	4091	/arch/ICS/tim/current_inde
ICS mps (last restart)	4092	/arch/ICS/mps/current_ind
CRYO	4100	/arch/CRYO/indexconfig.xr
CRYO ioc20 (last resta	4101	/arch/CRYO/ioc20/current_

Pattern: CHOP | Search

Add ... | Replace search results | RegEx

Name	Archive	End
MEBT_CHOP:PS1a2:Setpt1	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS1a2:Setpt2	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:HV_Enable	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:I	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Lcl	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Reset	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Sts	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Sts_Flw	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Sts_HV	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Sts_Itlk	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Sts_OI	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:Sts_Tim	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_1:V	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_2:HV_Enable	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_2:I	FE ctl-ioc	2009/03/17 (
MEBT_CHOP:PS_2:Lcl	FE ctl-ioc	2009/03/17 (

*<not saved>



Data Browser Config | Data Browser Export

Process Variables | Live Data Config | Plot | Time Config

Process Variables:

Trace?	Process Variable	A... #	Axis?	Min	Max	Autoscale	Color	Width	Type	Display Type	Request
☑	MEBT_CHOP:PS_2:V	0	☑	-2.2792708	3.18180095	☐		0	linear	Area	Optimized
☑	MEBT_CHOP:PS_2:I	1	☑	-0.0099368	2.11852576	☐		0	linear	Area	Optimized
	<Add PV>										

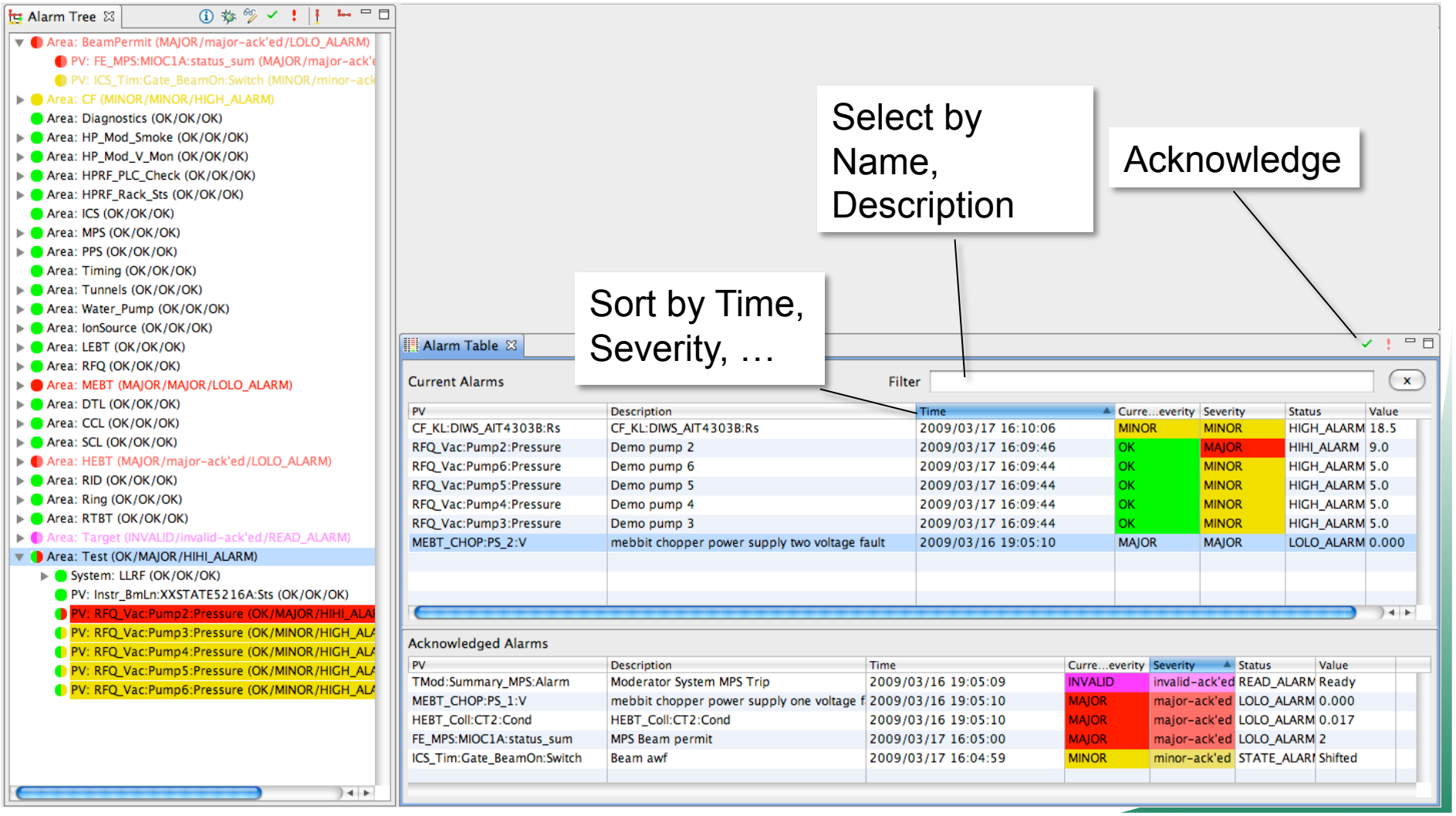
Archives used for selected Process Variable:

Archive	Key	URL
FE ctl-ioc1,2,3	4060	xnds://ics-srv-web2.sns.ornl.gov/archive/cgi/ArchiveDataServer.cgi

ky9

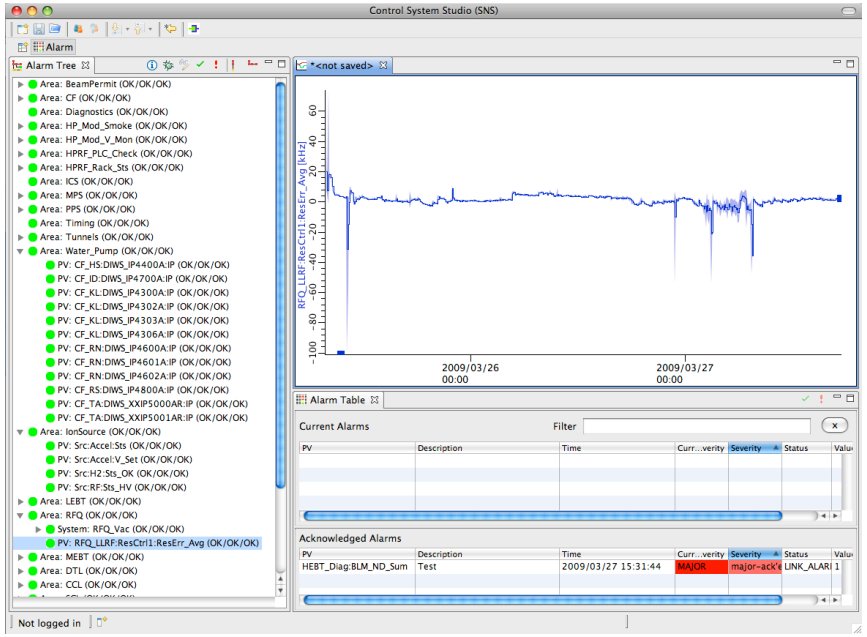
Alarm System (BEAST)

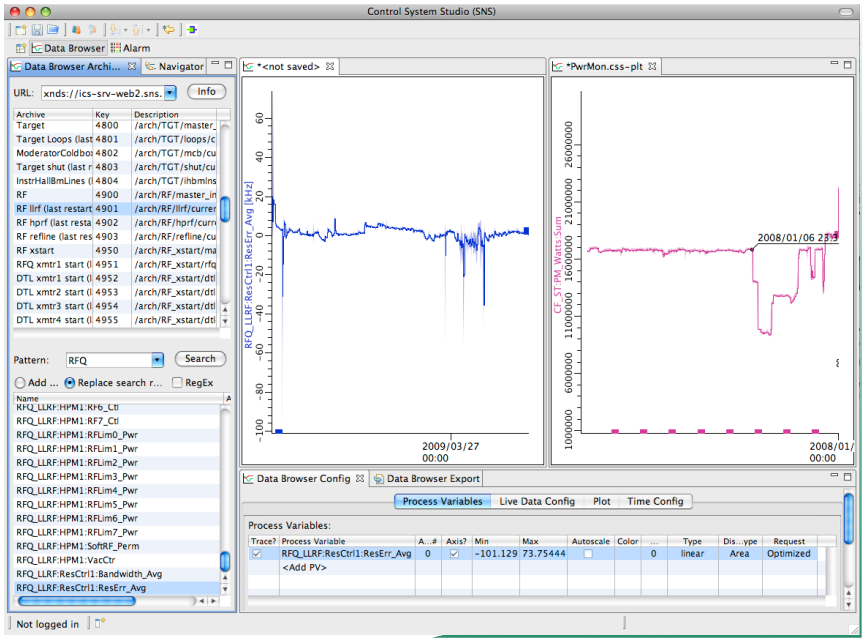
Tabular or Tree view, voice annunciations, …



Flexible Layout

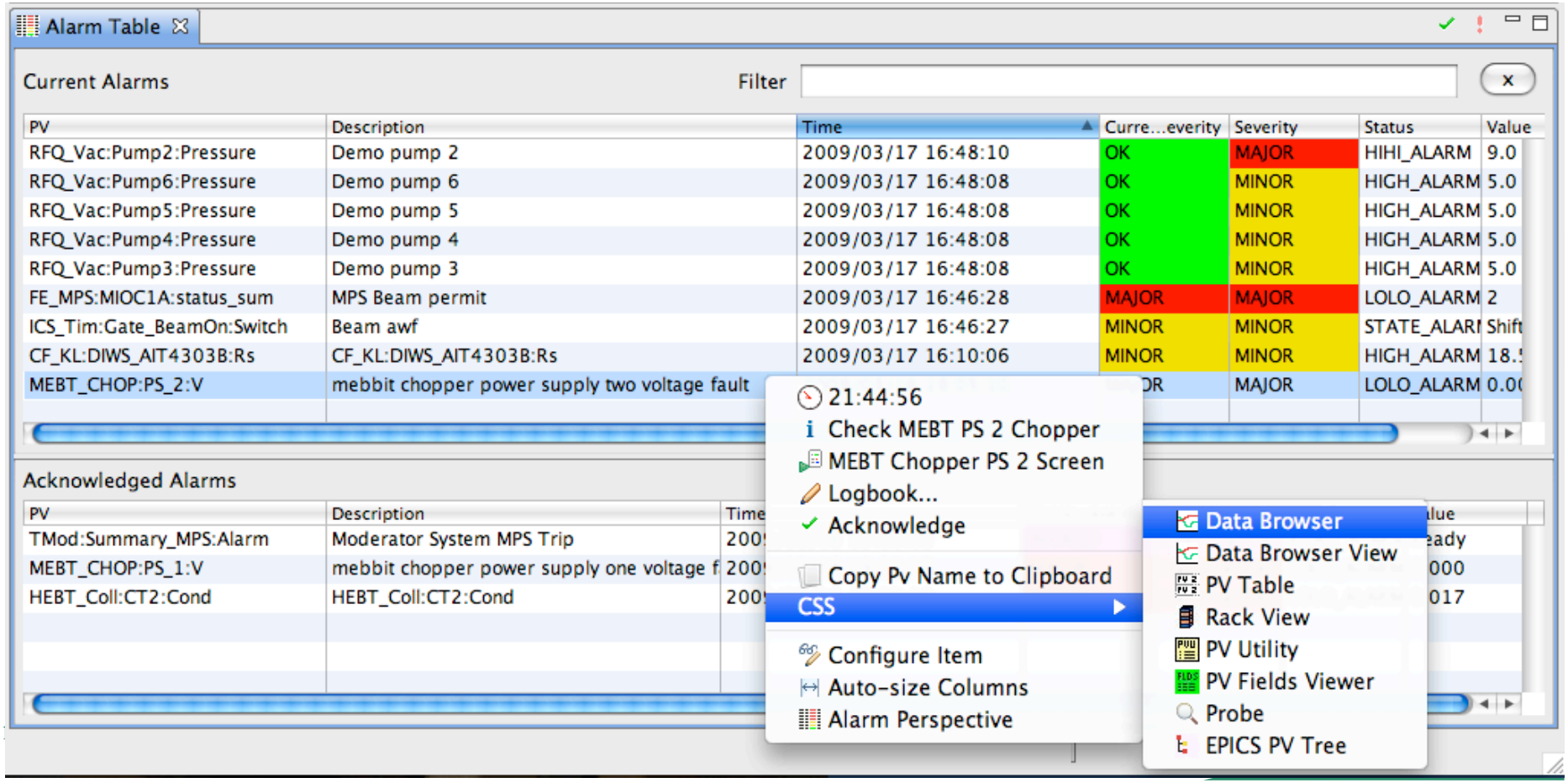
- Panels can be closed, reopened, repositioned
- Multiple Perspectives
  - Name, Save, Restore
- Multiple document instances share same configuration panels



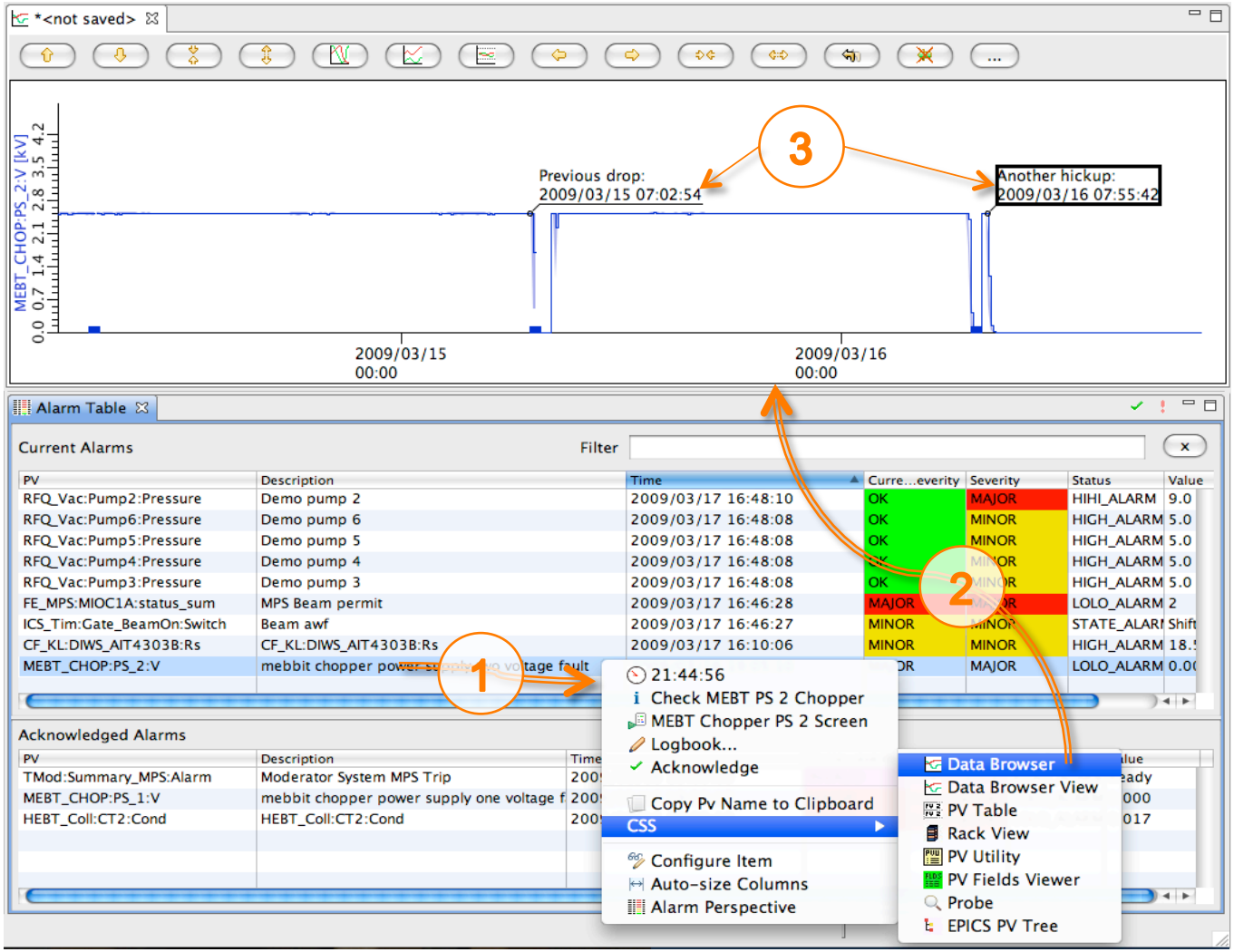


CSS PV Exchange

- **PV in *any* CSS Tool**
  ➔ Context Menu ➔ Select other PV Tools
  - **Opens other tool with that PV**



Example Work Flow: React to Alarm

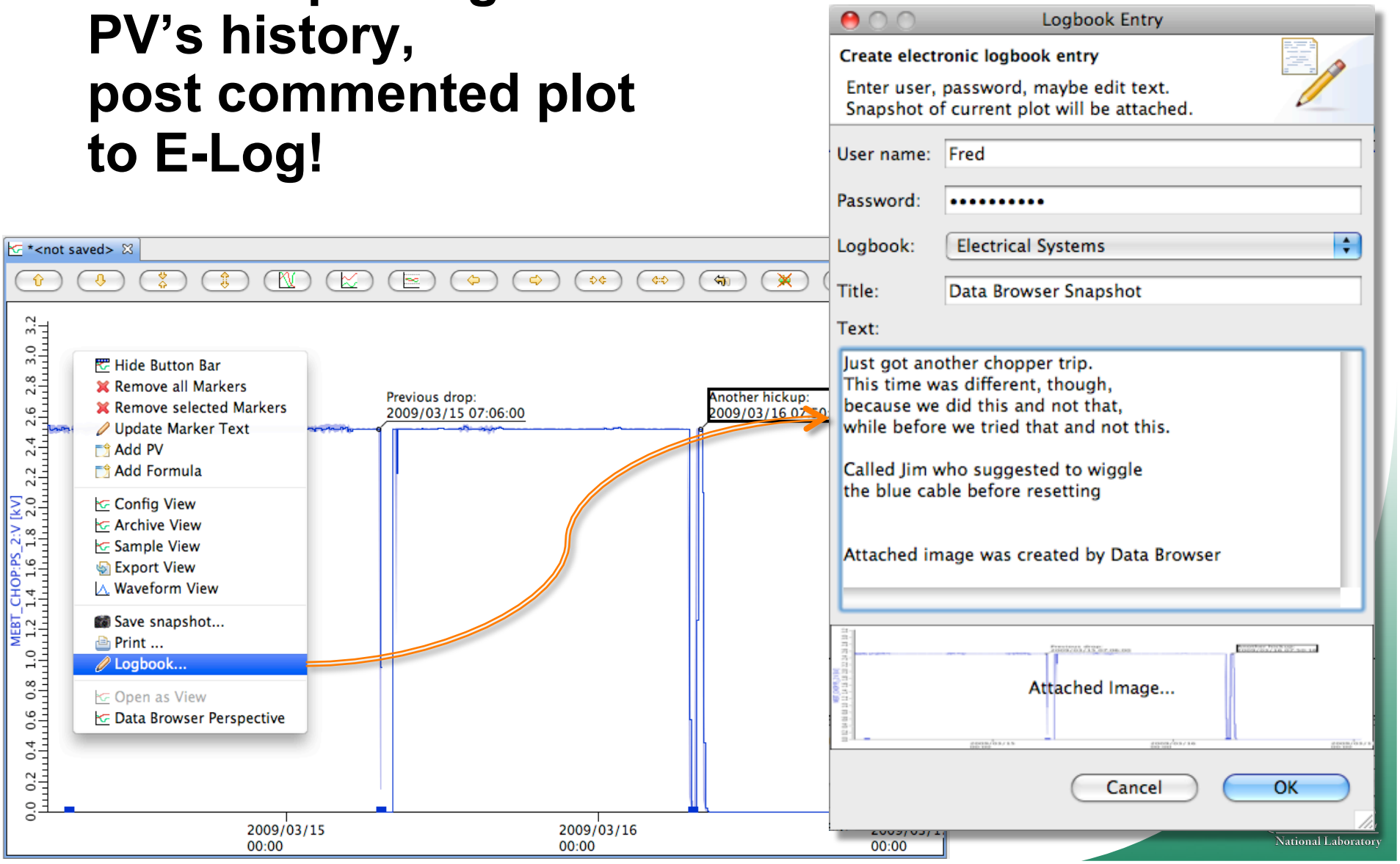


Inspect history of PV, annotate, …

OAK RIDGE National Laboratory

Data Browser → E-Log

After inspecting alarm PV's history, post commented plot to E-Log!



PV Fields Viewer

PV Fields Viewer

PV Name: HEBT_Coll:CT2:Cond

Record Type: ai

IOC Name: hebt-ldmp-ioc1

Boot Date: 2009-3-3.15.12. 13. 0

Boot File: /ade/epics/iocTop/R3.14.7/ring/dump/Devel/db/HEBT_Coll_PLC1.db

Field	DBD Type	Value in File	Live Value
VAL			0.015
DTYP	DBF_DEVICE	EtherIP	EtherIP
HIHI	DBF_DOUBLE	18	21.000
LINR	DBF_MENU	NO CONVERSION	NO CONVERSION
LLSV	DBF_MENU	MAJOR	MAJOR
PINI	DBF_MENU	YES	YES
EGU	DBF_STRING	MOhm	MOhm
HOPR	DBF_DOUBLE	20	20.000
PREC	DBF_SHORT	3	3
SCAN	DBF_MENU	1 second	1 second
INP	DBF_INLINK	@HEBT_Coll_PLC1 PHC1R01[8]	@HEBT_Coll_PLC1 PHC1R01[8]
LOPR	DBF_DOUBLE	-1	-1.000
LOLO	DBF_DOUBLE	3	0.000
HHSV	DBF_MENU	MAJOR	MAJOR
DESC	DBF_STRING	HEBT Skid Out Cond	HEBT Skid Out Cond
HYST	DBF_DOUBLE	0.05	0.050

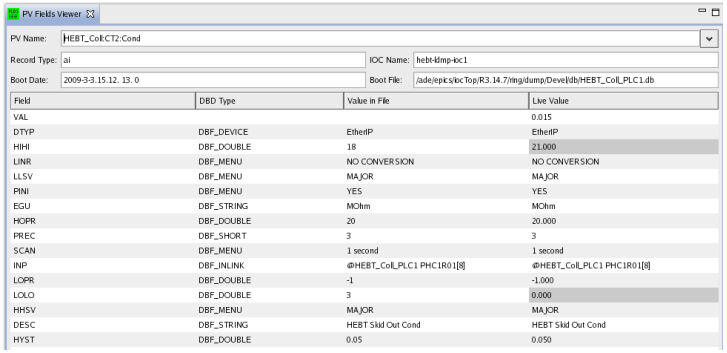
Detailed configuration info for a PV

@SNS: Info in Oracle, live data from EPICS

OAK RIDGE National Laboratory

PV Fields Viewer: Site-Specific?

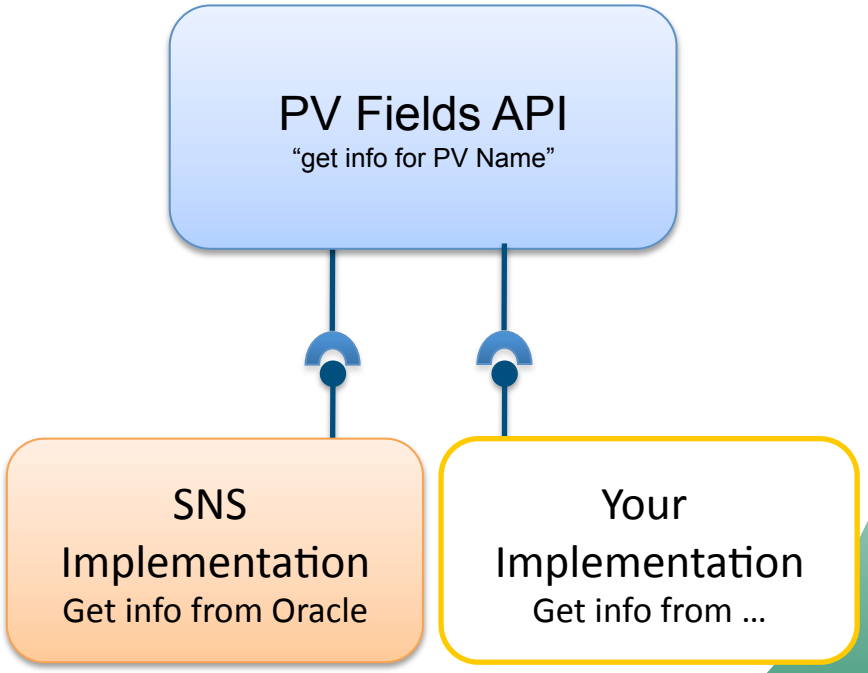
Fine, but how would I benefit from an SNS-specific tool?



Field	DBD Type	Value in File	Live Value
VAL			0.015
DTYP	DBF_DEVICE	EtherIP	EtherIP
HIHI	DBF_DOUBLE	18	21.000
LINR	DBF_MENU	NO CONVERSION	NO CONVERSION
LLSV	DBF_MENU	MAJOR	MAJOR
PINI	DBF_MENU	YES	YES
EGU	DBF_STRING	MOhm	MOhm
HOPR	DBF_DOUBLE	20	20.000
PREC	DBF_SHORT	3	3
SCAN	DBF_MENU	1 second	1 second
INP	DBF_INLINK	@HEBT_Coll_PLC1 PHC1R01[8]	@HEBT_Coll_PLC1 PHC1R01[8]
LOPR	DBF_DOUBLE	-1	-1.000
LOLO	DBF_DOUBLE	3	0.000
HHSV	DBF_MENU	MAJOR	MAJOR
DESC	DBF_STRING	HEBT Skid Out Cond	HEBT Skid Out Cond
HYST	DBF_DOUBLE	0.05	0.050

It's "Pluggable"!

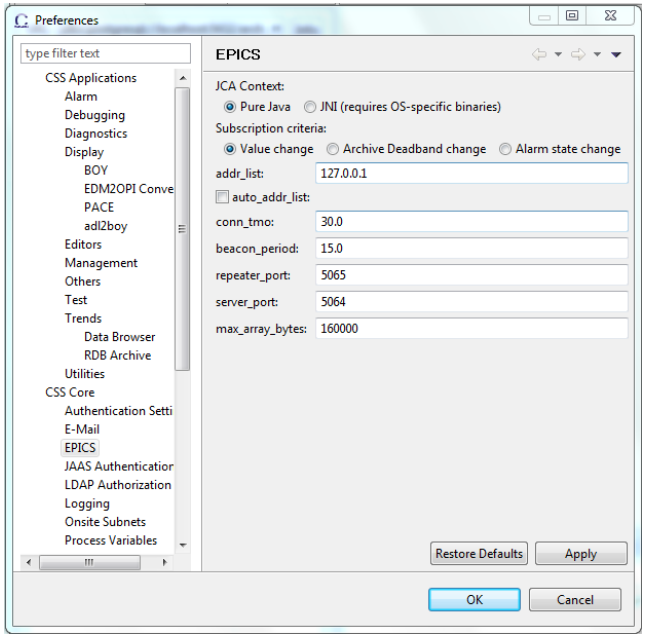
You can provide the glue code to your EPICS config in RDB, LDAP, text files

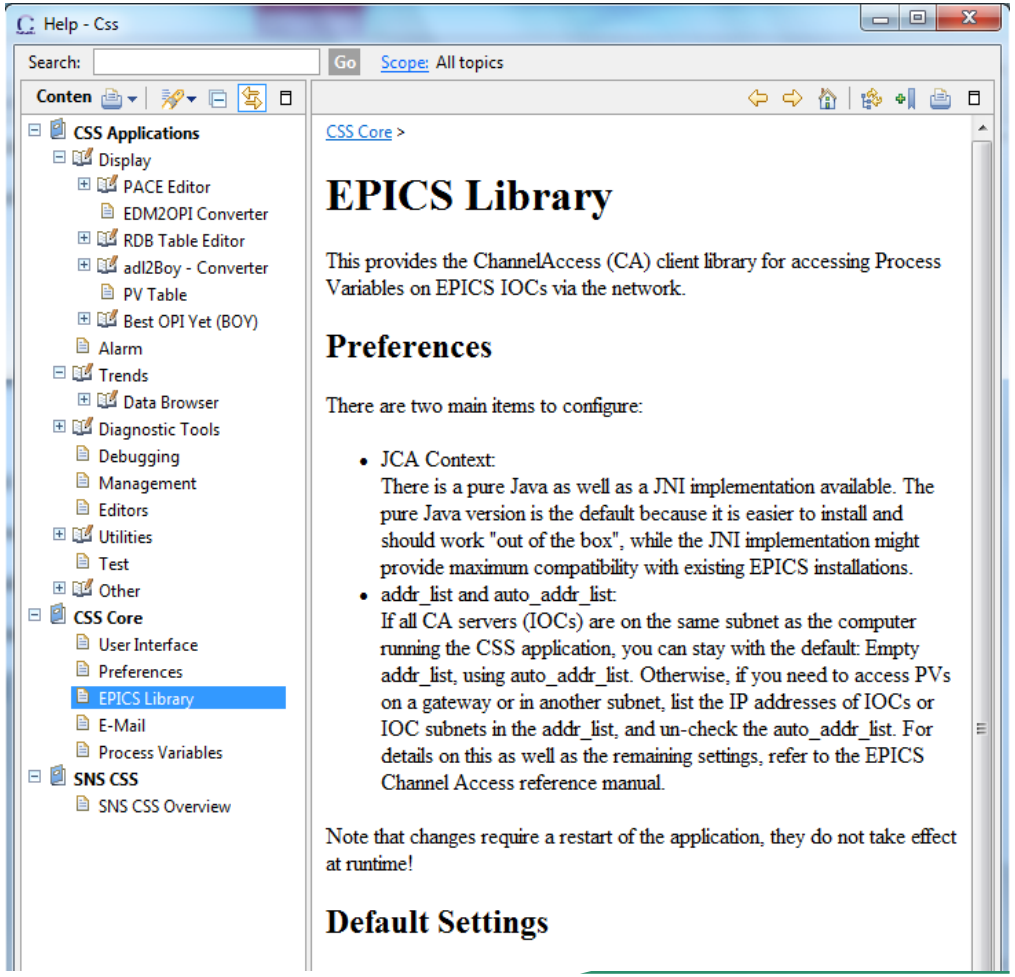


Oak Ridge National Laboratory

Integrated Help, Preferences

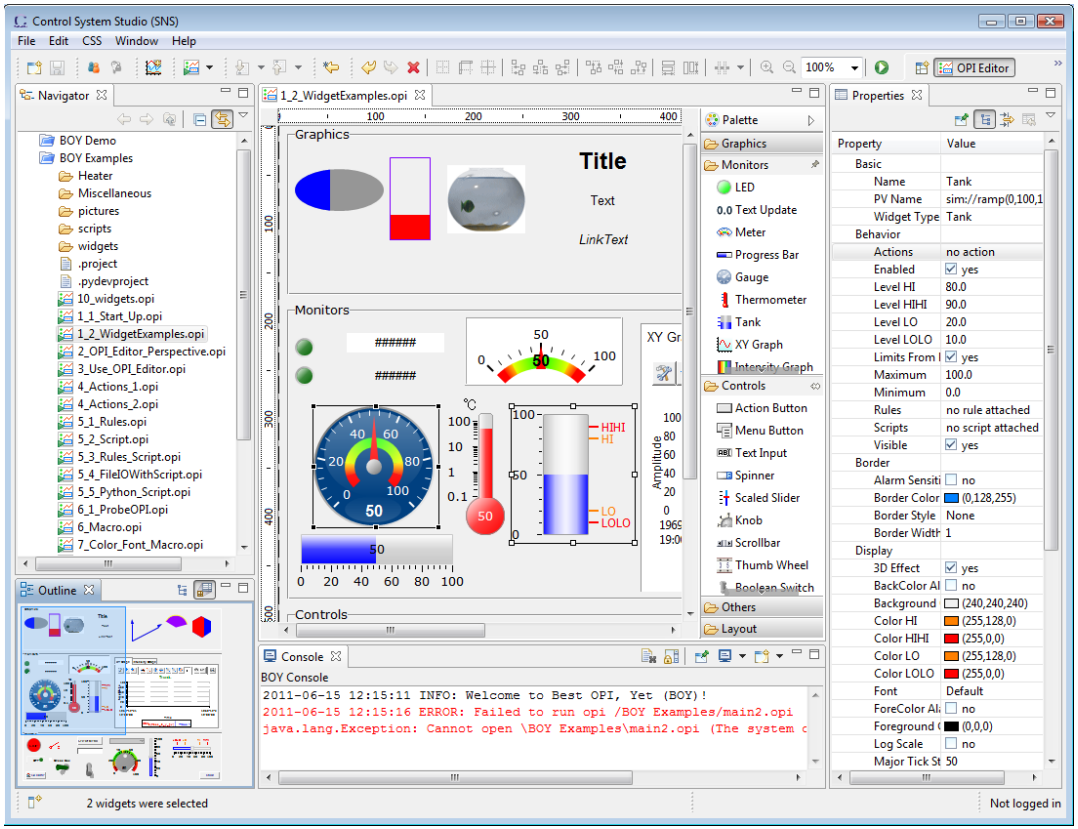
- Uniform access to settings, searchable help
  - Applications
  - Support Libraries
    - Logging
    - Control System access



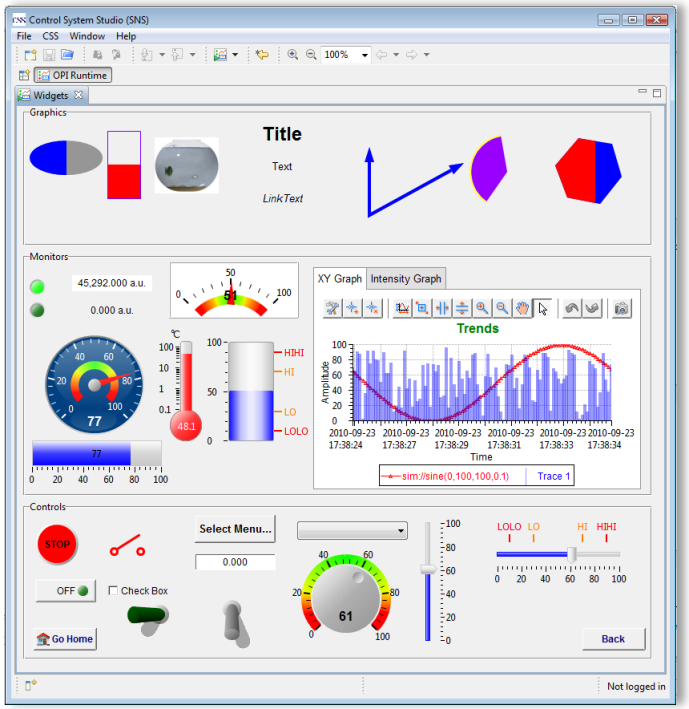


BOY – Best OPI, Yet

Operator Interface Editor



Runtime



Similar to EDM, MEDM, SDS, DM2K, but possibly better

OAK RIDGE National Laboratory

OPI Editor

Control System Studio (SNS)

File Edit CSS Window Help

Navigator

- BOY Demo
- BOY Examples
  - Heater
  - Miscellaneous
  - pictures
  - scripts
  - widgets
  - .project
  - .pydevproject
  - 10_widgets.opi
  - 1_1_Start_Up.opi
  - 1_2_WidgetExamples.opi
  - 2_OPI_Editor_Perspective.opi
  - 3_Use_OPI_Editor.opi
  - 4_Actions_1.opi
  - 4_Actions_2.opi
  - 5_1_Rules.opi
  - 5_2_Script.opi
  - 5_3_Rules_Script.opi
  - 5_4_FileIOWithScript.opi
  - 5_5_Python_Script.opi
  - 6_1_ProbeOPI.opi
  - 6_Macro.opi
  - 7_Color_Font_Macro.opi

Outline

1_2_WidgetExamples.opi

Graphics: Title, Text, LinkText

Monitors: ######, ######, 50, 0, 100, 40, 60, 20, 80, 0, 100, 50, °C, 100, 10, 1, 0.1, 50, 100, 50, 0, HIHI, HI, LO, LOLO, 50, 0 20 40 60 80 100, XY Gr, Amplitude

Controls

Palette: Graphics, Monitors, LED, 0.0 Text Update, Meter, Progress Bar, Gauge, Thermometer, Tank, XY Graph, Intensity Graph, Controls, Action Button, Menu Button, Text Input, Spinner, Scaled Slider, Knob, Scrollbar, Thumb Wheel, Boolean Switch, Others, Layout

Console

BOY Console

```
2011-06-15 12:15:11 INFO: Welcome to Best OPI, Yet (BOY)!
2011-06-15 12:15:16 ERROR: Failed to run opi /BOY Examples/main2.opi
java.lang.Exception: Cannot open \BOY Examples\main2.opi (The system c
```

Properties

Property	Value
Basic	
Name	Tank
PV Name	sim://ramp(0,100,1
Widget Type	Tank
Behavior	
Actions	no action
Enabled	yes
Level HI	80.0
Level HIHI	90.0
Level LO	20.0
Level LOLO	10.0
Limits From I	yes
Maximum	100.0
Minimum	0.0
Rules	no rule attached
Scripts	no script attached
Visible	yes
Border	
Alarm Sensiti	no
Border Color	(0,128,255)
Border Style	None
Border Width	1
Display	
3D Effect	yes
BackColor Al	no
Background	(240,240,240)
Color HI	(255,128,0)
Color HIHI	(255,0,0)
Color LO	(255,128,0)
Color LOLO	(255,0,0)
Font	Default
ForeColor Al	no
Foreground (	(0,0,0)
Log Scale	no
Major Tick St	50

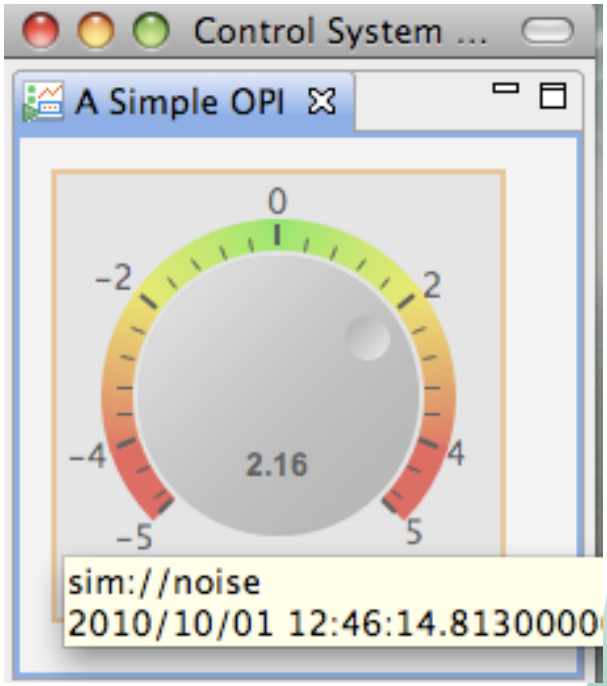
2 widgets were selected

Not logged in

AK
IDGE
nal Laboratory

Simple Things are Easy

1. Drag a widget, e.g. Knob, from palette to editor
2. Enter the PV name in Properties view
3. Click the "Run" button to execute!



What you will get

- ✓ PV *value* as text and via knob position
- ✓ PV *severity* reflected in border color
- ✓ PV *name* and *value* shown in tool-tip
- ✓ PV's *display limits* set the knob's default range
- ✓ Indicate 'disconnected' state via a pink border
- ✓ Widget will be greyed-out if read-only

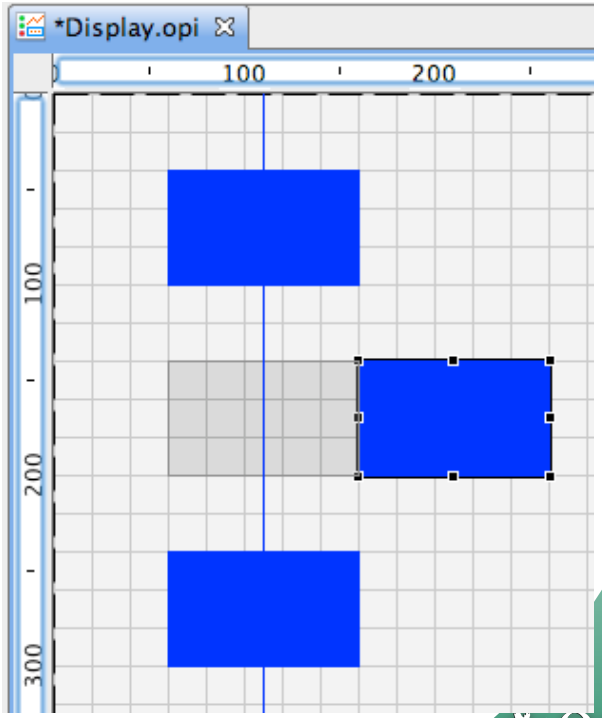
Oak Ridge National Laboratory

Editing Features

Add Widgets

- Drag & Drop from Palette
- Copy/paste, Ctrl+Drag existing widgets to duplicate

- Snap to grid, guideline, other widgets
- Align, distribute



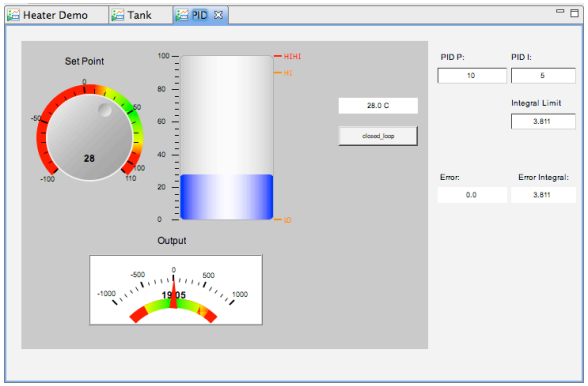
Select multiple widgets to

- Edit common properties
- Adjust size or move around

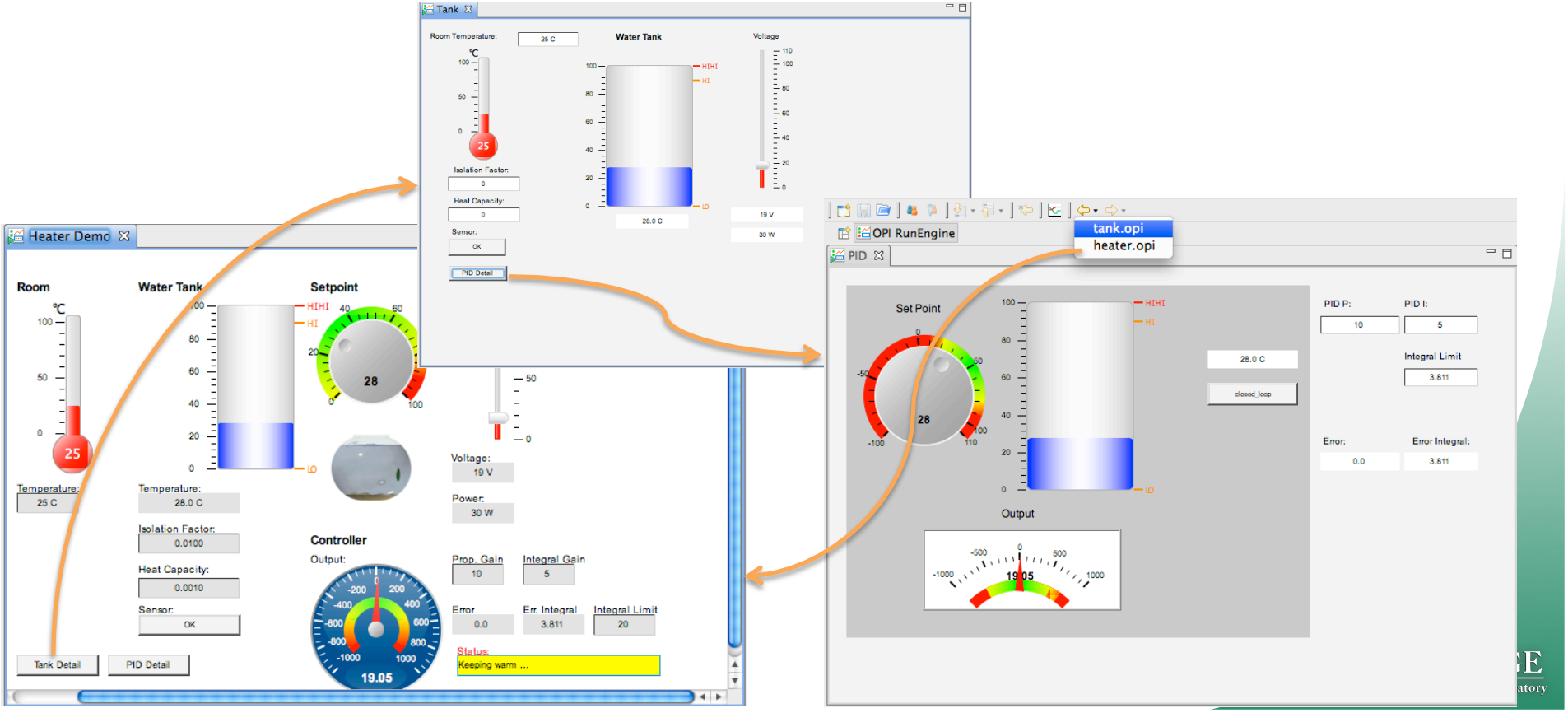
OAK RIDGE National Laboratory

Screen Navigation

- Idea: Minimize number of open screens.
- Similar to Web Browser links:
  - Default: Related displays replace the current display.
  - Optional open in 'tabs' or new window
  - Allow previous/next navigation over display history

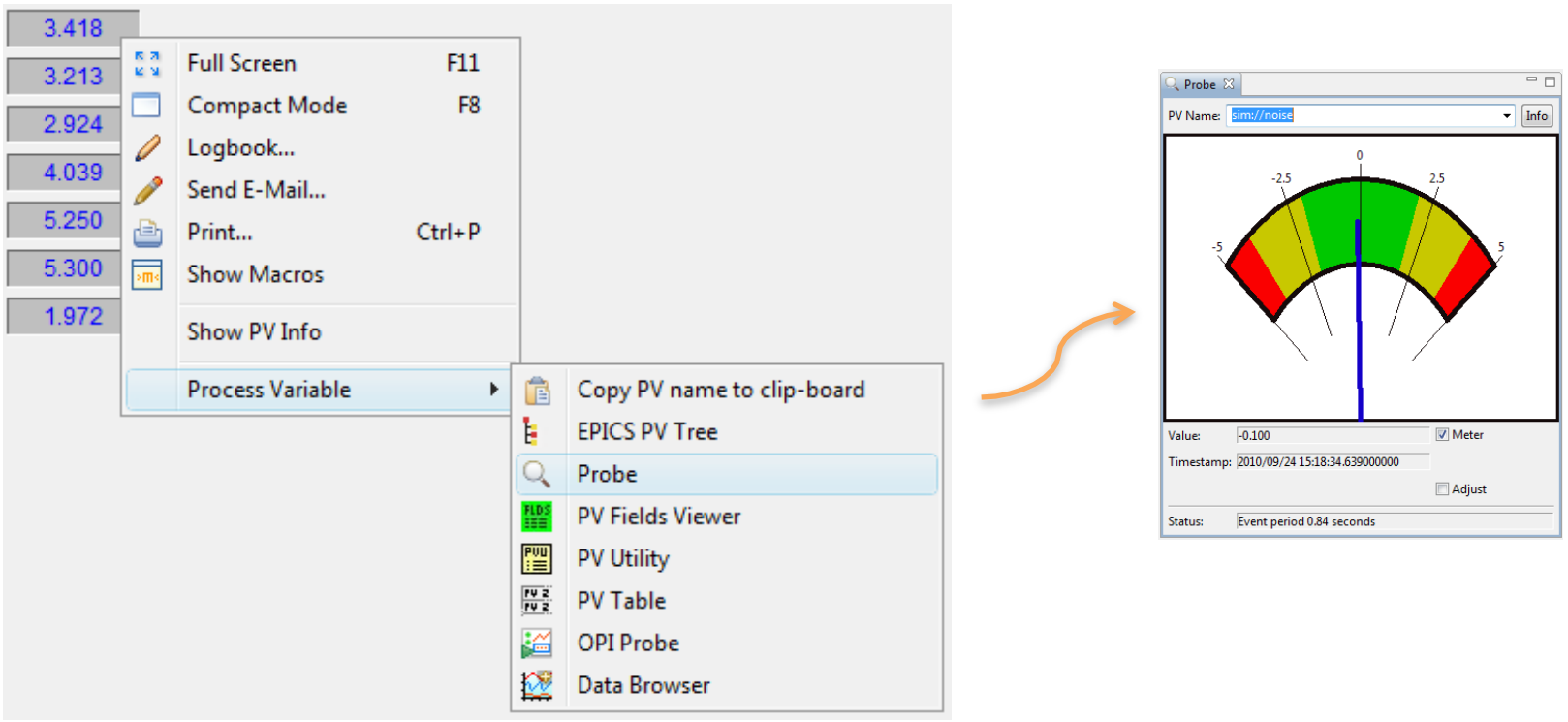


Displays in 'Tabs'

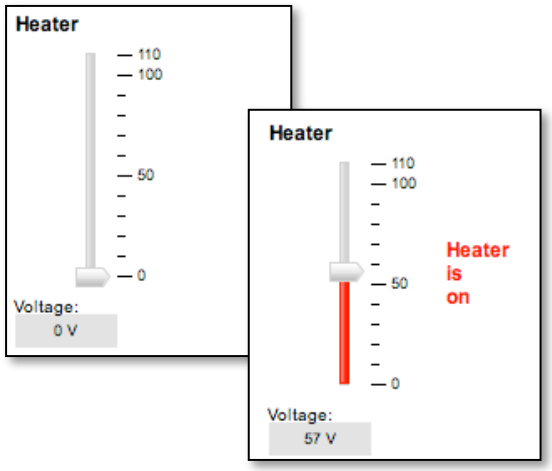


Send PV name to other CSS tools

Use common CSS Process Variable context menu to send PV name to other CSS tools



Rules, Scripts



Rules create dynamic displays

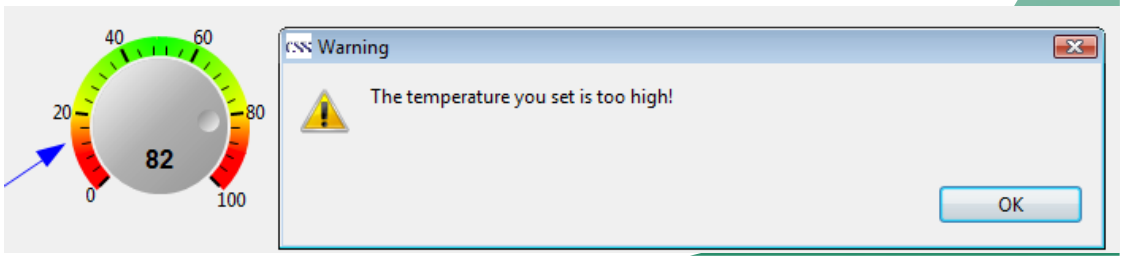
- Easy: PV → Widget Property

Scripts can to "anything"

- Read PVs,
  change widget properties,
  open dialog, …
- JavaScript or Phython

KnobValueDialog.js

```
importPackage(Packages.org.eclipse.jface.dialogs);
importPackage(Packages.org.csstudio.opibuilder.scriptUtil);

var flagName = "popped";

if(widgetController.getExternalObject(flagName) == null){
    widgetController.setExternalObject(flagName, false);
}

var b = widgetController.getExternalObject(flagName);

if(PVUtil.getDouble(pvArray[0]) > 80){
        if( b == false){
            widgetController.setExternalObject(flagName, true);
            MessageDialog.openWarning(
                null, "Warning", "The temperature you set is too high!");
        }

}else if (b == true){
    widgetController.setExternalObject(flagName, false);
}
```



SNS Examples

Control System Studio (SNS)

File Edit CSS Window Help

100% OPI Runtime

Test Bench | ReadBack Test

SNS Timing Receiver Test Bench

Card A (0x0) | Card B (0x080000)

Board Info

Board ID	SNS Timing Receiver VME Board V232S	Board Rev	-	Base Address	0x0
Firmware Version	FW v 0.xxx Date 02 24 2011	Board SN	0x0	Geog Address	0x8

	Event # 0-255	DelayTurns 0-65535	Delay 1/64th Turn 0-63	Delay Time us	Pulse Width 1/64th Turn 0-262143	Pulse Width Time us	Enable Output	Inverted Output	1 Shot Enable Output	Manual Fire
CH1	1	2	3	0000.000	4	0000.000				
CH2	5	6	7	0000.000	8	0000.000				
CH3	9	10	11	0000.000	12	0000.000				
CH4	0	0	0	0000.000	0	0000.000				
CH5	0	0	0	0000.000	0	0000.000				
CH6	0	0	0	0000.000	0	0000.000				
CH7	0	0	0	0000.000	0	0000.000				
CH8	3	0	0	0000.000	0	0000.000				

ScratchPad

ScratchPad 0xC8	0xCFA71	0xCFA6D	Auto Test
ScratchPad 0xCC	0xCFA71	0xCFA6D	
ScratchPad 0xD0	0xCFA71	0xCFA6D	
ScratchPad 0xD4	0xCFA71	0xCFA6D	

Grouping Container

Temp Limit Set	55.0
Temperature	25.38 C

Write Data to Arbitrary Address

Offset_Address	0xC8	0xC8	Data at Offset_Address:
Data to Write	0xCE263	0xCFA6D	

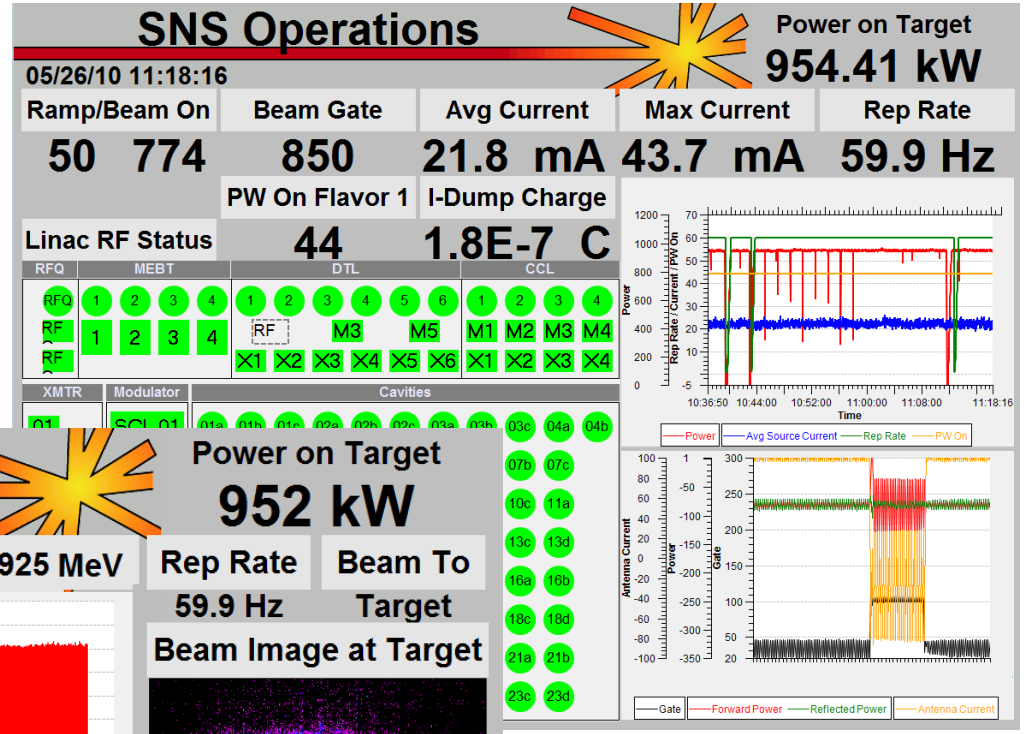
31:24 | 23:16 | 15:8 | 7:0

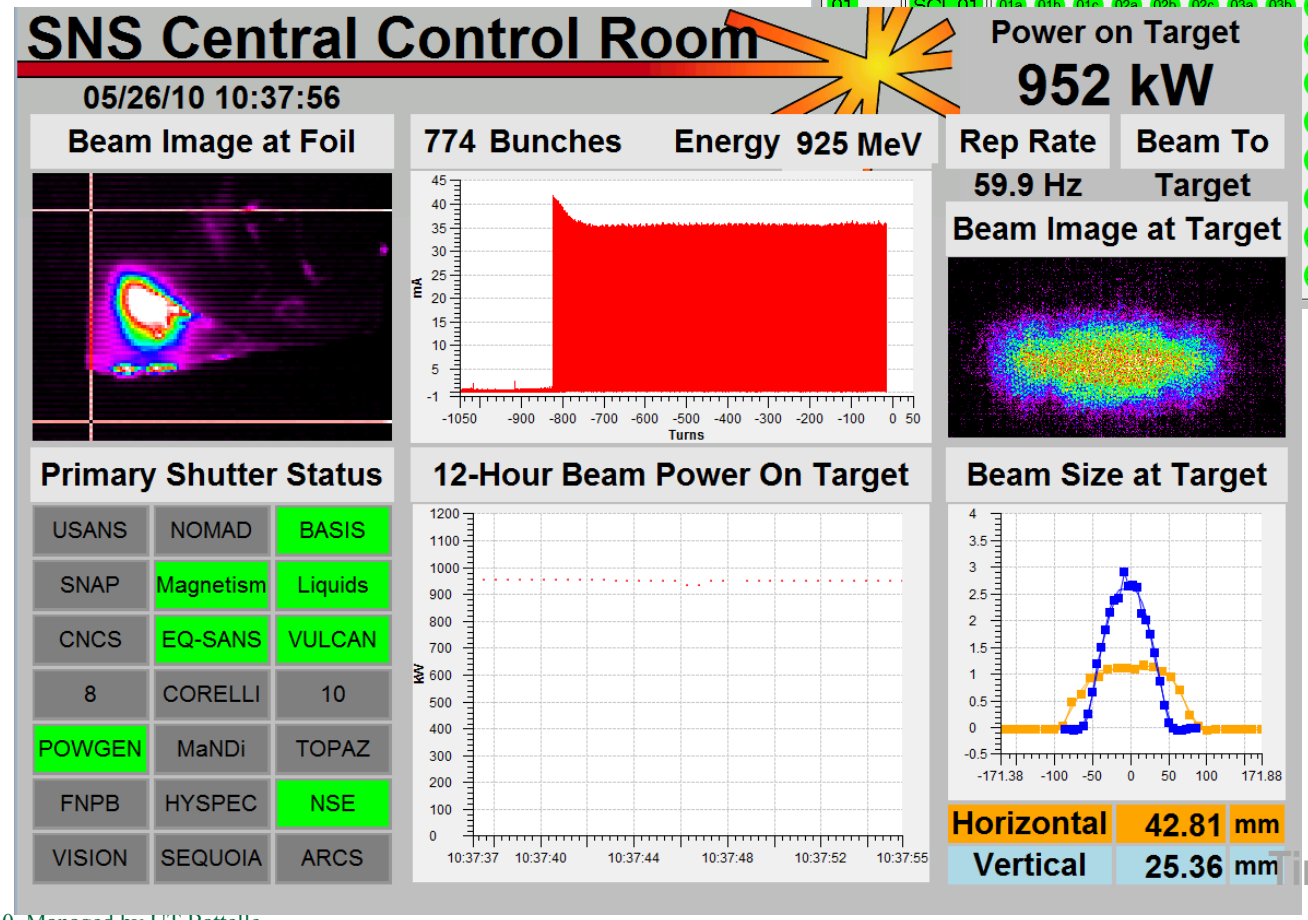
Not logged in

Oak Ridge National Laboratory

SNS Examples

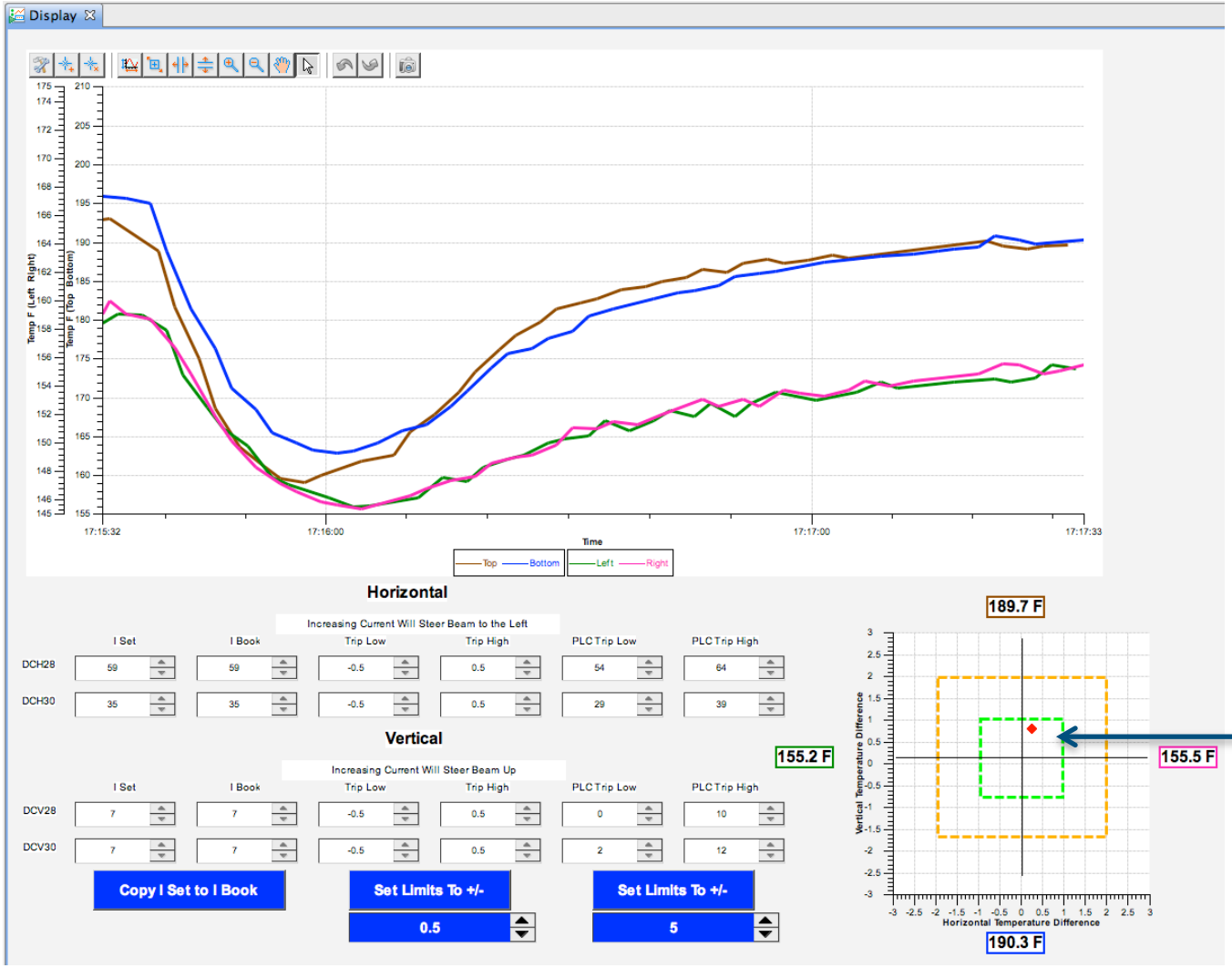
- Top-level displays created by operators





Tim Southern, Nick Luciano

SNS "Steering" Tool

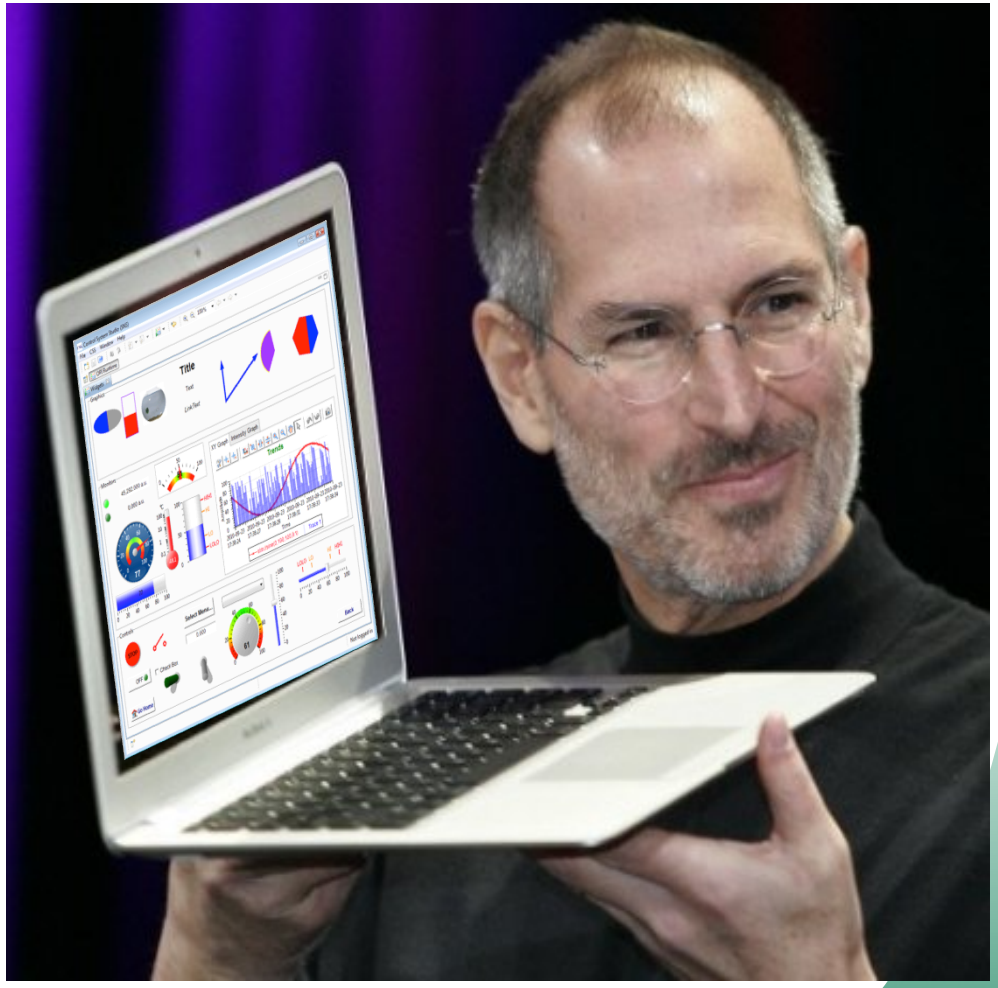


Try to get spot into the green, at least into orange

Tim Southern, Nick Luciano

So What is CSS?

Various control-system tools combined into a consistent product



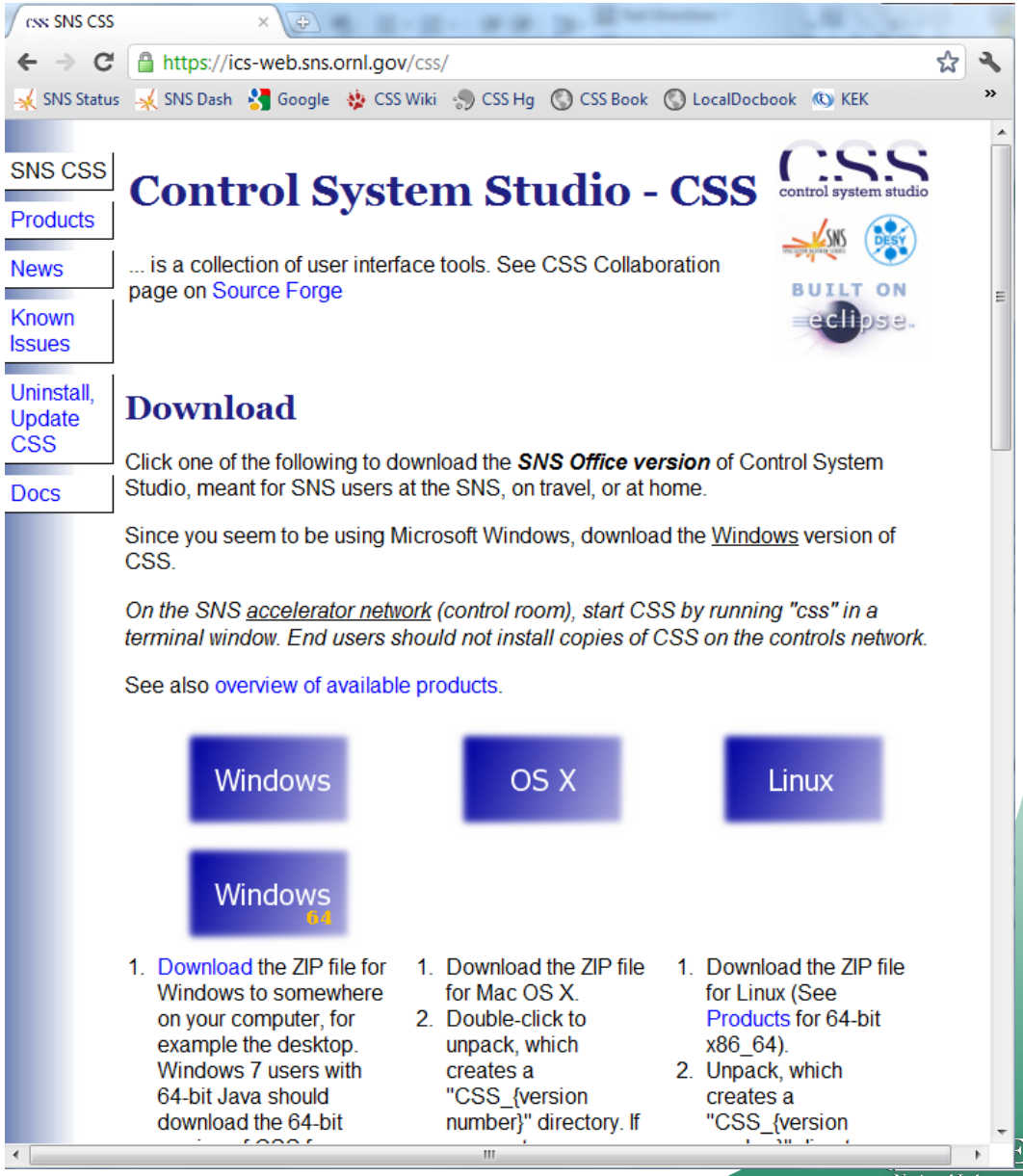
Excellent for end-users!

Based on http://buzzynews.com/wp-content/uploads/2008/01/steve-jobs-presente-le-mac-book-air-lordinateur-portable-le-plus-fin-du-monde.jpg

OAK RIDGE National Laboratory

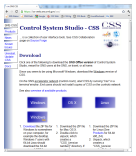
Hardest Part: Starting Site-Specific Setup

1. **Web site:**
   Initial download

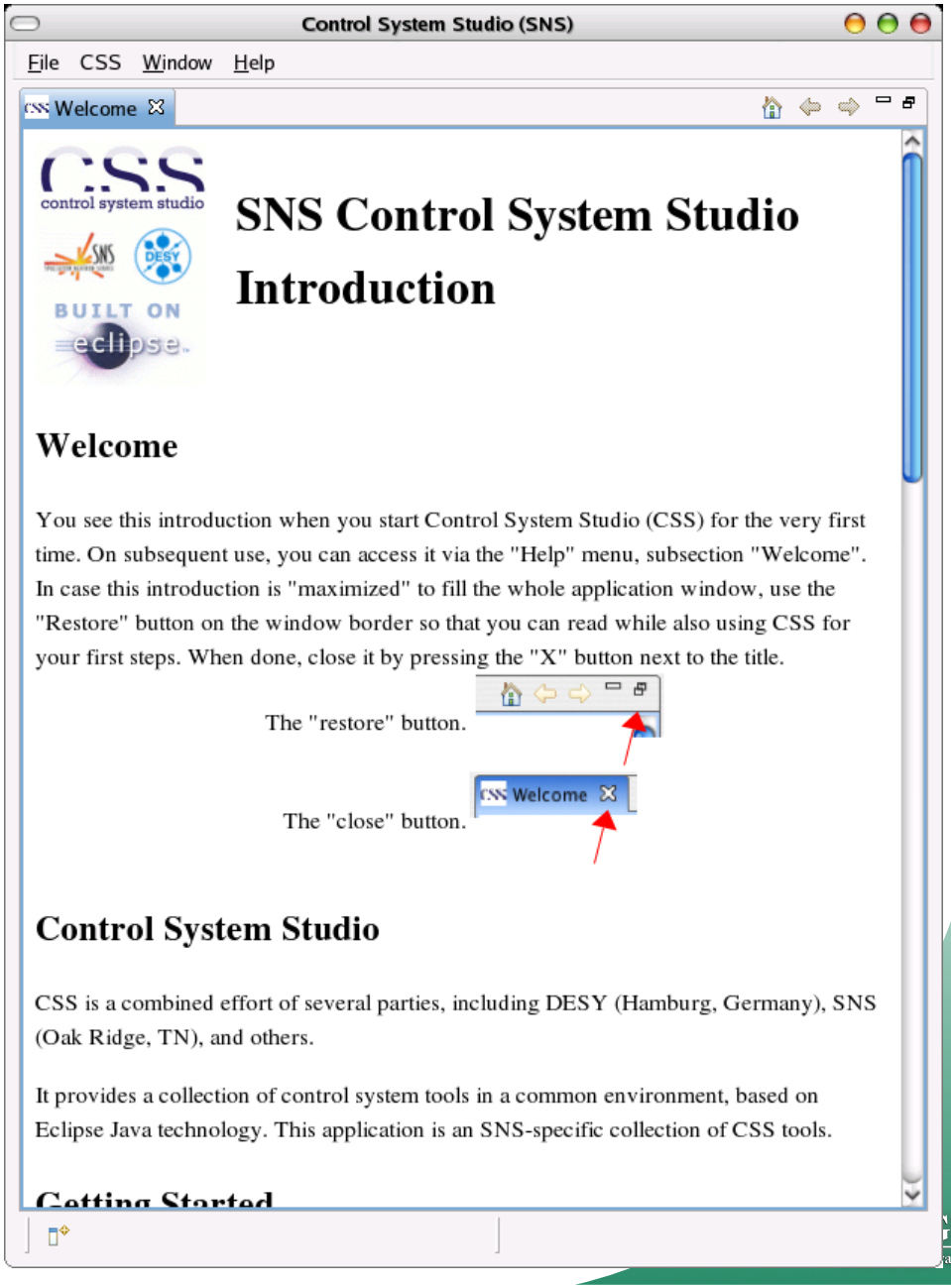


… Site-Specific Setup

1. Web site

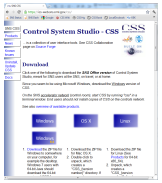


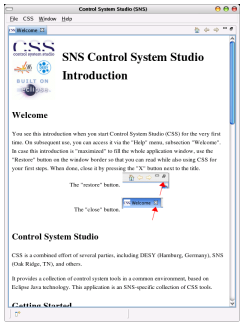
2. Product: Tools and settings for your users at your site



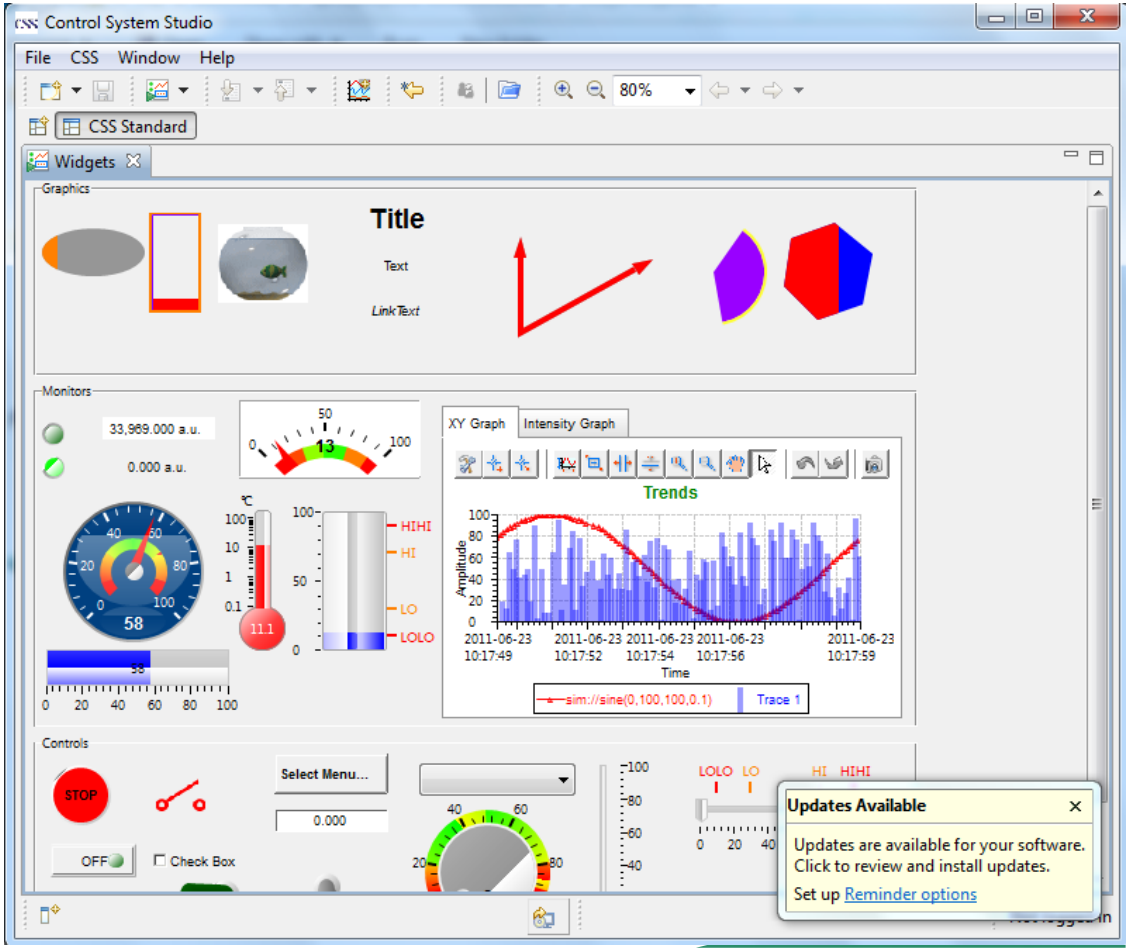
… Site-Specific Setup

1. Web site





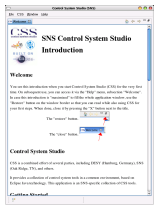
2. Product for your site

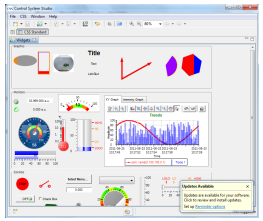


3. Automated updates

Need Site-Specific Setup

1. Web site
2. Product for your site
3. Automated updates





Steep Learning Curve for Developers

- … but also many Books, online Tutorials
- Invest to learn it, and you'll like it